



INTERNATIONAL JOURNAL OF CENTRAL BANKING

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The *International Journal of Central Banking* is published quarterly
(ISSN: 1815-4654). Online access to the publication is available free of charge
at **www.ijcb.org**. Individual print subscriptions are available. Orders may be placed
by phone (001 415 974 2035), via fax (001 415 974 2168), or by e-mail (editor@ijcb.org).

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International Journal of Central Banking
Economic Research Department
Federal Reserve Bank of San Francisco
101 Market Street
San Francisco, CA 94105
USA

Phone: 001 415 974 2035
Fax: 001 415 974 2168
E-mail: editor@ijcb.org

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ISSN: 1815-4654

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Eurosystem Household Finance and Consumption Survey: Main Results on Assets, Debt, and Saving*

Olympia Bover,^a Martin Schürz,^b Jiri Slacalek,^c and
Federica Teppa^d

^aBanco de España

^bOesterreichische Nationalbank

^cEuropean Central Bank

^dDe Nederlandsche Bank and Netspar

The following three articles summarize the evidence on assets, liabilities, and saving of households from fifteen European countries from a new data set, the Eurosystem Household Finance and Consumption Survey (HFCS). Before the articles expose the more detailed analytical results, this introductory note gives an overview of the data set and describes how it expands our information about household balance sheets. In addition, we provide some key summary statistics on holdings of assets and liabilities that document heterogeneity along sociodemographic and country dimensions. Finally, we preview the main findings from the three papers.

1. The Data Set

The HFCS collects detailed information on the distribution of household assets and liabilities, income, and indicators of consumption and credit constraints. The survey is a joint project of the euro-area central banks and some national statistical institutes. The first wave was released in April 2013¹ and collects data on more than 62,000 households from fifteen countries.²

*We thank Elisa Reinhold for excellent research assistance.

¹Additional information on various aspects of the survey can be found at <http://www.ecb.europa.eu/pub/economic-research/research-networks/html/researcher.hfcn.en.html>, where researchers can also apply for the complete micro data set.

²In the second wave, which is planned to be released in the second half of 2016, both the country coverage and the sample size will be substantially expanded.

The HFCS is the only European cross-country harmonized wealth survey for the whole population of households; it offers comprehensive information not usually found in administrative data. While survey data on household balance sheets had previously been collected in a few countries (including Italy and Spain), the HFCS covers a wide range of countries, with a completely or partly new survey in most countries. (In addition, the survey has an easy-to-use format so that users do not have to process each country data set separately, which would otherwise be quite time-consuming.)

When compared with other international initiatives on household wealth surveys (such as the Luxembourg Income/Wealth Study), a key distinguishing feature of the HFCS is that it collects country-representative data in an *ex ante harmonized* way. In particular, all HFCS country surveys provide survey variables according to a set of common definitions and descriptive features using an output-oriented approach: This means that the same list of “core” variables is collected in each country. At the same time, due to the substantial cross-country differences, obtaining comparable information sometimes requires different questions in each country, as well as a considerable amount of country-level expertise. In turn, questions in country surveys may be somewhat adapted to the specific circumstances, financial markets, and financial products in each country. Nonetheless, a common questionnaire is the starting point for country questionnaires.

The key value-added of the survey lies in that it allows cross-country comparative analysis for a large number of countries. Given the institutional variation in important features, such as mortgage market institutions (prevalence of fixation of mortgages—fixed- and adjustable-rate, loan-value ratios, tax deductibility of mortgage payments) and systems of pensions, taxes, and social benefits, cross-country data sets can substantially enhance our knowledge about how institutions and policies shape households’ decision making and economic outcomes.³

Household-level data on wealth can provide insights beyond what we can learn from aggregate data into a number of areas relevant both for monetary and public policy, and for research. For instance,

³The three papers that follow provide examples on how various institutions are related to holdings of assets and debt and to saving.

they allow studying how various groups of households (e.g., the indebted, low wealth, credit constrained, or unemployed) respond to shocks depending on the structure of their balance sheets, as well as identifying the groups of households that may be subject to increased debt burden and financial vulnerability, to detect threats to households' financial soundness and to model the response of such households to interest rate shocks. In addition, comparable micro data are key to analyzing the substantial cross-country differences in net wealth and the structure of portfolios across individual households in various countries, and for quantifying alternative motives for the accumulation of wealth (such as saving for pensions, for precautionary reasons, or for inheritance).

Table 1 gives an overview of the key features of the country data sets (see Household Finance and Consumption Network 2013a) for detailed information). The data are collected at the country level. While there is some heterogeneity regarding the fieldwork period, fieldwork and reference periods for income and wealth in most countries are 2009 and 2010.⁴ Countries (except for Italy) plan to collect data every three years. More than half of the countries have or plan to introduce the panel component (which enhances the analytical value of the data by allowing the users to analyze transitions and to account for unobserved household heterogeneity). Given the main focus of the survey on the balance sheets, to better capture the top tail of the wealth distribution, many countries oversample wealthy households. Arguably, the quality of oversampling varies depending on the method employed (the basis for oversampling is taxable wealth, net wealth, income, geographical areas, or electricity bills). The survey is typically conducted by computer-assisted personal interviews (CAPI), although web interviews are also used (in the Netherlands). The data set comes with survey weights, which allow the user to calculate statistics representative of the whole population (in each country and the euro area). Finally, the bulk of the variables (including the components of wealth and income) is multiply imputed (see HFCN 2013b, chapter 6); the results calculated in the three articles that follow account for this fact.

⁴The second wave of the survey aims to further harmonize the fieldwork periods and, eventually, to make data available to researchers faster.

Table 1. Main Features of the Household Finance and Consumption Survey

Country	Net Sample Size	Fieldwork (Year)	Frequency	Panel Component	Oversampling Wealthy Households	Survey Mode
Belgium	2,400	2010	Three	Planned	Yes	CAPI
Germany	3,600	2010/11	Three	Planned	Yes	CAPI
Greece	3,000	2009	Three	No	Yes	CAPI
Spain	6,200	2008/9	Three	Yes	Yes	CAPI
France	15,000	2009/10	Three	Planned	Yes	CAPI
Italy	8,000	2010	Two	Yes	No	CAPI
Cyprus	1,200	2010	Three	Planned	Yes	PAPI
Luxembourg	1,000	2010/11	Three	No	Yes	CAPI
Malta	800	2010/11	Three	Planned	No	CAPI
Netherlands	1,300	2010	Three	Yes	No	CAWI
Austria	2,400	2010/11	Three	No	No	CAPI
Portugal	4,400	2010	Three	Planned	Yes	CAPI
Slovenia	300	2010	Three	No	No	CAPI
Slovakia	2,100	2010	Three	Planned	No	CAPI
Finland	11,000	2010	Three	No	No	CAPI
Euro Area	62,500				Yes	CATI

Notes: CAPI: computer-assisted personal interviews; CATI: computer-assisted telephone interviews; CAWI: computer-assisted web interview; PAPI: paper-and-pencil interview.

2. Key Summary Statistics

The three articles aim to provide evidence on various aspects of the flow of funds of European households: on assets, liabilities, and saving. These three areas cover the core focus of the survey and are of interest to researchers working on household finance and to policymakers who need to take into account heterogeneities in the transmission mechanism of monetary or fiscal policy and in the response of household spending and households' financial pressure to shocks.

Before summarizing the key results from the articles, tables 2 and 3 illustrate the substantial heterogeneity in participation rates and values of various types of assets and liabilities along a number of dimensions: housing status, income, wealth, age, and country. The statistics are suggestive of a more extended set of stylized facts investigated in detail in the multivariate regression setup in the papers.

Following the articles, the tables break down assets and debt into the key components. The left-hand panels give an overview of the main real and financial asset types: the household main residence (HMR), other real estate, self-employment business, safe financial assets, and risky financial assets. The right-hand panels break down debt into secured (mortgages) and unsecured (e.g., credit lines, credit cards, and other non-mortgage loans).

Some key stylized facts are as follows:

- The household main residence makes up the bulk of total assets for most households. While the homeownership rate varies substantially across countries, the main residence is the key asset for most homeowners and represents a significant share of assets across all countries. In the euro area 60.1 percent of all households own their main residence, and its median value is EUR 180,300. In terms of share on total value, the HMR makes up about 61 percent of total real assets, which in turn are just above 83 percent of total assets.
- The second most substantial asset, in terms of the share on total value, is other real estate, which makes up about 23 percent of real assets. About 23 percent of households own other real estate, with the median value of EUR 103,400.

Table 2. Holdings of Assets and Liabilities—Participation Rates (percent)

	Assets						Debt	
	Real Assets			Financial Assets			Secured Debt	Unsecured Debt
	Household Main Residence	Other Real Estate	Self-Employment Business Wealth	Safe Assets	Risky Assets			
All Households	60.1	23.1	11.1	96.7	20.1		23.1	29.3
<i>Housing Status</i>								
Owner Outright	100.0	34.8	12.3	96.5	24.6		6.4	20.1
Owner with Mortgage	100.0	24.0	16.1	98.7	25.3		100.0	39.4
Renter or Other	0.0	10.7	7.3	95.9	13.0		3.0	33.9
<i>Percentile of Income</i>								
Less than 20	47.0	12.9	4.1	90.1	5.7		6.6	18.4
20–39	50.6	16.4	6.6	96.6	10.2		12.5	26.7
40–59	58.8	20.4	8.6	98.4	17.0		20.4	31.0
60–79	66.4	25.9	12.8	98.9	25.1		32.9	36.8
80–100	77.6	39.7	23.1	99.4	42.7		43.4	33.9
<i>Percentile of Net Wealth</i>								
Less than 20	4.8	1.9	2.3	92.8	3.1		5.6	41.9
20–39	28.7	8.3	7.3	96.5	13.0		15.0	29.9
40–59	78.9	19.1	8.5	96.3	16.9		32.4	27.2
60–79	93.4	26.9	10.3	98.4	23.6		31.0	24.4
80–100	94.8	59.1	26.9	99.4	44.2		31.7	23.3

(continued)

Table 2. (Continued)

	Assets					Debt	
	Real Assets			Financial Assets		Secured Debt	Unsecured Debt
	Household Main Residence	Other Real Estate	Self-Employment Business Wealth	Safe Assets	Risky Assets		
Age of Reference Person							
16-34	31.9	9.9	8.6	97.3	14.5	22.3	41.8
35-44	57.1	19.0	15.1	97.4	20.7	37.2	40.1
45-54	64.3	27.3	16.4	96.9	21.8	32.4	36.8
55-64	71.3	32.4	14.4	96.9	24.6	22.5	27.3
65-74	71.0	29.3	5.4	96.2	22.0	11.7	15.3
75+	65.2	19.5	1.8	94.7	15.7	2.7	5.5
Country							
Belgium (2010)	69.6	16.4	6.6	97.9	29.8	30.5	24.2
Germany (2010)	44.2	17.8	9.1	99.1	23.0	21.5	34.6
Greece (2009)	72.4	37.9	9.8	73.9	4.0	17.5	26.1
Spain (2009)	82.7	36.2	14.2	98.2	14.0	32.5	30.7
France (2010)	55.3	24.7	8.9	99.6	21.7	24.4	32.8
Italy (2010)	68.7	24.9	18.0	91.9	19.8	10.8	17.8
Cyprus (2010)	76.7	51.6	19.5	85.9	36.3	44.8	47.9
Luxembourg (2010)	67.1	28.2	5.2	98.4	25.8	38.8	36.9
Malta (2010)	77.7	31.4	11.5	96.9	33.7	15.6	25.2
Netherlands (2009)	57.1	6.1	4.8	97.3	23.9	44.7	37.3
Austria (2010)	47.7	13.4	9.4	99.4	14.6	18.4	21.4
Portugal (2010)	71.5	27.1	7.7	94.3	6.5	26.7	18.3
Slovenia (2010)	81.8	23.2	11.6	93.6	20.3	14.1	38.9
Slovakia (2010)	89.9	15.3	10.7	91.5	4.1	9.6	19.9
Finland (2009)	67.8	29.8	13.8	100.0	38.7	32.8	M
Notes: Table reports statistics on participation rates in assets and debt. M = missing value. Statistics calculated using survey weights (1,000 replicates). Safe financial assets consist of deposits (sight and savings accounts), life insurance contracts, and voluntary private pension plans. Risky financial assets consist of mutual funds, bonds, and shares. Secured debt consists of mortgages for the main residence and for other property. Unsecured debt includes credit lines or accounts with an overdraft facility, credit card debt, and other non-mortgage debt. Other non-mortgage debt includes car loans, consumer loans, installment loans, private loans from relatives, friends, etc., and other loans.							

Table 3. Holdings of Assets and Liabilities—Median Values Conditional on Participation (thousands EUR)

	Assets						Debt	
	Real Assets			Financial Assets			Secured Debt	Unsecured Debt
	Household Main Residence	Other Real Estate	Self-Employment Business Wealth	Safe Assets	Risky Assets			
All Households	180.3	103.4	30.0	10.0	12.2		68.4	5.0
<i>Housing Status</i>								
Owner Outright	175.2	104.0	43.1	14.5	20.0		41.9	6.4
Owner with Mortgage	200.0	119.9	32.7	14.8	7.8		70.0	5.4
Renter or Other	M	91.6	10.7	5.2	8.5		72.4	3.8
<i>Percentile of Income</i>								
Less than 20	102.1	46.4	7.0	2.7	12.4		42.6	2.9
20–39	150.0	69.2	18.0	5.0	8.8		46.5	3.0
40–59	170.0	90.0	25.1	9.3	9.4		54.9	4.6
60–79	199.3	109.3	23.3	15.0	10.0		66.8	6.0
80–100	250.0	178.1	52.0	36.4	20.0		92.8	7.0
<i>Percentile of Net Wealth</i>								
Less than 20	131.3	54.8	1.7	1.4	1.7		149.2	4.2
20–39	50.0	17.6	2.9	9.0	5.0		78.2	3.7
40–59	112.5	44.4	13.4	10.0	8.2		69.0	5.0
60–79	200.0	75.7	30.0	15.6	11.2		50.2	5.9
80–100	300.3	200.0	100.0	38.6	28.3		66.0	7.0

(continued)

- Household self-employment business wealth amounts to 11.5 percent of real assets and is held by 11.1 percent of households. Its median value for those households is EUR 30,000.
- Almost all households (more than 96 percent) hold some kind of safe financial assets, although their total value is typically quite low; the median is just EUR 10,000. Risky financial assets are held by 20 percent of households and have the median value of EUR 12,200.
- The two debt components, secured and unsecured debt, are held by roughly one-quarter of households. Secured debt (mortgages) is substantially higher, with a median value of EUR 68,400 and making up almost 83 percent of total debt. Unsecured debt has a median value of EUR 5,000.
- In terms of heterogeneity of various classes of assets and debt across households, participation and median values typically rise with income and net wealth. Participation and median values of assets and debt tend to have a hump-shaped profile over age, rising from a low level early in life, peaking around the age of fifty to sixty, and then slowly declining. A different pattern arises with the participation in unsecured debt, which tends to be quite high for most of the productive age and declines after retirement.
- A key feature of the data is the substantial heterogeneity in holding of components of assets and debt across countries. One of the goals of the three papers is to provide additional insights into this heterogeneity and to suggest what factors could contribute to explaining it.

3. Main Results of the Papers

This section summarizes some key results of the three papers. In general, the papers have a similar structure. Each paper first investigates in detail the key summary statistics in its area. Second, the papers estimate country-by-country regressions (such as probits or tobits) to investigate household-specific determinants of assets, debt, and saving and document their differences across countries. Finally, the papers attempt to find which institutions at the country level are responsible for key differences in the distributions of assets, debt, and saving.

The first paper focuses on the liability side of the balance sheet, specifically on the probability of holding debt, its amount, and the interest rate paid. This paper also makes the case for the methodological framework followed in the three papers. Key findings beyond the stylized facts reported so far based on the descriptive statistics and regressions are as follows:

- Among the numerous mortgage market and other institutions considered, the length of asset repossession periods best accounts for the features of the distribution of secured debt. In countries with longer repossession periods, fewer people tend to borrow, young households borrow less (conditional on borrowing), and the mortgage interest rates paid by low-income households are higher.
- The correlations between the statistics on secured debt and other institutions, such as loan-to-value ratios, the taxation of mortgage payment, and the prevalence of fixed-rate mortgages, are less robust.

The second paper covers the asset side of the balance sheet and finds the following:

- The probability of ownership of the household main residence, other real estate, risky assets, and business ownership increases with net wealth and for risky assets also with income. The portfolio shares of other real estate, risky assets, and business ownership rise with net wealth, whereas that of the household main residence is hump shaped, first increasing with wealth, then decreasing.
- The probability of owning the main residence and other real estate are positively linked to previously having received inheritances. The portfolio share of other real estate is higher for households having received an inheritance in the past.
- The probability of owning risky assets and the portfolio share is positively related to the educational attainment of the household (head). The probability of owning and the portfolio share of risky assets are higher for single households.

The third paper investigates the determinants of saving behavior and the motives for saving. The key findings are as follows:

- Precautionary saving is the most commonly reported motive in all countries, followed by saving for old-age provision. Preferences for other motives are then rather heterogeneous across countries.
- Saving for home purchase and precautionary saving are monotonically decreasingly important with age. Retired respondents consider saving to purchase a home less important than younger households. Variables related to the structure of the tax system and to the financing/generosity of the social security and welfare systems are important determinants of household saving.
- A cross-country view on the most important saving motives reveals that households in all countries are more likely to save for unexpected events than German households (with the exception of Slovenian households), even after controlling for sociodemographic and economic variables. Compared with households in Germany, saving for home purchase is more likely in the Netherlands, Portugal, and Malta. The saving motive old-age provision is more prevalent in the Netherlands, Malta, and Portugal than in Germany, while it is less prevalent in Cyprus and Spain.
- Most households in the euro area perceived their expenses over the last twelve months to be about the same as expenses in a “normal” year in the past and about the same as income over the last twelve months. Households whose head is female, young, or divorced are significantly more likely to have expenses exceeding income; in contrast, wealthier households are less likely to incur expenses higher than income. The data provide evidence of households being rather confident in the possibility to get funded through informal lending channels, such as family and/or friends.
- From a cross-country perspective, financing negative saving out of informal loans plays a bigger role in Greece and Portugal than in Germany, while in all countries the probability of using formal loans to finance negative saving is significantly lower than in Germany. Distressed households in Greece and

Cyprus have a higher tendency to leave bills unpaid than distressed households in Germany and are less likely to finance negative savings out of wealth. Only Dutch and Maltese households have a higher probability to cover negative savings out of their wealth.

4. Conclusion

The three papers are meant to make the reader aware of the new data set and its key features, and to stimulate more detailed cross-country comparative work on household finance and consumption. In parallel to the ongoing additional research work both at central banks and in the wider research community, the processing of data from the second wave of the HFCS is under way; the data set is planned to be released in the second half of 2016.

References

- Household Finance and Consumption Network (HFCN). 2013a. “The Eurosystem Household Finance and Consumption Survey—Methodological Report for the First Wave.” ECB Statistics Paper No. 1.
- . 2013b. “The Eurosystem Household Finance and Consumption Survey—Results from the First Wave.” ECB Statistics Paper No. 2.

Household Saving Behavior in the Euro Area*

Julia Le Blanc,^a Alessandro Porpiglia,^b Federica Teppa,^c
Junyi Zhu,^a and Michael Ziegelmeyer^{b,d}

^aDeutsche Bundesbank

^bBanque centrale du Luxembourg (BCL)

^cDe Nederlandsche Bank (DNB) and Netspar

^dMunich Center for the Economics of Aging (MEA)

We study saving motives and household saving behavior in fifteen euro-area countries using the first wave of the Household Finance and Consumption Survey that covers the years 2008–11. We find that precautionary saving is the most commonly reported motive in all countries, followed by saving for old-age provision. Preferences for other motives are then rather heterogeneous across countries. Saving for home purchase and precautionary saving are monotonically decreasingly important with age. Variables related to the structure of the tax system and to the generosity of the social security and welfare systems are important determinants of household saving. As for actual saving behavior, we find that most households in the euro area perceived their expenses over the last twelve months to be about the same as expenses in a “normal” year in the past and about the same as income over the last twelve

*We thank Luigi Guiso, Tullio Jappelli, Richard Blundell, Christopher Carroll, Michael Hurd, the Household Finance and Consumption Network, and two anonymous referees for useful suggestions and comments. The paper benefited from presentation and discussion at the 2013 Royal Economic Society Conference (Royal Holloway University of London, April 3–5, 2013), at the Conference on Household Finance and Consumption (European Central Bank, Frankfurt, October 17–18, 2013), and at the Netspar International Pension Workshop (Venice, June 19–20, 2014). This paper should not be reported as representing the views of the BCL, Deutsche Bundesbank, DNB, or the Eurosystem. The views expressed are those of the authors and may not be shared by other research staff or policymakers in the BCL, Deutsche Bundesbank, DNB, or the Eurosystem. Any remaining errors are the authors’ own responsibility. Corresponding Author: Federica Teppa, DNB, Economics and Research Division, Westeinde 1 1017ZN Amsterdam Netherlands; Tel: +31 20 5245841; Fax: +31 20 5142506; E-mail: f.teppa@dnb.nl.

months. The analysis by country reveals some degree of heterogeneity for this measure of self-assessed household saving: the countries that were hit most severely by the financial crisis display higher financial stress.

JEL Codes: C8, D12, D14, D91.

1. Introduction

The severe and prolonged financial crisis that started in 2007 has hit the household sector massively worldwide, through adverse labor market shocks, turbulent financial markets, declining house prices, and tightening credit market conditions. The responses implemented at different points in time since then in terms of monetary policy and fiscal measures have been exceptional in many respects (targets, instruments, effects). This paper focuses on household saving behavior in the euro area at the onset of the recent economic crisis, with particular emphasis on why households save, how much heterogeneity in saving motives there is across households and countries, whether and how different saving motives relate to each other, and the main determinants of current saving behavior. We also shed light on the prevalence and background characteristics of households that report incurring negative savings, i.e., whose expenses are higher than income, and we study how the households at higher risk of financial fragility finance their negative savings.

The empirical analysis is based on a new cross-country household data set, the Household Finance and Consumption Survey (HFCS), that collects detailed information on wealth holdings, consumption, and income in the fifteen euro-area countries for the years 2008–11 (see Bover et al. 2015b for a more comprehensive description of the data set). The present paper improves upon earlier studies on saving behavior by analyzing a larger number of saving motives and by using new and comparable micro data across fifteen countries in the euro zone. Since the data is from 2008 to 2011, strong conclusions regarding the present are difficult to draw, and the comparability between countries might be partly limited due to the different field periods. Moreover, the crisis may have affected the data, especially in countries that were severely hit.

Household saving behavior has been extensively studied in the literature. Several saving motives were listed by Keynes (1936). Subsequent papers have primarily concentrated on precautionary saving, on life-cycle or retirement saving, and on saving for bequest. An additional saving motive, namely the “downpayment” motive, was added by Browning and Lusardi (1996). Most of these motives have by now been incorporated into the life-cycle model (Modigliani and Brumberg 1954; Friedman 1975). Early versions of this theory explain the old-age provision motive as the main saving motive: individuals save while working in order to counteract the income drop at retirement. The basic version of the life-cycle model has been extended to include also other saving motives, most prominently the precautionary savings motive. Precautionary saving can explain a large share of individual and aggregate wealth accumulation (Skinner 1988; Carroll 1997; Gourinchas and Parker 2002). The longevity risk and large out-of-pocket expenses that may occur at different stages of the life cycle are other reasons to save (Hubbard, Skinner, and Zeldes 1995; Palumbo 1999). Further extensions of the life-cycle model include a housing motive (Hayashi, Ito, and Slemrod 1988) and a bequest motive (Hurd 1987).

On the empirical side, a large literature has linked precautionary savings to income risk, coming to mixed results for the prevalence of a precautionary savings motive (Skinner 1988; Guiso, Jappelli, and Terlizzese 1992). While most papers focus on one saving motive only, a few papers in the economic and psychologic literature have studied the coexistence of different motivations to save (Katona 1975; Lindqvist, Julander, and Fjaestad 1978; Alessie, Lusardi, and Aldershof 1997; Horioka and Watanabe 1997; Schunk 2009). Only limited evidence of saving motives and saving behavior is available for cross-country comparable studies (with few exceptions such as Boersch-Supan and Lusardi 2003).

Saving behavior may be affected by the institutional and political environment, through social safety nets, tax rules, and capital market regulations (see Poterba 1994; Boersch-Supan 2003; Bover, Casado et al. 2015). Therefore, institutional differences across countries should be taken into account properly in explaining household saving. Countries with a higher degree of uncertainty in income and other (future) economic circumstances will most likely feature higher household savings rates in the presence of a precautionary savings

motive (Boersch-Supan and Lusardi 2003). High replacement rates after retirement may replace the need for precautionary savings (see Browning and Lusardi 1996), and unemployment benefits and other welfare policies which aim to reduce changes and shocks to lifetime income might have the same effects (see Hubbard, Skinner, and Zeldes 1995). In addition to public safety nets, individuals may also rely on the network of relatives and friends to offset shocks. Such informal borrowing opportunities may replace formal lending channels and binding credit constraints and hence replace the need to save (Boersch-Supan and Lusardi 2003). To understand saving, it therefore helps to exploit institutional variation.

Our findings can be summarized as follows.

Precautionary saving is the most commonly reported motive in all countries, followed by saving for old-age provision. Preferences for other motives are then rather heterogeneous across countries. We observe a relevant role for education and support of children and grandchildren, home purchase, and other major purchases. We also find evidence of a significant complementarity between the home-purchase saving motive and saving for old-age provision, as well as between precautionary saving and saving to build up a financial wealth stock to serve as a buffer against adverse financial shocks. In addition, saving for unexpected events is significantly and negatively correlated with saving for home purchase, and positively with the bequest motive. Both household characteristics and institutional macroeconomic variables are significant and economically important determinants of saving preferences. Saving for home purchase and precautionary saving are monotonically decreasingly important with age. Moreover, in accordance with the life-cycle model, retired respondents consider saving to purchase a home less important than younger households. Finally, variables related to the structure of the tax system and to the financing/generosity of the social security and welfare systems are important determinants of household saving. A cross-country view on the most important saving motives reveals that households in all countries are more likely to save for unexpected events than German households (with the exception of Slovenian households), even after controlling for sociodemographic and economic variables. Again, compared with households in Germany, saving for home purchase is more likely in the Netherlands, Portugal, and Malta. The saving motive for old-age provision is more

prevalent in the Netherlands, Malta, and Portugal than in Germany, while it is less prevalent in Cyprus and Spain.

As for actual saving behavior, we find that in the years 2008–11 most households in the euro area perceived their expenses over the last twelve months to be about the same as expenses in a “normal” year in the past and about the same as income over the last twelve months. This finding suggests that at the onset of the financial crisis household finances had not been influenced substantially. We also find that households whose head is female, young, or divorced are significantly more likely to have expenses exceeding income; in contrast, wealthier households are less likely to incur expenses higher than income. In addition, the data provide evidence of households being rather confident in the possibility to get funded through informal lending channels, like family and/or friends. From a cross-country perspective, financing negative saving out of informal loans plays a bigger role in Greece and Portugal than in Germany, while in all countries the probability of using formal loans to finance negative saving is significantly lower than in Germany. Distressed households in Greece and Cyprus have a higher tendency to leave bills unpaid than distressed households in Germany and are less likely to finance negative savings out of wealth. Only Dutch and Maltese households have a higher probability to cover negative savings out of their wealth.

The rest of the paper is organized as follows. Section 2 provides a description of the data set used in the empirical analysis, including an overview of the econometric models used. The relevance of saving motives and their main determinants are analyzed in section 3. Section 4 focuses on self-assessed, qualitative measures of household saving, with emphasis on how households perceive their saving and on how negative saving is financed. Section 5 concludes the paper.

2. The Data and Econometric Methods

The analysis in this paper is based on data collected from households participating in the first wave of the Eurosystem Household Finance and Consumption Survey (HFCS). A detailed description of the data set is provided by Bover, Schurz et al. (2015).

Our main indicators on household saving are an extensive list of saving motives, subjective perception of saving, and a list of sources

to finance negative saving. In the following, we describe the variables and methods used.

2.1 Household Characteristics and Institutional Variables

In our regressions we use a number of sociodemographic variables of the household, such as age, marital status, household size, employment and education, income, and wealth.

Individual variables for the reference person are selected according to the financially knowledgeable person, considered to be the main respondent providing financial information for the whole household, as this information is collected together for the household instead of by individual persons (Household Finance and Consumption Network 2013b). Table 1 displays the main variables and reports the summary statistics of the variables we use as controls in the regressions throughout the paper.

The sample is characterized by a slight predominance of male heads of households (54 percent). Age classes are roughly equally represented, although we observe more household heads aged between forty and fifty-four years (30 percent) and fewer household heads aged seventy years and above (20 percent). More than half of the sample consists of couples, defined as married or living with a partner (54 percent); single respondents represent 22 percent of the sample; and widowed and divorced follow with 13 and 11 percent, respectively. The average household size is slightly more than 2.3 persons. About one-third of household heads have a low level of education; 41 percent and 24 percent have a medium and high level of education, respectively.

As for labor-related variables, we observe that 5 percent only have a temporary contract. The vast majority of the sample consists of employees (44 percent), followed by retired respondents (31 percent), self-employed (8 percent), and unemployed (5 percent). About 12 percent work in the public sector and 2 percent in the financial sector. The public and financial sector are of special importance for this analysis, since public employees face a lower income risk compared with other occupational groups, and employees in the financial sector might have not only more knowledge on credits but also possibly easier access via their own institution.

Table 1. Summary Statistics of Household Characteristics

Statistics	Mean	Std. Err.	Min.	Max.	No. Obs.
Male Indicator	0.543	0.004	0	1	62,521
<i>Age Classes—Dummies</i>					
Less than 40 Years (ref. group)	0.255	0.003	0	1	62,521
Between 40 and 54 Years	0.300	0.003	0	1	62,521
Between 55 and 69 Years	0.243	0.002	0	1	62,521
Equal/More than 70 Years	0.202	0.002	0	1	62,521
<i>Marital Status—Dummies</i>					
Couple (ref. group)	0.537	0.003	0	1	62,514
Single	0.222	0.003	0	1	62,514
Divorced	0.107	0.003	0	1	62,514
Widowed	0.134	0.003	0	1	62,514
Household Size	2.321	0.005	1	16	62,521
<i>Education Level—Dummies</i>					
Low Education (ref. group)	0.350	0.003	0	1	62,370
Mid Education	0.414	0.004	0	1	62,370
High Education	0.236	0.003	0	1	62,370
Temporary Contract	0.054	0.002	0	1	57,930
<i>Employment Status—Dummies</i>					
Employee (ref. group)	0.445	0.003	0	1	62,521
Self-employed	0.082	0.002	0	1	62,521
Unemployed	0.054	0.001	0	1	62,521
Retired	0.309	0.002	0	1	62,521
Other	0.103	0.002	0	1	62,521
Missing Employment	0.008	0.001	0	1	62,521
Financial Sector	0.020	0.001	0	1	62,240
Public Sector	0.123	0.003	0	1	62,240
Household Gross Income	37,841	283	−449,254	9,804,966	62,521
Household Net Wealth	230,809	4,244	−1,370,892	4,09E+08	62,521

(continued)

Table 1. (Continued)

Statistics	Mean	Std. Err.	Min.	Max.	No. Obs.
<i>Countries—Dummies</i>					
Austria (AT)	0.027	0.000	0	1	62,521
Belgium (BE)	0.034	0.000	0	1	62,521
Cyprus (CY)	0.002	0.000	0	1	62,521
Finland (FI)	0.018	0.000	0	1	62,521
France (FR)	0.202	0.006	0	1	62,521
Germany (DE, ref. group)	0.287	0.002	0	1	62,521
Spain (ES)	0.123	0.001	0	1	62,521
Greece (GR)	0.030	0.000	0	1	62,521
Italy (IT)	0.172	0.001	0	1	62,521
Luxembourg (LU)	0.001	0.000	0	1	62,521
Malta (MT)	0.001	0.000	0	1	62,521
Netherlands (NL)	0.053	0.000	0	1	62,521
Portugal (PT)	0.028	0.000	0	1	62,521
Slovenia (SI)	0.006	0.000	0	1	62,521
Slovakia (SK)	0.014	0.000	0	1	62,521
Notes: Personal variables for the reference person are selected according to the financially knowledgeable person, considered to be the main respondent providing financial information for the whole household, since this information is collected together for the whole household instead of by individual persons (HFCN 2013b). Education dummies: Low education (ISCED-97 = 0,1,2); Mid education (ISCED-97 = 3,4); High education (ISCED-97 = 5,6). Employment sector dummies: Financial sector (NACE-code: K); Public sector (NACE-code: O, P, Q). Standard errors are calculated with the Rao-Wu rescaled bootstrap method using 1,000 replicate weights and five multiply imputed data sets.					

The country with the highest number of weighted households is Germany (29 percent), followed by France (20 percent), Italy (17 percent), and Spain (12 percent).

Financial institutions and capital markets are key in bringing together savers who want to lend and consumers with a shortage of funds who want to borrow. The functioning of financial intermediation is very likely to affect differences in individual saving behavior.

In addition, household private savings might be influenced by the presence of mandatory public pension schemes. In a simple life-cycle framework, a public pension scheme financed through payroll taxes

may lead to a one-to-one crowding out of private saving for retirement, and high future replacement rates may lead to lower private saving. However, several studies show that this theoretical prediction is not fully supported empirically (Feldstein 1980; Koskela and Viren 1983; Gale 1998). The quantitative impact of the crowding-out effect of compulsory public retirement programs on saving behavior has been very difficult to estimate appropriately (see Jappelli 1995, among others), mainly for the lack of proper data (Hurd, Michaud, and Rohwedder 2012) and is estimated well below one.

Moreover, the impact of public policy on household saving behavior and spending has gained increasing importance in recent years, as reforms of both pension and tax systems in many euro-area countries will very likely influence consumption and saving through the effects on lifetime wealth and on the rate of return on saving. A relatively easy way to influence saving behavior is to change fiscal regimes or tax levels. One mechanism at place behind these policies is that the increase in the net returns to saving induced by the reduction in capital income taxation increases private savings, provided that the substitution effect dominates the income effect. Yet the empirical evidence shows that the impact is rather small (Willi, Thornton, and Bibee 1997; Attanasio, Banks, and Wakefield 2004; Disney, Emmerson, and Wakefield 2010).

Finally, household characteristics that are only available at the country level, such as financial literacy, can be key in savings decisions over the lifetime. Lusardi, Michaud, and Mitchell (2015) use a life-cycle model with endogenous financial knowledge accumulation to study how financial education programs affect retirement savings (among other key economic outcomes). They show that financial education provided to employees aged around forty years can raise savings at retirement by roughly 10 percent.

2.2 *Econometric Methodology*

Our main model is a probit model run either on a country-by-country basis or taking the pooled data and adding country-level fixed effects. A probit model with the pooled data and country fixed effects has the following form:

$$P(D_{h,c} = 1 | \alpha_c, X_{h,c}) = \Phi(\alpha_c + \beta X_{h,c}), \quad (1)$$

where $D_{h,c}$ is a dummy denoting a binary outcome (e.g., whether expenses for household h in country c are higher than income), α_c is a vector of country-level fixed effects, and β is the slope for household-level characteristics that is common across countries. The country fixed effect captures country-specific differences in the distribution of wealth and income as well as other macro factors and is thus crucial for our type of analysis. As the coefficients of the model have no direct interpretation, after estimating the probit models, we calculate the marginal effects at the household level and then average them. The appendix elaborates further on the data preparation and manipulation.

As institutional variation across countries is likely to play an important role for households' behavior in different countries, we then implement a two-step estimation procedure using the institutional variables defined above that might have a direct effect on saving behavior.¹ The two-step procedure uses as a first step a probit model such as the one described by equation (1) with country-level fixed effects. In a second step, we then calculate the predicted values linked to each probit and run linear regressions of these fitted values from the first-step estimation on the macro indicators described above, i.e., we obtain $\hat{P}(D_{h,c} = 1|\alpha_c, X_{h,c})$ and then regress this on the country-specific institution(s) of interest.

Our model is

$$\hat{P}(D_{h,c} = 1|\alpha_c, X_{h,c}) = \text{const} + \beta X_c + \epsilon, \quad (2)$$

where X_c now captures country-level institution(s). Note that the number of observations in this regression corresponds to the number of countries with a particular institution in place and there is no heterogeneity with respect to households anymore.

While the first step of micro-level estimations accounts for compositional outcomes within and across each country, the second step analyzes pure differences at the macro level that influence saving motives across the sample of countries. We then derive scatter plots reporting country-specific regression coefficients with the institutional variables in order to better visualize the outcome of this methodology.

¹We thank an anonymous referee for suggesting this procedure.

Table 2. Institutional Variables

Variable	Description and Source
Income Tax	Average and marginal income taxes (national average) (OECD 2010). For average income tax: table 1.3. For marginal income tax: table 1.7. We use the figures for the average worker who is single without children. Data refer to 2009.
Financial Literacy	Senior business leaders' evaluation of the following statement: Economic literacy among the population is generally high, measured on a 0–10 scale. (International Institute for Management Development, various years). Averages for the period 1998–2005, as reported in figure 1 of Japelli (2010).
Dependency Ratios (past or projected)	Ratio of population aged 65 and more to the population aged between 15 and 64 computed at the year the household becomes 65 years of age. (AMECO dependency ratio (from 1960–2010/2011), Eurostat, projected old-age dependency ratio (2015–2060).) The future years with missing values are our own calculations using linear approximation.
Replacement Ratios (past or projected)	Ratio of average first pension to the average wage at retirement. Three replacement ratios are available and considered: (i) gross replacement rates from the first pillar (public), (ii) total gross replacement rates (in cases where replacement rates from the second pillar are minor, the total gross replacement rate is the same as the replacement rate from the first pillar), and (iii) total net replacement rates (European Commission 2006). In addition we also consider gross average replacement rates in 2010 and 2060 (European Commission 2012, p. 129).

The institutional factors used in the two-step procedure are reported in table 2. As discussed above, differences in household saving behavior across countries may be likely induced by differences in the pension systems in place. Hence, we include a set of pension-related variables, which have the advantage that they vary both across countries and across households. Income tax rates and the overall financial literacy of the population in a specific country

may also have effects on household saving behavior. Life-cycle saving for retirement may be connected to the current and, in particular, future dependency ratios and replacement rates in each country.

3. Saving Motives

The HFCS elicits information on the importance of a number of saving motives. The question used in this paper to identify saving purposes asks respondents to report their (household's) most important reasons for saving.² The list of saving motives includes home purchase, other major purchases (other residences, vehicles, furniture, etc.), set up a private business or finance investments in an existing business, invest in financial assets,³ provide for unexpected events, pay off debts, provide for old age, travels/holidays, education/support of children or grandchildren, bequests, and take advantage of state subsidies (for example, subsidies to voluntary pension plans).⁴

Similar questions are also asked in the Survey of Consumer Finances (SCF) for the United States⁵ and in the SAVE Survey for Germany, even though in the latter case each reason for saving has to be rated on a scale from 0 (no importance) to 10 (very important). The British Household Panel Survey (BHPS) contains data on whether respondents save, the reasons why they save, and their average monthly saving amounts. The Health and Retirement Survey (HRS) lacks information on overall saving motives, with the exception of the bequest motive. This is probably due to the fact that the survey focuses on the elderly population, thus inheritance

²Information on savings motives was not collected in Italy, France, and Finland.

³One can argue that "invest in financial assets" and "pay off debts" could be seen more as vehicles of saving rather than as motives to save.

⁴Multiple answers are allowed. In the Netherlands, however, a slightly different format is used: respondents rate each reason for saving on a scale from 1 (no importance) to 7 (very important). In all countries, respondents may also choose the "Do not know" option or the "No answer" option.

⁵In particular, the thirty-four categories of saving reasons in the SCF can be grouped into six types of saving goals as in Katona (1975), Xiao and Noring (1994), and Devaney, Anong, and Whirl (2007): saving for basic needs, saving for emergency and safety, saving for retirement and security, saving for love/family needs, saving for esteem/luxuries, and saving for self-growth.

and intergenerational relationships are very relevant. Similarly, the English Longitudinal Survey of Ageing (ELSA) and the Survey of Health, Ageing and Retirement in Europe (SHARE) do not specifically elicit reasons for savings, as they are targeted to the population aged fifty plus. SHARE only asks how likely it is whether respondents leave a bequest.

Table 3 reports the average percentage of respondents reporting each single motive for saving as important, both at the euro-area level and at the country level.

Precautionary saving (saving for unexpected events) is reported as the most important motive at the euro-area level by 53 percent of respondents, followed by saving for old-age provision (40 percent of respondents). Also, major purchases such as second homes, cars, and other durables are important motives to save, as is education/support of children and grandchildren. The percentage of households reporting precautionary saving as an important reason for saving ranges between 89 percent in the Netherlands and 43 percent in Germany. This motive is most prevalent across all countries, stressing its high importance despite differences in institutions and welfare systems. These findings are fully in line with Kennickell and Lusardi (2005), who used SCF data and find that “a precautionary saving motive exists and affects virtually every household.” The percentage related to saving for old age ranges between 71 percent in the Netherlands and 28 percent in Spain. Preferences for other motives are then rather heterogeneous across countries. We observe a relevant role for education and support of children and grandchildren, home purchase, and other major purchases. Saving to pay off debts is rather important in the Netherlands, a country with a relatively substantial household indebtedness. These patterns are remarkably in line with those from the SCF, where the retirement/security goal is the most prevalent goal in both frequency and percent saved, followed by the emergency/saving goal.

3.1 Links among Saving Motives

Up to this point each preference for saving has been considered separately. This implicitly points to the direction of mental accounting: individuals save either for one purpose or for another one. In reality, we may think that saving behavior should be interpreted in a

Table 3. Summary Statistics for Saving Motives in the Euro Area and by Country

Statistics	Mean Perc.	Std. Err.	No. Obs.	Mean Perc.	Std. Err.	No. Obs.
	<i>Euro Area (Excluding Finland, France, and Italy)</i>					
Purchase Own Home	0.097	0.005	24,144			
Other Major Purchases (other residences, vehicles, furniture)	0.331	0.010	24,150			
Set up a Private Business, Invest in Existing Business	0.016	0.002	24,147			
Invest in Financial Assets	0.035	0.002	24,147			
Provision for Unexpected Events	0.525	0.009	24,151			
Pay Off Debts	0.070	0.003	24,150			
Old-Age Provision	0.398	0.008	24,149			
Travels/Holidays	0.312	0.010	24,151			
Education/Support of Children or Grandchildren	0.242	0.007	24,147			
Bequests	0.057	0.003	24,148			
Take Advantage of State Subsidies	0.039	0.003	20,973			
Other (specify)	0.214	0.007	24,152			
	<i>Austria</i>					
Purchase Own Home	0.101	0.007	2,380	0.144	0.013	950
Other Major Purchases (other residences, vehicles, furniture)	0.349	0.012	2,380	0.218	0.015	950
Set up a Private Business, Invest in Existing Business	0.024	0.004	2,380	0.023	0.005	950
Invest in Financial Assets	0.031	0.004	2,380	0.038	0.006	950
Provision for Unexpected Events	0.668	0.012	2,380	0.600	0.019	950
Pay Off Debts	0.094	0.008	2,380	0.103	0.011	950
Old-Age Provision	0.371	0.012	2,380	0.354	0.017	950
Travels/Holidays	0.349	0.012	2,380	0.370	0.019	950
Education/Support of Children or Grandchildren	0.228	0.011	2,380	0.215	0.014	950
Bequests	0.076	0.007	2,380	0.123	0.013	950
Take Advantage of State Subsidies	0.112	0.010	2,380	0.050	0.008	950
Other (specify)	0.058	0.006	2,380	0.052	0.009	950

(continued)

Table 3. (Continued)

Statistics	Mean Perc.	Std. Err.	No. Obs.	Mean Perc.	Std. Err.	No. Obs.
	Belgium			Malta		
Purchase Own Home	0.120	0.009	2,327	0.145	0.014	841
Other Major Purchases (other residences, vehicles, furniture)	0.159	0.010	2,327	0.236	0.017	842
Set up a Private Business, Invest in Existing Business	0.012	0.003	2,327	0.043	0.008	839
Invest in Financial Assets	0.021	0.003	2,327	0.107	0.012	842
Provision for Unexpected Events	0.541	0.014	2,327	0.839	0.013	843
Pay Off Debts	0.050	0.006	2,327	0.197	0.015	842
Old-Age Provision	0.356	0.012	2,327	0.436	0.018	840
Travels/Holidays	0.236	0.012	2,327	0.453	0.018	843
Education/Support of Children or Grandchildren	0.229	0.011	2,327	0.390	0.016	843
Bequests	0.142	0.009	2,327	0.168	0.013	842
Take Advantage of State Subsidies	0.105	0.008	2,327	Missing Category		0
Other (specify)	0.045	0.005	2,327	0.029	0.006	843
			Cyprus			
			Netherlands			
Purchase Own Home	0.065	0.010	1,237	0.190	0.015	1,167
Other Major Purchases (other residences, vehicles, furniture)	0.080	0.010	1,237	0.666	0.018	1,172
Set up a Private Business, Invest in Existing Business	0.030	0.007	1,237	0.075	0.012	1,172
Invest in Financial Assets	0.041	0.008	1,237	0.200	0.016	1,173
Provision for Unexpected Events	0.617	0.018	1,237	0.886	0.012	1,172
Pay Off Debts	0.158	0.014	1,237	0.251	0.018	1,172
Old-Age Provision	0.276	0.016	1,237	0.707	0.018	1,173
Travels/Holidays	0.173	0.014	1,237	0.742	0.017	1,172
Education/Support of Children or Grandchildren	0.321	0.016	1,237	0.521	0.020	1,168
Bequests	0.064	0.009	1,237	0.230	0.018	1,170
Take Advantage of State Subsidies	0.001	0.002	1,237	0.176	0.014	1,172
Other (specify)	0.018	0.005	1,237	0.951	0.008	1,173

(continued)

Table 3. (Continued)

Statistics	Mean Perc.	Std. Err.	No. Obs.	Mean Perc.	Std. Err.	No. Obs.
	Germany			Portugal		
Purchase Own Home	0.080	0.007	3,453	0.149	0.013	4,260
Other Major Purchases (other residences, vehicles, furniture)	0.362	0.016	3,453	0.028	0.003	4,260
Set up a Private Business, Invest in Existing Business	0.005	0.002	3,453	0.011	0.002	4,260
Invest in Financial Assets	0.014	0.003	3,453	0.016	0.003	4,260
Provision for Unexpected Events	0.426	0.015	3,453	0.545	0.018	4,260
Pay Off Debts	0.031	0.005	3,453	0.083	0.007	4,260
Old-Age Provision	0.360	0.012	3,453	0.408	0.014	4,260
Travels/Holidays	0.284	0.016	3,453	0.063	0.005	4,260
Education/Support of Children or Grandchildren	0.195	0.012	3,453	0.261	0.011	4,260
Bequests	0.008	0.003	3,453	0.093	0.007	4,260
Take Advantage of State Subsidies	0.008	0.003	3,453	0.015	0.007	4,260
Other (specify)	0.181	0.012	3,453	0.017	0.002	4,260
			Spain	Slovenia		
Purchase Own Home	0.045	0.007	2,331	0.072	0.016	343
Other Major Purchases (other residences, vehicles, furniture)	0.234	0.017	2,331	0.228	0.024	343
Set up a Private Business, Invest in Existing Business	0.038	0.007	2,331	0.027	0.011	343
Invest in Financial Assets	0.111	0.013	2,331	Missing Category		
Provision for Unexpected Events	0.525	0.019	2,331	0.378	0.028	343
Pay Off Debts	0.075	0.009	2,331	0.077	0.018	343
Old-Age Provision	0.276	0.016	2,331	0.337	0.029	343
Travels/Holidays	0.400	0.021	2,331	0.173	0.024	343
Education/Support of Children or Grandchildren	0.312	0.020	2,331	0.197	0.024	343
Bequests	0.092	0.011	2,331	0.012	0.005	343
Take Advantage of State Subsidies	Missing Category		0	Missing Category		339
Other (specify)	0.189	0.015	2,331	0.113	0.021	343

(continued)

Table 3. (Continued)

Statistics	Mean Perc.	Std. Err.	No. Obs.	Mean Perc.	Std. Err.	No. Obs.
	<i>Greece</i>			<i>Slovakia</i>		
Purchase Own Home	0.054	0.009	2,798	0.054	0.005	2,057
Other Major Purchases (other residences, vehicles, furniture)	0.071	0.011	2,798	0.186	0.011	2,057
Set up a Private Business, Invest in Existing Business	0.015	0.003	2,798	0.030	0.004	2,057
Invest in Financial Assets	0.024	0.005	2,798	0.021	0.003	2,057
Provision for Unexpected Events	0.716	0.014	2,798	0.589	0.014	2,057
Pay Off Debts	0.133	0.013	2,798	0.090	0.006	2,057
Old-Age Provision	0.348	0.016	2,798	0.413	0.013	2,057
Travels/Holidays	0.210	0.016	2,798	0.300	0.013	2,057
Education/Support of Children or Grandchildren	0.225	0.016	2,798	0.296	0.014	2,057
Bequests	0.036	0.008	2,798	0.199	0.012	2,057
Take Advantage of State Subsidies	0.003	0.001	2,798	0.028	0.007	2,057
Other (specify)	0.000	0.000	2,798	0.001	0.001	2,057

Notes: The table reports the mean percentage of households' self-reported main reasons to save. Multiple answers are allowed. Standard errors are calculated with the Rao-Wu rescaled bootstrap method using 1,000 replicate weights and five multiply imputed data sets. Sample: Euro area excludes Finland, France, and Italy, as the question about saving motives is not collected in those countries.

broader sense instead. It is an attitude, a personal trait. Some people save (irrespective of the specific reason why) because they can and because they are patient and prudent; some other people do not save, not only because they cannot, but also because they are impatient or risk lovers. Ultimately, reasons for saving are not necessarily mutually exclusive (Smith 1999; Dynan, Skinner, and Zeldes 2004). Despite the large empirical literature on saving motives, it is surprising that relatively few studies allow for several saving motives to coexist. One exception is the paper by Fisher and Montaldo (2010), who investigate how several saving motives are related to the likelihood of saving by using SCF data. They find that saving motives differ by saving horizon, but the exact relationships are unclear. In this section we investigate whether and how different saving motives relate to each other, by computing simple pairwise correlations.⁶ Table 4 reports the results.

We observe very high significance levels for basically all pairs of saving motives. It is interesting to note that the motive reported to be the most important one across countries and households—saving to provide for unexpected events—is associated negatively with the motives that immediately follow in importance—saving for home purchase, saving for old-age provision, and saving for other major purchases. This indicates that these motives for saving are substitutes. A positive effect is nevertheless observed between saving for unexpected events and saving to invest in financial assets, and saving to pay off debts and saving to take advantage of state subsidies, suggesting a complementarity between precautionary saving and building up a financial wealth stock intended to be used as buffer against adverse financial shocks. The bequest motive is positively related to precautionary saving. This finding is in line with the literature and has an intuitive interpretation. Bequests can be unintentional, so that a (risk-averse) household may decide to save for “rainy days” and leave the amount of savings left to its offspring. In addition, we observe that the bequest motive is associated positively with the family support motive, so that *intervivos* transfers are complements to bequests.

⁶The correlation coefficient comes from an OLS regression between a pair of standardized binary variables (motives to save) under multiply imputed data with 1,000 replicate weights.

Table 4. Correlations between Saving Motives

	Purchase Own Home	Old-Age Provision	Other Major Purchases	Set Up/Invest in Private Business	Invest in Financial Assets	Pay Off Debts	Travels/Holidays	Education/Support of (Grand) Children	Bequests	Take Advantage of Subsidies
Provision for Unexpected Events	-0.062*** (-4.365)	-0.043*** (-2.899)	-0.063*** (-3.528)	0.015 (1.422)	0.059*** (5.934)	0.035*** (2.979)	0.049*** (3.222)	0.008 (0.608)	0.070*** (7.932)	0.126*** (11.488)
Purchase Own Home		0.020 (1.263)	0.053*** (3.207)	0.082*** (4.473)	0.097*** (5.610)	0.061*** (3.982)	0.064*** (3.819)	0.0305** (2.105)	0.044*** (3.387)	0.085*** (5.255)
Old-Age Provision			0.052*** (2.979)	0.041*** (3.671)	0.087*** (8.204)	0.038*** (3.371)	0.090*** (6.304)	0.100*** (7.464)	0.089*** (9.191)	0.121*** (10.388)
Other Major Purchases				0.045*** (4.079)	0.061*** (5.958)	0.046 (4.198)	0.230*** (13.97)	0.052*** (3.752)	0.011 (1.459)	0.058*** (5.345)
Set Up/Invest in Private Business					0.145*** (4.842)	0.122*** (4.988)	0.079*** (4.394)	0.060*** (3.605)	0.073*** (3.441)	0.120*** (3.972)
Invest in Financial Assets						0.142*** (6.985)	0.115*** (7.787)	0.070*** (4.746)	0.133*** (6.917)	0.183*** (7.697)
Pay Off Debts							0.114*** (6.709)	0.116*** (7.728)	0.098*** (5.631)	0.152*** (6.929)
Travels/Holidays								0.134*** (8.630)	0.065*** (6.357)	0.109*** (8.591)
Education/Support of (Grand)Children									0.154*** (12.257)	0.086*** (6.591)
Bequests										0.151*** (6.341)
Take Advantage of Subsidies										

Notes: The table reports the coefficient from OLS regressions between a pair of standardized binary variables (saving motives) under multiply imputed data with 1,000 replicate weights. Sample: Euro area excludes Finland, France, and Italy, as the question about saving motives is not collected in those countries.

Saving for holidays is positively related with all other motives, indicating that holidays are luxury goods.

3.2 Determinants of Saving Motives

We now focus on three motives for saving, namely saving for home purchase, saving for old-age provision, and saving for unexpected events.⁷ For each of these motives we perform probit analyses with country fixed effects to better characterize the main determinants of saving behavior. Table 5 reports the results.

In all countries but Slovenia, saving for unexpected events is significantly (at the 1 percent level) more important than in Germany (the omitted category). The marginal effects are rather large and rather heterogenous in magnitude, going from 10 percentage points in Spain to 51 percentage points in the Netherlands. As for the other two savings motives, we observe that saving for buying a home is significantly (at the 1 percent level) more important for households in Austria, Belgium, Luxembourg, Malta, the Netherlands, and Portugal than for households in Germany. In Spain and Slovakia, however, this reason for saving is significantly less important than in Germany. Putting money aside for old-age provision is significantly less important in Cyprus and in Spain than in Germany, and significantly more important in Malta, the Netherlands, Portugal, and Slovakia than in Germany.

Age is a relevant determinant for saving behavior, both in terms of significance levels and in terms of marginal effects. There is a clear pattern for home purchase: saving for buying a home is monotonically decreasingly important with age. Marginal effects range between 8 and 14 percentage points. Households belonging to the younger age class (defined as households aged less than forty) are significantly more likely to report saving for buying a house as a very important motive for putting money aside. Moreover, the age marginal effects for saving for old-age provision imply that retirement savings are particularly important in the middle part of the life cycle and less so for the young (defined as people up to forty

⁷We chose saving for home purchase because the main residence is typically the asset with the highest value in household finances in all countries. In addition, saving for old-age provision and precautionary saving are reported as the most important reasons to put money aside.

**Table 5. Determinants of Main Saving Motives:
Probit Estimates**

	Home Purchase	Old-Age Provision	Unexpected Events
Male	0.004 (0.51)	-0.003 (-0.18)	-0.014 (-0.90)
Age 41-55 Years	-0.082*** (-7.98)	0.124*** (5.80)	-0.024 (-1.06)
Age 56-70 Years	-0.126*** (-9.24)	0.118*** (4.52)	-0.021 (-0.78)
Age 71 Years and More	-0.142*** (-7.88)	0.104*** (3.09)	-0.066* (-2.06)
Single	0.006 (0.56)	0.033 (1.34)	0.019 (0.77)
Divorced	0.007 (0.45)	-0.032 (-1.22)	-0.025 (-0.80)
Widowed	-0.019 (-1.28)	-0.011 (-0.43)	-0.029 (-1.03)
Household Size	-0.005 (-1.30)	-0.028*** (-3.75)	-0.007 (-0.77)
Mid Education	-0.027** (-2.25)	-0.016 (-0.80)	0.016 (0.73)
High Education	0.006 (0.44)	0.007 (0.31)	0.039* (1.77)
Temporary Contract	-0.017 (-1.00)	-0.096** (-2.56)	0.011 (0.30)
Self-employed	-0.031** (-2.08)	-0.019 (-0.69)	0.025 (0.91)
Unemployed	-0.008 (-0.47)	-0.095*** (-3.16)	-0.073** (-2.46)
Other	-0.036** (-2.35)	-0.066** (-2.49)	0.045 (1.60)
Missing Employment	-0.097*** (-3.66)	-0.077 (-1.37)	0.012 (0.21)
Retired	-0.032** (-2.14)	-0.097*** (-4.01)	0.011 (0.48)
Financial Sector	0.027 (1.29)	0.120*** (2.75)	0.028 (0.51)
Public Sector	-0.006 (-0.42)	-0.016 (-0.59)	0.001 (0.03)
HH Income: 2nd Quintile	-0.032* (-1.86)	0.012 (0.41)	0.044 (1.47)
HH Income: 3rd Quintile	0.008 (0.48)	0.012 (0.43)	0.074** (2.44)

(continued)

Table 5. (Continued)

	Home Purchase	Old-Age Provision	Unexpected Events
HH Income: 4th Quintile	0.012 (0.78)	0.059** (2.03)	0.053* (1.58)
HH Income: 5th Quintile	0.015 (0.78)	0.069** (2.23)	0.040 (1.16)
HH Net Wealth: 2nd Quintile	0.022 (1.41)	0.043 (1.56)	0.065** (2.46)
HH Net Wealth: 3rd Quintile	0.020 (1.42)	0.112*** (4.20)	0.064** (2.30)
HH Net Wealth: 4th Quintile	0.022 (1.37)	0.151*** (5.59)	0.070*** (2.80)
HH Net Wealth: 5th Quintile	0.006 (0.34)	0.193*** (7.53)	0.024 (0.95)
AT	0.030*** (3.15)	0.019 (1.08)	0.234*** (12.65)
BE	0.040*** (3.93)	0.005 (0.28)	0.123*** (6.58)
CY	-0.023 (-1.45)	-0.071*** (-3.19)	0.181*** (7.61)
ES	-0.055*** (-3.45)	-0.107*** (-4.58)	0.095*** (3.98)
GR	-0.022 (-1.38)	0.019 (0.87)	0.280*** (13.11)
LU	0.049*** (4.14)	-0.011 (-0.49)	0.165*** (6.98)
MT	0.076*** (6.12)	0.086*** (3.57)	0.442*** (17.15)
NL	0.099*** (8.72)	0.318*** (14.70)	0.511*** (19.81)
PT	0.075*** (5.84)	0.060*** (2.70)	0.141*** (5.84)
SI	0.011 (0.57)	0.001 (0.03)	-0.038 (-1.24)
SK	-0.027** (-2.28)	0.077*** (4.20)	0.156*** (7.77)
Mean No. Obs.	23,921	23,926	23,928

Notes: The table reports probit marginal effects and t-statistics (in parentheses) of the importance of saving for home purchase, old-age provision, and unexpected events. All specifications include country fixed effects. Reference groups are reported in table 1. Sample: Finland, France, and Italy are excluded, as the questions about saving motives are not available. The mean number of observations reported refers to the average over the five imputates used in the regressions. Standard errors are calculated with the Rao-Wu rescaled bootstrap method using 1,000 replicate weights and five multiply imputed data sets. ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent level, respectively.

years old) and the eldest old (seventy and above). While it is not very surprising that pension savings are perceived to be not very relevant for the eldest old (very likely to be already retired), it is more difficult to understand why young agents do not devote enough importance to retirement issues, given that several countries have implemented pension reforms that include the entire lifetime earnings rather than the best five/ten years of earnings, typically coinciding with the last phase of the working life. The main consequence will be that the last periods will count less than they did previously in determining the pension level, while earlier years will count much more.

Household size is significantly (at the 1 percent level) and negatively associated with saving for old-age provision, suggesting a potential substitutability between formal (via pension plans) and informal (via intrafamily support) financial provisions upon retirement.

Education level is a significant determinant for saving for home purchase and for saving for unexpected events. Households with mid-level education consider saving for buying a house less important than the low-educated households (marginal effects of about 3 percentage points), maybe because credit constraints are less relevant for them. On the other hand, high education is positively associated with the importance of precautionary saving. This finding is in line with Solomon (1975), who finds a positive association between precautionary savings rates and schooling.

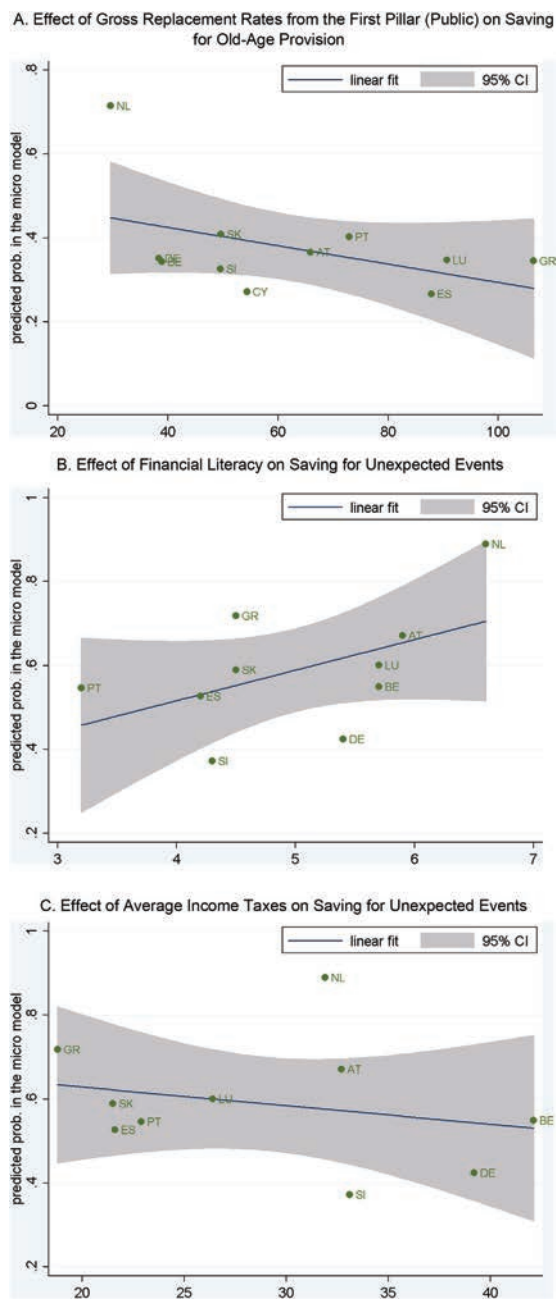
The self-employed are significantly less likely than employees to report saving for home purchase as an important motive for putting money aside. This could reflect the lower degree of risk aversion of the self-employed. One plausible explanation for our finding could be that this motive conflicts with the project to improve their business. On the other hand, if we believe the latter hypothesis, we should be expecting a significant and positive relationship between the self-employed and saving for unexpected events, as indeed Kennickell and Lusardi (2005) find for business owners, or as Deaton (1991) and Carroll (1994), among others, find for households facing higher income risk. Instead, our finding is more in line with Fisher (2010), who finds no significant relationship between income uncertainty and saving behavior.

As expected and in accordance with the life-cycle model, being retired is negatively related to the importance of saving for buying a house: presumably households are already homeowners or they have sold their house to finance old-age consumption. Not surprisingly, retired households are significantly less likely to report saving for old-age provision as an important motive to set money aside.

All other household characteristics, including income and wealth, have no significant impact on the probability of considering home purchase as an important motive for saving. However, there is a significant positive wealth effect (and to a minor extent, an income effect) on both old-age provision and on saving for unexpected events. Our finding is not consistent with Leland (1968) or with Dynan, Skinner, and Zeldes (2004): both studies show that poorer individuals save more against future uncertainties. However, the empirical evidence of a positive relationship between saving and income (Chang 1994 and Yuh and Hanna 2010, among others) finds support in our data.

Certainly, savings motives across our sample of countries should also be shaped by the diverse country-specific institutional arrangements in place. When considering differences in pension systems (see figure 1), we find that the gross replacement rate from the first (public) pillar remarkably decreases the importance of saving for old-age provision, suggesting a substitution effect between public and private pension savings. This finding is in line with Attanasio and Brugiavini (2003), among others, who find that savings rates increase as a result of a reduction in (public) pension wealth. We also find a significant and positive effect of financial literacy on saving for unexpected events, consistently with the literature showing better/more sophisticated financial choices and higher wealth levels by the households scoring high in numeracy and financial literacy (Lusardi and Mitchell 2007). Finally, saving for unexpected events is significantly and negatively related to (average) income taxes, implying that public and personal insurance mechanisms are perceived to be substitutes. Overall, our findings are line with International Monetary Fund (1997), which finds that variables related to the structure of the tax system and to the financing/generosity of the social security and welfare systems are important determinants of household saving.

Figure 1. The Effect of Institutional Variables on Saving Motives



Notes: The estimations are based on the two-step procedure described in section 2.2. The institutional variables are described in table 2.

4. Self-Assessed Measures of Household Saving

This section focuses on how households perceive their saving behavior and, in addition, on how they cope with negative saving.

4.1 *Perception of Saving*

In the HFCS, households are asked to report how their overall expenses in the previous twelve months compare with the average expenses they typically face and with their income.⁸ The two questions read as follows:

- (i) Aside from any purchases of assets, would you say that your (household's) overall expenses over the last twelve months were unusually high or low compared to what you would expect in a "normal" year, or were they about normal?
- (ii) Again aside from any purchases of assets, over the last twelve months would you say that your (household's) regular expenses were higher than your (household's) income, just about the same as your (household's) income or that (you/your household) spent less than (your/its) income?

Similar questions are also asked in the Survey of Consumer Finances (SCF) for the United States.

Table 6 reports the average percentages of respondents claiming how their overall expenses compare with average typical expenses and with income for the euro area and by country. More than 70 percent of respondents in the euro area claim that in the previous twelve months their household expenses were in line with their past average expenses (i.e., the household faced no higher expenses compared with what they expect in a "normal" year).

About 19 percent claim current expenses were higher and the remaining 8 percent claim they were lower than their average expenses in the past. The analysis by country reveals some degree of heterogeneity for this measure of self-assessed households saving. The expenses in the last twelve months are perceived to be higher

⁸Finland and France are excluded from the analysis, as the dependent variable is not available in these countries.

**Table 6. Subjective Measures of Household Saving
in the Euro Area and by Country**

Statistics	Household Expenses in the Last Twelve Months Compared with:					
	Average Expenses			Household Income		
	Mean Perc.	Std. Err.	No. Obs.	Mean Perc.	Std. Err.	No. Obs.
<i>Euro Area (Excluding Finland and France)</i>						
Higher	0.189	0.004	36,199	0.112	0.003	36,342
About the Same	0.735	0.005	36,199	0.477	0.006	36,342
Lower	0.077	0.002	36,199	0.411	0.006	36,342
<i>Austria</i>						
Higher	0.264	0.012	2,380	0.111	0.009	2,380
About the Same	0.681	0.013	2,380	0.483	0.013	2,380
Lower	0.054	0.006	2,380	0.406	0.013	2,380
<i>Belgium</i>						
Higher	0.280	0.012	2,294	0.121	0.009	2,294
About the Same	0.636	0.013	2,294	0.403	0.014	2,294
Lower	0.084	0.007	2,294	0.477	0.014	2,294
<i>Cyprus</i>						
Higher	0.480	0.018	1,237	0.211	0.015	1,237
About the Same	0.477	0.018	1,237	0.581	0.018	1,237
Lower	0.044	0.008	1,237	0.207	0.015	1,237
<i>Germany</i>						
Higher	0.164	0.010	3,565	0.101	0.007	3,565
About the Same	0.802	0.011	3,565	0.368	0.015	3,565
Lower	0.033	0.004	3,565	0.531	0.015	3,565
<i>Spain</i>						
Higher	0.266	0.011	6,197	0.175	0.009	6,197
About the Same	0.597	0.012	6,197	0.513	0.012	6,197
Lower	0.137	0.008	6,197	0.313	0.011	6,197
<i>Greece</i>						
Higher	0.250	0.017	2,971	0.131	0.013	2,971
About the Same	0.570	0.015	2,971	0.650	0.016	2,971
Lower	0.180	0.011	2,971	0.219	0.014	2,971

(continued)

than typical ones by a larger fraction of respondents in Malta (65 percent), Cyprus (48 percent), Spain (27 percent), and Portugal (26 percent). There is some evidence that the countries that were hit most severely by the financial crisis display higher financial stress, but also in Luxembourg the percentage is high (31 percent).

The answers to the second question above are consistent with this finding. If compared with household income in the last twelve months, expenses turn out to be about the same for almost half of the respondents and lower for 41 percent in the euro area. However, a smaller fraction of respondents who report their expenses being lower than income is observed in Portugal, Cyprus, Greece, and Malta (between 20 and 24 percent).

About 11 percent of all households report that their expenses were above their income over the last twelve months. We perform a simple probit analysis in order to better understand who these households are more likely to be. Results (average marginal effects over the five imputates of the multiply imputed data set and t-statistics) are reported in table 7. We start with a specification for the euro area that includes country fixed effects and household background characteristics (regression (1)). Germany serves as a reference group. We then run the same specification in each single country (regressions (2)–(14)) by including the same set of household covariates as in regression (1).

Country fixed effects (reported at the bottom of table 7, corresponding with each country) enter significantly (at the 1 percent level) and with a positive sign for Cyprus, Spain, Malta, and the Netherlands, and significantly (at the 1 percent level) with a negative sign for Italy, Luxembourg, and Slovakia. In all other cases, country fixed effects are not significantly different from Germany. The highest marginal effect (in absolute value) is found for Malta (11.8 percentage points). Slovakia and Cyprus follow (8.9 and 7.6 percentage points, respectively).

Households whose head is divorced are significantly more likely to have expenses exceeding income in the euro area (the marginal effect is 3.7 percentage points), whereas singles are significantly less likely to incur expenses higher than their income, with a marginal effect of 3.2 percentage points. In both cases the significance level is 1 percent. When running the analysis by country, we observe that the marginal effect for divorced heads of households is higher in

Table 7. Household with Expenses Higher than Income: Probit Estimates

	Euro Area Marg. Eff. (t-stats) (1)	AT Marg. Eff. (t-stats) (2)	BE Marg. Eff. (t-stats) (3)	CY Marg. Eff. (t-stats) (4)	DE Marg. Eff. (t-stats) (5)	ES Marg. Eff. (t-stats) (6)	GR Marg. Eff. (t-stats) (7)	IT Marg. Eff. (t-stats) (8)	LU Marg. Eff. (t-stats) (9)	MT Marg. Eff. (t-stats) (10)	NL Marg. Eff. (t-stats) (11)	PT Marg. Eff. (t-stats) (12)	SI Marg. Eff. (t-stats) (13)	SK Marg. Eff. (t-stats) (14)
Male	-0.014* (-1.81)	-0.023 (-1.50)	-0.030* (-1.65)	-0.049 (-1.52)	-0.034** (-2.14)	-0.011 (-0.63)	-0.015 (-0.95)	0.024** (2.30)	0.021 (1.01)	0.020 (0.45)	-0.038 (-0.88)	-0.025* (-1.71)	-0.010 (-0.39)	-0.007 (-0.63)
Age 41-55 Years	0.003 (0.26)	-0.002 (-0.10)	0.066** (2.20)	0.006 (0.14)	-0.014 (-0.66)	0.003 (0.12)	-0.006 (-0.25)	0.015 (1.37)	0.042* (1.69)	-0.008 (-0.15)	-0.016 (-0.31)	-0.022 (-1.22)	0.089** (2.32)	0.005 (0.42)
Age 56-70 Years	-0.002 (-0.13)	-0.001 (-0.03)	0.040 (1.14)	-0.049 (-0.97)	-0.007 (-0.25)	-0.024 (-0.89)	0.023 (0.89)	0.002 (0.12)	0.031 (0.86)	0.004 (0.07)	-0.034 (-0.58)	-0.019 (-0.86)	0.011 (0.24)	0.032 (1.42)
Age 71 Years and More	-0.039** (-2.49)	-0.072** (-2.27)	0.050 (1.17)	-0.237*** (-2.98)	-0.074* (-1.94)	-0.028 (-0.82)	-0.011 (-0.32)	-0.018 (-0.89)	-0.062 (-1.11)	-0.019 (-0.27)	-0.091 (-1.18)	-0.041 (-1.50)	0.040 (0.66)	0.036 (0.88)
Single	-0.032*** (-2.79)	0.024 (1.16)	-0.038 (-1.29)	0.010 (0.16)	-0.052** (-2.00)	0.001 (0.04)	-0.021 (-0.88)	-0.031* (-1.87)	0.024 (0.86)	0.021 (0.39)	-0.037 (-0.74)	0.021 (1.11)	0.084** (2.21)	0.012 (0.78)
Divorced	0.037*** (3.19)	0.042* (1.90)	-0.032 (-1.08)	0.007 (0.14)	0.033 (1.48)	0.080*** (2.89)	0.021 (0.71)	0.006 (0.41)	0.037 (1.08)	-0.002 (-0.03)	0.030 (0.46)	0.060*** (2.81)	0.163*** (3.62)	0.020 (1.29)
Widowed	0.002 (0.13)	0.028 (0.92)	-0.028 (-1.02)	0.043 (0.66)	-0.021 (-0.69)	0.050* (1.76)	0.011 (0.45)	0.000 (0.02)	-0.027 (-0.56)	0.020 (0.32)	-0.021 (-0.27)	0.008 (0.43)	0.010 (0.23)	0.004 (0.23)
Household Size	0.016*** (4.85)	0.009 (0.13)	-0.000 (-0.02)	0.032** (2.55)	0.011 (1.31)	0.027*** (3.05)	0.014* (1.84)	0.013*** (2.80)	0.011 (1.36)	0.046*** (2.95)	0.041** (2.41)	0.016*** (2.60)	0.012 (0.95)	0.013** (2.10)
Mid Education	0.009 (0.94)	-0.013 (-0.63)	0.048** (2.29)	0.020 (0.49)	0.019 (0.82)	0.008 (0.37)	-0.010 (-0.49)	0.013 (1.27)	0.026 (1.04)	-0.114*** (-2.60)	-0.020 (-0.53)	-0.022 (-1.12)	0.020 (0.69)	0.012 (0.41)
High Education	-0.000 (-0.00)	-0.039 (-1.34)	0.066*** (2.85)	0.005 (0.11)	0.029 (1.06)	-0.035* (-1.65)	-0.033 (-1.29)	0.011 (0.69)	0.028 (0.91)	-0.041 (-0.73)	-0.053 (-1.16)	-0.052** (-2.07)	0.017 (0.41)	0.004 (0.13)
Temporary Contract	-0.001 (-0.08)	-0.075 (-0.71)	-0.032 (-0.53)	-0.118 (-0.93)	-0.034 (-0.99)	0.019 (0.59)	-0.009 (-0.38)	0.010 (0.48)	0.007 (0.11)	0.025 (0.17)	-0.040 (-0.16)	0.051** (2.07)	0.002 (0.03)	0.007 (0.39)
Self- Employed	0.050*** (3.35)	0.008 (0.25)	-0.033 (-0.70)	-0.050 (-0.98)	0.046 (1.30)	0.080*** (2.44)	-0.005 (-0.22)	0.043*** (2.61)	0.072** (2.29)	-0.074 (-0.80)	-0.080 (-0.69)	0.054** (2.38)	0.161** (2.56)	0.026 (1.30)
Unemployed	0.072*** (5.57)	0.103*** (3.21)	0.105*** (3.21)	0.102 (1.59)	0.057* (1.82)	0.097*** (3.63)	0.081*** (2.35)	0.038* (1.80)	§ (0.052)	0.131 (1.32)	0.144 (1.26)	0.052*** (2.71)	0.153*** (3.85)	0.035 (1.30)
Other	0.037*** (2.80)	0.023 (0.68)	-0.002 (-0.06)	0.069 (1.06)	0.053** (2.06)	0.027 (0.91)	-0.031 (-1.19)	0.018 (1.05)	0.080 (1.57)	0.080 (1.32)	0.110* (1.84)	0.039 (1.39)	0.156*** (3.54)	-0.010 (-0.36)
Retired	0.026** (2.10)	0.046** (1.99)	0.030 (0.81)	0.053 (0.88)	0.052* (1.76)	-0.015 (-0.52)	-0.077** (-2.39)	0.021 (1.32)	0.030 (0.70)	0.085 (1.45)	0.035 (0.61)	0.010 (0.47)	0.022 (0.54)	-0.047 (-1.57)

(continued)

Table 7. (Continued)

	Euro Area Marg. Eff. (t-stats)	AT Marg. Eff. (t-stats)	BE Marg. Eff. (t-stats)	CY Marg. Eff. (t-stats)	DE Marg. Eff. (t-stats)	ES Marg. Eff. (t-stats)	GR Marg. Eff. (t-stats)	IT Marg. Eff. (t-stats)	LU Marg. Eff. (t-stats)	MT Marg. Eff. (t-stats)	NL Marg. Eff. (t-stats)	PT Marg. Eff. (t-stats)	SI Marg. Eff. (t-stats)	SK Marg. Eff. (t-stats)
Financial Sector	0.015 (0.66)	0.022 (0.47)	-0.006 (-0.10)	0.055 (0.69)	0.011 (0.29)	-0.033 (-0.43)	0.080 (1.30)	0.017 (0.31)	0.040 (1.07)	0.135 (1.17)	0.082 (0.56)	0.051 (0.83)	0.011 (0.17)	§
Public Sector	0.012 (0.66)	0.044* (0.47)	0.002 (0.02)	-0.028 (-0.66)	0.036 (1.57)	-0.042 (-1.47)	-0.007 (-0.19)	0.001 (0.08)	-0.010 (-0.28)	0.055 (0.93)	-0.005 (-0.09)	0.031 (1.27)	-0.043 (-0.94)	0.004 (0.29)
Household Income: 2nd Quintile	0.001 (0.13)	0.029 (1.06)	0.036 (1.22)	-0.048 (-0.92)	0.020 (0.77)	0.024 (1.08)	-0.091*** (-3.92)	-0.033*** (-2.65)	0.009 (0.25)	-0.065 (-1.19)	0.032 (0.58)	0.015 (0.85)	0.046 (1.32)	-0.018 (-1.04)
Household Income: 3rd Quintile	-0.027** (-2.12)	-0.002 (-0.07)	-0.005 (-0.17)	-0.089* (-1.66)	0.001 (0.04)	-0.025 (-0.96)	-0.097*** (-3.96)	-0.065*** (-4.34)	-0.001 (-0.04)	-0.100 (-1.60)	-0.009 (-0.16)	-0.016 (-0.80)	0.060 (1.46)	-0.029 (-1.43)
Household Income: 4th Quintile	-0.039*** (-2.89)	0.031 (0.96)	-0.017 (-0.49)	-0.110* (-1.92)	-0.019 (-0.62)	-0.020 (-0.64)	-0.173*** (-5.58)	-0.061*** (-3.26)	-0.029 (-0.73)	-0.103 (-1.61)	-0.027 (-0.50)	-0.037* (-1.65)	-0.050 (-0.93)	-0.032 (-1.41)
Household Income: 5th Quintile	-0.065*** (-4.70)	0.022 (0.66)	-0.072* (-1.70)	-0.207*** (-3.23)	-0.058* (-1.69)	-0.016 (-0.50)	-0.201*** (-4.80)	-0.015 (-0.49)	-0.034 (-0.79)	-0.161** (-2.32)	-0.055 (-0.86)	-0.042* (-1.69)	0.036 (0.72)	-0.081** (-2.28)
Household Net Wealth: 2nd Quintile	-0.039*** (-3.54)	-0.049* (-1.75)	0.013 (0.42)	-0.022 (-0.44)	-0.050** (-2.18)	-0.057** (-2.30)	-0.036 (-1.57)	-0.015 (-0.98)	-0.049 (-1.41)	-0.053 (-0.90)	-0.037 (-0.63)	-0.035** (-2.04)	0.021 (0.38)	-0.012 (-0.64)
Household Net Wealth: 3rd Quintile	-0.032*** (-2.85)	-0.017 (-0.58)	-0.001 (-0.02)	0.007 (0.14)	-0.049** (-1.98)	-0.042* (-1.67)	-0.022 (-1.06)	-0.012 (-0.91)	-0.015 (-0.49)	-0.059 (-1.13)	-0.042 (-0.72)	-0.017 (-0.89)	-0.033 (-0.93)	-0.004 (-0.22)
Household Net Wealth: 4th Quintile	-0.037*** (-3.23)	-0.011 (-0.41)	-0.053 (-1.63)	-0.001 (-0.02)	-0.047* (-1.91)	-0.052** (-1.99)	-0.068*** (-3.02)	0.006 (0.37)	-0.046 (-1.25)	-0.017 (-0.28)	-0.087 (-1.64)	-0.023 (-1.18)	-0.183*** (-3.44)	-0.024 (-1.12)
Household Net Wealth: 5th Quintile	-0.036*** (-2.66)	-0.020 (-0.58)	-0.033 (-0.96)	0.008 (0.14)	-0.048 (-1.62)	-0.056* (-1.84)	-0.045 (-1.42)	0.013 (0.77)	-0.042 (-1.03)	-0.133** (-2.30)	-0.077 (-1.49)	-0.149** (-2.18)	-0.037 (-0.77)	-0.025 (-1.21)
Country Fixed Effect for Regression (1)	Yes	0.006 (0.48)	0.015 (1.32)	0.076*** (6.37)	Ref. Group	0.050*** (5.24)	0.013 (0.99)	-0.037*** (-3.76)	-0.032** (-2.07)	0.118*** (10.36)	0.045*** (3.03)	0.001 (0.05)	0.016 (0.86)	-0.089*** (-5.72)
Mean No. Obs.	36,100	2,361	2,205	1,206	3,565	6,182	2,904	2,904	950	840	1,173	4,371	342	2,057

Notes: The table reports probit marginal effects and t-statistics (in parentheses) of the probability of reporting household expenses in the previous twelve months higher than income. The dependent variable takes value 1 if household expenses in the previous twelve months are higher than income; 0 if household expenses in the previous twelve months are about the same or lower than income. Sample: Finland and France are excluded from the analysis, as the dependent variable is not available in these countries. Reference groups are reported in table 1. The mean number of observations reported refers to the average over the five imputates used in the regressions. ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent level, respectively. §= "Unemployment" for Luxembourg and "Financial Sector" for Slovakia had to be dropped due to perfect failure prediction.

Slovenia, Spain, and Portugal (16.3, 8, and 6 percentage points, respectively). Single heads of households are instead more likely to report expenses higher than income in Slovenia, with a marginal effect of 8.4 percentage points and a significance level of 5 percent.

The role of gender is somewhat mixed across European countries. At the euro-area level, male heads of households are less likely to incur expenses higher than income (the marginal effect is 1.4 percentage points) and significantly so at the 10 percent level only. In Italy, however, the finding is reversed: households whose head is male report more likely to have expenses higher than income, with a higher marginal effect (2.4 percentage points) and a higher significance level (5 percent). In most of the other countries, gender does not play any significant role.

For the euro area, aging is negatively correlated with having expenditures exceed income. Households whose head is in the oldest age category are less likely to have expenditures exceeding income compared with those households whose head is less than or equal to forty years old (marginal effect is 3.9 percentage points). This finding is in line with the predictions of the life-cycle model. Young households whose incomes are low and whose marginal propensity to consume is high are more likely to spend all of their income and will additionally finance their age-specific expenses by borrowing. As households grow older and their income increases, they will have enough means to cover their expenses. In addition, the retirement dummy is estimated to be positive and significant. Our result is also in line with the findings of Bover, Casado et al. (2015), who show that negative saving and holding secured debt or unsecured debt is predominant in the beginning of the life cycle and decreases after age forty-four. These results hold for most of the countries, separately. The biggest difference is found for Greece, where being retired significantly (at the 5 percent level) decreases the probability to have spending higher than income, with a rather large marginal effect (7.7 percentage points).

There are no significant effects for the level of education at the aggregate level. However, in Belgium higher education is significantly and positively related to claiming expenses higher than income; in Spain, Malta, and Portugal reversed findings are obtained. From a theoretical point of view, it is not clear what effect one should expect *ex ante*. On the one hand, there is ample evidence in the

wage differential literature of the positive correlation of education with wages (Tinbergen 1974; Katz and Murphy 1992; Acemoglu and Autor 2010; Carneiro and Lee 2011, among others), and therefore with income and earnings. On the other hand, the empirical evidence of the correlation of education with expenditures is much less clear, in view of the redistributive role and progressivity of income taxes, which is substantial in European countries (Verbist and Figari 2014). Therefore, whether household spending rises more or less than proportionately as income rises remains an open question.

Household size, being self-employed, or being unemployed are positively and significantly related to having expenses higher than income. Similarly, wealthier households (in terms of household income and household net wealth) are less likely to incur expenses higher than income. These findings hold both at the euro-area level and for most of the countries analyzed separately.

4.2 Financing Negative Saving

The fact that expenses are higher than income is not per se an indication of vulnerability, as long as it is a transitory/occasional situation and it is possible to finance this negative saving somehow. Therefore, in order to better understand this issue we consider additional information available in the HFCS.

The respondents who reported their expenses were higher than their income in the last twelve months are then asked the following question:⁹ You have told me that your expenses in the last twelve months have been above your income. What did you do to meet expenses?

Multiple answers are allowed. Respondents may also choose the “Do not know” option or the “No answer” option. This HFCS question is similar to the one in the SCF for the United States.

The main summary statistics relative to the answers given to this question, both at the euro-area level and by country, are reported in table 8. Figure 2, panel A helps better visualize the distribution of answers by country.

⁹Data on financing negative saving have not been collected in Italy, Finland, and France. Moreover, multiple answers are responsible for mean values not summing up to 100.

Table 8. Summary Statistics for Financing Sources of Negative Saving
in the Euro Area and by Country

Statistics	Mean Perc.	Std. Err.	No. Obs.	Mean Perc.	Std. Err.	No. Obs.
	<i>Euro Area (Excluding Finland, France, and Italy)</i>					
Sold Assets	0.067	0.014	3,654			
Got a Credit Card/Overdraft Facility	0.203	0.022	3,655			
Got Some Other Loan	0.167	0.019	2,732			
Spent Out of Savings	0.521	0.023	3,654			
Asked for Help from Relatives or Friends	0.228	0.019	3,654			
Left Some Bills Unpaid	0.127	0.017	2,590			
Other (specify)	0.054	0.010	3,654			
<i>Austria</i>						
Sold Assets	0.048	0.015	252	0.055	0.029	75
Got a Credit Card/Overdraft Facility	0.139	0.027	252	0.095	0.037	75
Got Some Other Loan	0.172	0.030	252	0.198	0.056	75
Spent Out of Savings	0.696	0.031	252	0.451	0.071	75
Asked for Help from Relatives or Friends	0.234	0.027	252	0.125	0.040	75
Left Some Bills Unpaid	0.040	0.013	252	0.109	0.040	75
Other (specify)	0.065	0.016	252	0.165	0.052	75
<i>Luxembourg</i>						

(continued)

Table 8. (Continued)

Statistics	Mean Perc.	Std. Err.	No. Obs.	Mean Perc.	Std. Err.	No. Obs.
	<i>Belgium</i>			<i>Malta</i>		
Sold Assets	0.055	0.017	288	0.026	0.011	237
Got a Credit Card/Overdraft Facility	0.094	0.023	288	0.054	0.020	237
Got Some Other Loan	0.095	0.023	288	0.045	0.017	237
Spent Out of Savings	0.634	0.038	288	0.664	0.035	237
Asked for Help from Relatives or Friends	0.063	0.020	288	0.082	0.019	237
Left Some Bills Unpaid	0.080	0.021	288	0.085	0.021	237
Other (specify)	0.128	0.027	288	0.046	0.014	237
<i>Cyprus</i>						
Sold Assets	0.016	0.010	324	0.052	0.024	142
Got a Credit Card/Overdraft Facility	0.997	—	325	0.249	0.047	142
Got Some Other Loan	0.162	0.029	324	0.071	0.036	142
Spent Out of Savings	0.265	0.035	324	0.708	0.054	142
Asked for Help from Relatives or Friends	0.239	0.036	324	0.163	0.045	142
Left Some Bills Unpaid	0.217	0.032	324	Missing Category		0
Other (specify)	0.052	0.017	324	0.024	0.015	142

(continued)

Table 8. (Continued)

Statistics	Mean Perc.	Std. Err.	No. Obs.	Mean Perc.	Std. Err.	No. Obs.
	Germany			Portugal		
Sold Assets Got a Credit Card/Overdraft Facility Got Some Other Loan Spent Out of Savings Asked for Help from Relatives or Friends Left Some Bills Unpaid Other (specify)	0.083	0.021	361	0.023	0.008	507
	0.247	0.033	361	0.083	0.013	507
	0.201	0.030	361	0.053	0.012	507
	0.528	0.035	361	0.567	0.029	507
	0.205	0.029	361	0.320	0.027	507
	0.125	0.026	361	0.138	0.019	507
	0.049	0.015	361	0.003	0.002	507
	Spain			Slovenia		
Sold Assets Got a Credit Card/Overdraft Facility Got Some Other Loan Spent Out of Savings Asked for Help from Relatives or Friends Left Some Bills Unpaid Other (specify)	0.014	0.005	922	0.010	0.010	48
	0.281	0.024	922	0.177	0.047	48
	Missing Category		0	0.309	0.074	48
	0.562	0.024	922	0.212	0.056	48
	0.225	0.020	922	0.130	0.045	48
	Missing Category		0	0.105	0.044	48
	0.031	0.007	922	0.056	0.030	48

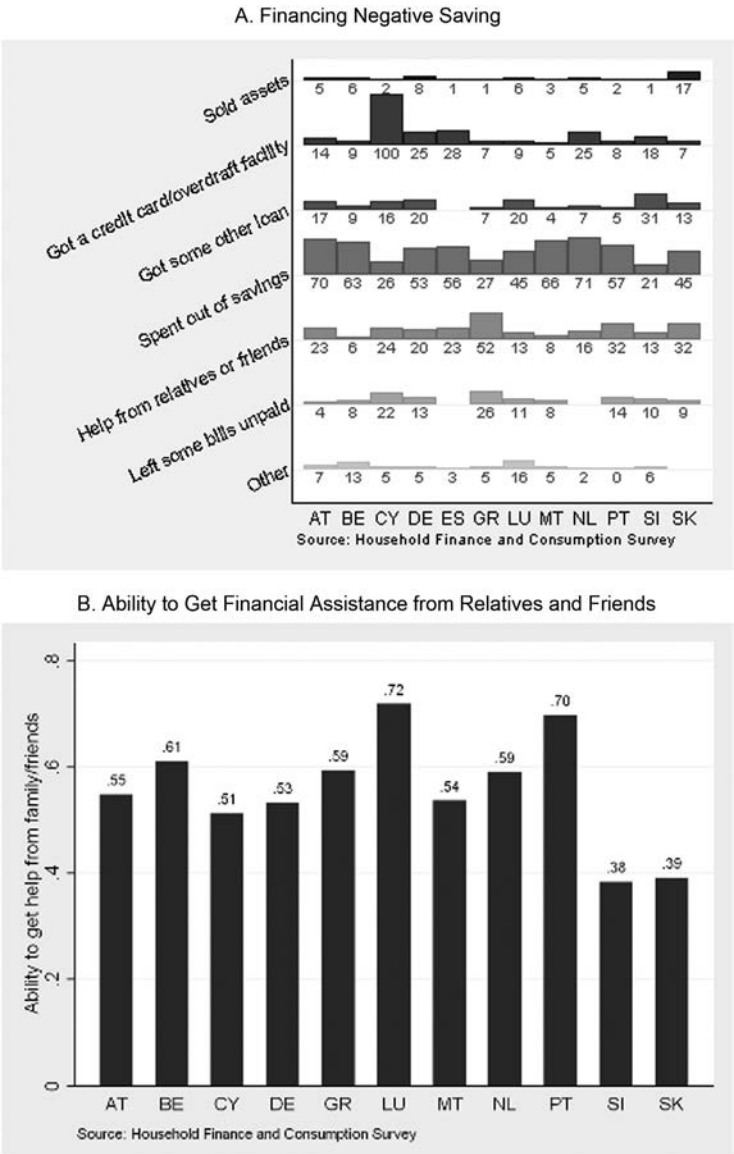
(continued)

Table 8. (Continued)

Statistics	Mean Perc.	Std. Err.	No. Obs.	Mean Perc.	Std. Err.	No. Obs.
	Greece			Slovakia		
Sold Assets	0.011	0.006	392	0.174	0.099	106
Got a Credit Card/Overdraft Facility	0.072	0.018	392	0.073	0.028	106
Got Some Other Loan	0.066	0.017	392	0.130	0.042	106
Spent Out of Savings	0.272	0.037	392	0.450	0.072	106
Asked for Help from Relatives or Friends	0.518	0.040	392	0.317	0.063	106
Left Some Bills Unpaid	0.260	0.042	392	0.087	0.035	106
Other (specify)	0.049	0.018	392	Missing Category		106

Notes: This table reports the mean percentage of households claiming how they finance their negative savings. Multiple answers are allowed. Standard errors are calculated with the Rao-Wu rescaled bootstrap method using 1,000 replicate weights and five multiply imputed data sets. Sample: Euro area excludes Finland, France, and Italy, as these questions are not collected in those countries.

Figure 2. Financing Negative Saving



Notes: Panel A is derived from the following question: You have told me that your expenses in the last 12 months have been above your income. What did you do to meet expenses? Multiple answers are allowed. Respondents may also choose the “Do not know” option or the “No answer” option. Panel B is derived from the following question: In an emergency, could (you/your household) get financial assistance of say EUR 5,000 from friends or relatives who do not live with you? Data on the ability to get financial assistance from relatives and friends have not been collected in Spain, Italy, Finland, and France.

The majority of households in the euro area reports that they mostly spent out of past savings (52 percent). The next most relevant sources of financing are assistance from relatives/friends (23 percent) and a credit card/overdraft facility (20 percent). Some 13 percent of households, for which average expenses were above average income during the last twelve months, claim they left bills unpaid. At least two other European surveys include questions relative to utility arrears (and mortgage or rent arrears), namely the European Union Statistics on Income and Living Conditions (EU-SILC) and Eurofound's European Quality of Life Survey (EQLS). Our finding is consistent with Eurofound (2013). This report shows that the proportion of people unable to make payments related to utility bills increased between 2007 and 2011, especially among homeowners, both without a mortgage (from 11 percent to 14 percent) and with a mortgage (from 10 percent to 13 percent).

Figure 2, panel A displays the different instruments that households use to finance negative saving by country, and the fraction of households in each country who reported to use the instrument. A certain degree of homogeneity can be observed across countries. The most commonly reported source of financing negative saving is spending out of savings cumulated in the past in all countries, with the exception of Greece, where there is a predominance of the habit to ask for help from relatives and friends (52 percent); of Cyprus, where it is very common to get a credit card/overdraft facility (almost 100 percent); and of Slovenia, where it is common to get some other form of loan (31 percent).¹⁰ In addition, Greece and Cyprus are the two countries with the highest fraction of households claiming they left bills unpaid (26 and 22 percent, respectively).

The HFCS question allows identification of four groups of households. Negative saving can be financed out of wealth/past saving, out of formal loans (credit cards/overdraft facilities/other loans), out of informal loans (family and friends), and out of unpaid bills.

Therefore we are able to identify the households who have been able to cope with negative saving (either by dissaving or by

¹⁰For Cyprus, the share of households reporting to get a credit card/overdraft facility was exactly 100 percent for two out of the five implicates. Since no variance exists for those two implicates, it is not possible to calculate the standard error over all five implicates.

relying on some forms of borrowing) and those who have not (by leaving unpaid bills), thus being financially vulnerable to adverse economic conditions and potentially “at risk” of poverty. The recent Social Investment Package (European Commission 2013) reports an increase in evictions and homelessness since the onset of the crisis in Europe. An increasingly prominent cause of poverty is over-indebtedness. The focus of policy discussion, data collection, and research is typically on formal debts, e.g., debts with institutions such as banks and insurance companies, utility companies, and public authorities. However, many people borrow from family, relatives, or friends when in need of money.

We perform a probit regression analysis for each of the four sources of financing negative savings.¹¹ Table 9 reports the full set of results.

In all regressions we control for country fixed effects, where Germany serves as a reference. Greece is the only country for which the country fixed effect enters strongly significantly in the four regressions. The marginal effects are also high. We observe that Greek households are less likely than German households to finance their negative savings by dissaving, either by wealth decumulation (marginal effect of 28 percentage points) or by relying on formal loans (marginal effect of 26 percentage points). At the same time, Greek households are more likely to rely either on informal forms of loans (marginal effect of 21 percentage points) or by leaving bills unpaid (marginal effect of 8 percentage points). The same story applies to Cyprus and to Portugal. In the former country, the fixed-effect dummy enters significantly and positively in the specification for unpaid bills (marginal effect of 8 percentage points), and significantly and negatively in the one for wealth/past savings decumulation (marginal effect of 29 percentage points). In the latter country, the fixed-effect dummy enters significantly and positively in the specification for informal loans (marginal effect of 12 percentage points), and significantly and negatively in the one for formal loans (marginal effect of 32 percentage points). Households from Belgium and Malta are significantly less likely to report financing negative savings by

¹¹ Another way to model this analysis is to perform multinomial probit regressions. However, our data do not allow this since multiple answers are possible, making the four alternative forms of financing not fully mutually exclusive.

**Table 9. Financing Negative Saving:
Probit Estimates for the Euro Area**

Variable	Out of Wealth Marg. Eff. (t-stats) (1)	Out of Formal Loans Marg. Eff. (t-stats) (2)	Out of Informal Loans Marg. Eff. (t-stats) (3)	Unpaid Bills Marg. Eff. (t-stats) (4)
Male	0.017 (0.46)	0.027 (0.62)	-0.032 (-1.13)	0.038 (1.16)
Age 41-55 Years	0.006 (0.13)	-0.121** (-2.27)	-0.012 (-0.37)	0.028 (0.93)
Age 56-70 Years	0.037 (0.66)	-0.144** (-2.01)	-0.061 (-1.41)	-0.010 (-0.20)
Age 71 Years and More	0.042 (0.56)	-0.274*** (-2.71)	-0.005 (-0.10)	-0.045 (-0.80)
Single	-0.043 (-0.85)	-0.065 (-1.05)	0.043 (1.11)	-0.005 (-0.11)
Divorced	-0.077 (-1.36)	0.091 (1.30)	0.041 (1.03)	0.034 (0.75)
Widowed	0.025 (0.43)	0.060 (0.65)	0.043 (1.13)	0.048 (1.02)
Household Size	-0.021 (-1.36)	0.004 (0.21)	0.015 (1.27)	0.010 (0.93)
Mid Education	0.011 (0.25)	0.005 (0.09)	-0.002 (-0.05)	-0.069* (-1.77)
High Education	0.049 (0.96)	-0.084 (-1.32)	0.020 (0.52)	-0.150*** (-2.86)
Temporary Contract	0.059 (0.85)	-0.198* (-1.89)	0.039 (0.67)	-0.000 (-0.00)
Self-employed	0.024 (0.33)	-0.065 (-0.80)	-0.013 (-0.25)	0.111* (1.73)
Unemployed	0.044 (0.75)	-0.131* (-1.85)	0.049 (1.13)	0.048 (1.02)
Other	0.056 (0.89)	-0.189** (-2.25)	0.052 (1.06)	0.046 (0.82)
Missing Employment	-0.115 (-0.64)	0.192 (1.22)	0.232 (1.31)	-
Retired	0.070 (0.99)	-0.083 (-1.07)	-0.119** (-2.47)	-0.074 (-1.62)
Financial Sector	0.014 (0.12)	-0.132 (-1.09)	0.030 (0.25)	-0.071 (-0.66)

(continued)

Table 9. (Continued)

Variable	Out of Wealth Marg. Eff. (t-stats) (1)	Out of Formal Loans Marg. Eff. (t-stats) (2)	Out of Informal Loans Marg. Eff. (t-stats) (3)	Unpaid Bills Marg. Eff. (t-stats) (4)
Public Sector	−0.057 (−0.92)	0.006 (0.10)	0.022 (0.41)	0.040 (0.75)
HH Income: 2nd Quintile	0.124*** (2.73)	0.018 (0.24)	−0.108*** (−3.12)	0.069* (1.79)
HH Income: 3rd Quintile	0.082* (1.68)	0.209*** (3.26)	−0.161*** (−3.83)	0.015 (0.31)
HH Income: 4th Quintile	0.043 (0.73)	0.172** (2.16)	−0.143*** (−3.11)	0.031 (0.53)
HH Income: 5th Quintile	0.129** (2.08)	0.107 (1.36)	−0.194*** (−4.11)	−0.013 (−0.25)
HH Net Wealth: 2nd Quintile	0.127*** (2.94)	−0.019 (−0.34)	−0.095*** (−2.67)	−0.102*** (−2.94)
HH Net Wealth: 3rd Quintile	0.273*** (6.19)	−0.161*** (−2.94)	−0.172*** (−5.10)	−0.149*** (−4.06)
HH Net Wealth: 4th Quintile	0.348*** (7.16)	−0.153** (−2.23)	−0.156*** (−4.13)	−0.177*** (−4.15)
HH Net Wealth: 5th Quintile	0.368*** (7.41)	−0.162** (−2.47)	−0.218*** (−5.70)	−0.091* (−1.67)
AT	0.125 (2.61)	−0.117** (−2.39)	0.067* (1.83)	−0.095* (−1.89)
BE	0.055 (1.08)	−0.171*** (−3.36)	−0.177*** (−3.08)	−0.038 (−0.97)
CY	−0.285*** (−5.06)	†	0.037 (0.88)	0.076*** (2.72)
ES	−0.015 (−0.32)	‡	0.006 (0.20)	§
GR	−0.283*** (−5.00)	−0.256*** (−4.84)	0.213*** (5.99)	0.082** (2.43)
LU	−0.070 (−0.94)	−0.074 (−0.97)	−0.092 (−1.19)	−0.055 (−0.99)
MT	0.097* (1.67)	−0.286*** (−4.04)	−0.146*** (−2.82)	−0.076 (−1.59)
NL	0.168** (2.39)	−0.103 (−1.63)	−0.084 (−1.53)	§

(continued)

Table 9. (Continued)

Variable	Out of Wealth Marg. Eff. (t-stats) (1)	Out of Formal Loans Marg. Eff. (t-stats) (2)	Out of Informal Loans (Marg. Eff. (t-stats) (3)	Unpaid Bills Marg. Eff. (t-stats) (4)
PT	0.018 (0.33)	−0.319*** (−5.56)	0.116*** (3.19)	−0.061 (−1.36)
SI	−0.333*** (−4.69)	0.073 (1.10)	−0.068 (−1.21)	−0.035 (−0.77)
SK	0.083 (1.09)	−0.258*** (−3.80)	0.053 (0.84)	−0.039 (−0.71)
Mean No. Obs.	3,621	2,384	3,621	2,549
Notes: The table reports probit marginal effects and t-statistics (in parentheses) of the probability of financing negative saving out of wealth (1), out of formal loans (2), out of informal loans (3), or by leaving bills unpaid (4). Reference groups are reported in table 1. Sample: Finland, France, and Italy are dropped from all specifications since data on financing negative saving have not been collected. The mean number of observations reported refers to the average over the five implicates used in the regressions. ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent level, respectively. †Cyprus is dropped from specification 2 since all households in this subsample can rely on a credit card or overdraft facility (four households cannot, but they have missing values for the category “Got Some Other Loan”). ‡Spain is excluded from specification 2 since the category “Got Some Other Loan” was not asked. §The Netherlands and Spain are dropped from specification 4 since this category is not asked in these countries.				

taking out loans, both formal (the marginal effect is 17 and 29 percentage points, respectively) and informal ones (the marginal effect is 18 and 15 percentage points, respectively).

Another aspect we observe is that households are less likely than German ones to rely on formal loans in all countries where the dummies are significant. The HFCS data do not allow disentangling demand from supply factors behind this finding. Similarly, any comparison with the U.S. experience is difficult to document, and we refrain from doing so. Nevertheless, it is interesting to note that Brown et al. (2010) report that “the Federal Reserve Bank of New York Consumer Credit Panel shows a substantial run-up in

total consumer indebtedness between the first quarter of 1999 and the peak in the third quarter of 2008, followed by a steady decline through the third quarter of 2010. During the same period, delinquencies rose sharply: Delinquent balances peaked at the close of 2009 and then began to decline again. . . . The data suggest that lenders have acted to curtail consumers existing credit in the face of growing delinquency rates and broader financial market uncertainty.”

Turning the attention to households’ characteristics, we observe a very significant (at the 1 percent level) effect of the stock of household wealth for all four sources of financing and with the expected sign. Wealthier households are more likely to cover negative saving by decumulating existing wealth or by dissaving. The marginal effects are rather high and monotonically increasing with wealth quintiles from 13 percentage points in quintile 2 to 37 percentage points in quintile 5. Wealthier households are also significantly less likely to leave bills unpaid, although the marginal effects are lower (in the range between 9 percentage points and 18 percentage points) and non-monotonic. In addition, wealthier households are significantly less likely to take out new loans or credit cards/overdraft facilities. Similarly, higher wealth quintiles are associated with lower probabilities of asking for informal loans from family and friends. The marginal effects are again rather high (between 10 percentage points and 22 percentage points) and non-monotonic.

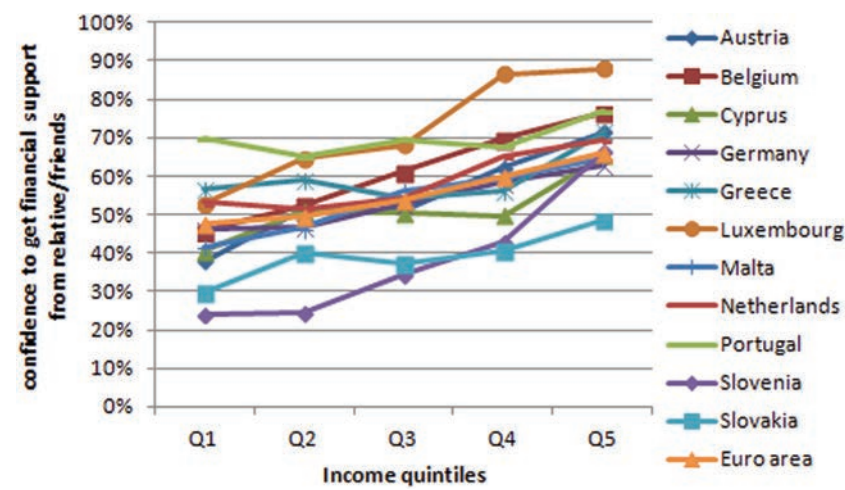
We also observe an effect of household income, although some findings are less intuitive than for wealth. We find that the higher the income, the higher the probability of dissaving, but also the higher the probability of leaving bills unpaid, even if the significance level is very high for the former effect and much lower for the latter (only for the second income quintile). Interestingly, we observe that income is positively related to the probability to take out new formal loans and negatively to the probability to ask for informal loans. This finding is not fully in line with Eurofound (2013), where people in higher income quartiles more often say they would turn to family, while people in lower income quartiles are more likely to have nobody to turn to. Rather, our finding underlines the fact that income-richer households can take out formal loans more easily, while the poorer households may be credit constrained and have to rely on informal loans.

Overall, households who leave bills unpaid are significantly more likely to be low educated and self-employed. Older or unemployed households and households with a temporary contract are significantly less likely to rely on formal loans or borrowing.

A relevant share of financial support to relatives and friends is provided as gifts rather than loans, but there is evidence that borrowing is common as well. According to Eurofound (2013), when urgently in need of money, people tend to turn to family or relatives (70 percent in 2011). A Portuguese study describes how loans are often provided free of interest and without any specific repayment schedule (Frade 2003), and households repay them whenever they have a surplus. This situation may change when the lending household itself is in urgent need of money, and this may have become more common during the crisis. To investigate the role of informal lending channels, the HFCS contains a question on the ability to get financial assistance from relatives and friends. The question reads as follows: In an emergency, could (you/your household) get financial assistance of say EUR 5,000 from friends or relatives who do not live with you? Figure 2, panel B shows the distribution of the percentages reported by countries.¹² In all countries where this information is available, there seems to be a fairly high confidence in the possibility to get financial assistance through informal borrowing. Peaks are found for Luxembourg and Portugal (70 percent). Only in Slovakia and in Slovenia is the percentage below 40. If one thinks of this informal borrowing in terms of a substitute for more formal credit channels (e.g., via the banking system or other financial institutions), then one should expect this form of borrowing to be more prominent for households with lower incomes or holding lower wealth stocks. Figure 3 reports the percentage of households claiming to be confident to be able to borrow from friends or relatives across income quintiles in each country. We see that for most countries the gradient is increasing with income. At the euro-area level the percentage goes from 48 percent for the lowest income quintile to 66 percent for the highest income quintile. However, in some countries that increase is much larger. In Austria, for example, the percentage goes from 38 percent to 71 percent. It is interesting to note that

¹²Data on the ability to get financial assistance from relatives and friends have not been collected in Spain, Italy, Finland, and France.

Figure 3. Confidence to Get Financial Support from Relatives and Friends by Income Quintiles



Notes: The question reads as follows: In an emergency, could (you/your household) get financial assistance of say EUR 5,000 from friends or relatives who do not live with you? Data on the ability to get financial assistance from relatives and friends have not been collected in Spain, Italy, Finland, and France.

in Mediterranean countries, typically associated with higher market imperfections, the gradient is less steep. In Portugal, for example, the difference ranges between 70 percent and 77 percent. Our findings are in a sense consistent with Eurofound (2013), where relatives and friends are considered sources of emergency financial support by households belonging to the top income quintile more than those belonging to the bottom income quintile.

5. Concluding Remarks

The paper studies different perspectives of household saving behavior in fifteen countries in the euro zone, using the Household Finance and Consumption Survey, a new harmonized data set collecting detailed information on wealth holdings, consumption, and income.

We first analyze individual motives for household saving. We find evidence of some degree of homogeneity across countries with

respect to saving preferences and the relative importance of several motives for saving. Saving for unexpected events is the most commonly reported motive in all countries, followed by saving for old-age provision. We observe also a relevant role for education and support of children and grandchildren, home purchase, and other major purchases. Households in all countries are more likely to save for unexpected events than German households (with the exception of Slovenian households). This finding holds also after controlling for sociodemographic and economic variables. Saving for home purchase is more likely to be important in the Netherlands, Portugal, and Malta than in Germany. The saving motive old-age provision is more prevalent in the Netherlands, Malta, and Portugal than in Germany, while it is less prevalent in Cyprus and Spain.

Our findings show evidence of heterogeneity with respect to the relevance of reasons for putting money aside among households depending on their financial situation. Saving for paying off debts is very important for the households reporting expenses higher than income, while this motive is relatively less important for the households with positive saving. Saving for home purchase and precautionary saving are decreasingly important with age. Consistent with the life-cycle model, being retired is negatively related to the importance of saving for buying a house. The gross replacement rate from the first (public pension) pillar significantly decreases the importance of saving for old-age provision, suggesting a substitution effect between public and private pension savings. We also find a significant and positive effect of financial literacy on saving for unexpected events. In addition, saving for unexpected events is significantly and negatively related to (average) income taxes, implying that public and personal insurance mechanisms are substitutes.

We then study how households perceive their actual saving behavior. We find a rather similar perception of household saving behavior across countries. The majority of respondents claim that in the previous twelve months their household expenses were about the same as average household expenses as well as their household income. Nevertheless, about 11 percent of households report that their expenses were above their income. These households potentially at risk of financial vulnerability are more likely to have a head who is female, less than forty years old, or divorced. In contrast,

wealthier households are less likely to incur expenses higher than income. We further analyze alternative sources of financing negative saving, namely dissaving, borrowing, and leaving bills unpaid.

Financing negative saving out of informal loans plays a bigger role in Greece and Portugal than in Germany, while in all countries the probability of using formal loans to finance negative saving is significantly lower than in Germany. Distressed households in Greece and Cyprus have a higher tendency to leave bills unpaid than distressed households in Germany and are less likely to finance negative savings out of wealth. Only Dutch and Maltese households have a higher probability of covering negative savings out of their wealth.

Wealthier households are more likely to cover negative saving by decumulating existing wealth or by dissaving and are less likely to leave bills unpaid. We also observe an income effect: the higher the income, the higher the probability of dissaving, but also the higher the probability of leaving bills unpaid. Income is positively related to the probability to take out new formal loans and negatively to the probability to ask for informal loans. Overall, households who leave bills unpaid are significantly more likely to be low educated and self-employed. Older or unemployed households and households with a temporary contract are significantly less likely to rely on formal loans or borrowing.

In view of the European integration process, our findings reveal that a micro perspective on household savings uncovers substantial heterogeneity within and across the population in each country. As the European integration process proceeds, future research should focus on the changing institutional environments and their impact on household behavior and the investigation of possible effects of cross-country heterogeneity of household savings on the monetary transmission process.

Appendix. Data Preparation

A key distinguishing feature of the HFCS is that it provides country-representative data, which have been collected in a harmonized way in all euro-area countries—with the exception of Estonia, Ireland, and Latvia—for a sample of more than 62,000 households (see Bover,

Schurz et al. 2015 for a more detailed description of the data collection and preparation).

The survey was conducted from November 2008 in Spain to August 2011 in Italy. The fieldwork for most countries was conducted in 2010.¹³ Thus, the reference year of wealth is in most cases 2010 (at the point the survey was conducted) and the year prior to the survey year for income, which is 2009 for most countries. Almost all countries used CAPI (computer-assisted personal interviews) as the interview mode¹⁴ and applied a stratified random sampling as the sampling strategy. Most countries oversampled the wealthy in order to better assess the right tail of the wealth distribution (HFCN 2013a, section 4).¹⁵ Differences in purchasing power parities are taken into account, since monetary control variables such as income and wealth are included as weighted quintile dummies and are calculated separately over each country. Thus, the richest 20 percent of households in one country or another are always located in income or wealth quintile 5. Individual answers are subject to logical consistency checks and possible corrections based on editing that is performed prior to transmitting national data to the European Central Bank. Item non-response is addressed by country-specific multiple imputation models, which results in five imputates for each country data set to properly adjust for imputation uncertainty (HFCN 2013a, section 6).

In fact, the HFCS data are multiply imputed using the method of Rubin (1987) with five imputates. All descriptive and multivariate analyses combine the results obtained from each of the five imputates according to Rubin's rule (Rubin 1987). Instead of single imputation, multiple imputation can take into account the uncertainty in specifying the imputation model. The combined point estimate is

¹³The field phases were as follows: Austria (09/10–05/11), Belgium (04/10–11/10), Cyprus (04/10–01/11), Germany (09/10–07/11), Spain (11/08–07/09), Finland (01/10–05/10), France (10/09–02/10), Greece (06/09–09/09), Italy (01/11–08/11), Luxembourg (09/10–04/11), Malta (10/10–02/11), the Netherlands (04/10–12/10), Portugal (04/10–07/10), Slovenia (10/10–12/10), and Slovakia (09/10–10/10).

¹⁴In the Netherlands CAWI (computer-assisted web interviews) was adopted instead.

¹⁵For a detailed overview on sampling mode and fieldwork periods, see HFCN (2013a).

the average of the point estimates over five imputates. The variance is produced as the weighted sum of two variances: the within-imputation variance and the between-imputation variance. The individual imputation value is simulated by drawing repeatedly from an estimate of the conditional distribution of the data using also the imputed outcomes from the last iteration (Gibbs sampling). During imputation, the logical constraints imposed by the questionnaire are incorporated.

Each country adopts the multi-stage weighting procedure to alleviate the deviations from a simple randomized survey due to complex sample design, which include unequal selection probability, unit non-response, undercoverage or overcoverage, and other design inadequacies. Due to data-protection reasons, additional replicate weights are provided to allow variability measures of the estimates. They result from the bootstrap simulations that integrate the sample design information and are calibrated, like the single survey weight, to maintain the representativeness of important marginal distributions in the population.

Therefore, all descriptive statistics and marginal effects are weighted with the sample weights to obtain country and euro-area representative results (HFCN 2013a, section 5). Standard errors are calculated with the Rao-Wu rescaled bootstrap method using 1,000 replicate weights and five multiply imputed data sets. We execute weighted regressions, as suggested in the case of complex survey designs (Magee, Robb, and Burbidge 1998).

References

- Acemoglu, D., and D. Autor. 2010. "Skills, Tasks and Technologies: Implications for Employment and Earnings." In *Handbook of Labor Economics*, Vol. 4B, ed. O. Ashenfelter and D. Card, 1043–1171 (chapter 12). Amsterdam: Elsevier.
- Alessie, R., A. Lusardi, and T. Aldershof. 1997. "Income and Wealth over the Life Cycle: Evidence from Panel Data." *Review of Income and Wealth* 43 (1): 1–32.
- Attanasio, O., J. Banks, and M. Wakefield. 2004. "Effectiveness of Tax Incentives to Boost (Retirement) Saving: Theoretical Motivation and Empirical Evidence." *OECD Economic Studies* 39 (2004/02): 111–44.

- Attanasio, O., and A. Brugiavini. 2003. "Social Security and Households' Saving." *Quarterly Journal of Economics* 118 (3): 1075–1119.
- Boersch-Supan, A., ed. 2003. *Life-Cycle Savings and Public Policy*. Academic Press.
- Boersch-Supan, A., and A. Lusardi. 2003. "Saving: A Cross-National Perspective." In *Life-Cycle Savings and Public Policy: A Cross-National Study of Six Countries*, ed. A. Boersch-Supan, 1–32 (chapter 1). New York: Academic Press.
- Bover, O., J. Casado, S. Costa, P. Du Caju, Y. McCarthy, E. Sierminska, P. Tzamourani, E. Villanueva, and T. Zavadil. 2015. "The Distribution of Debt across Euro Area Countries: The Role of Individual Characteristics, Institutions and Credit Conditions." ECB Working Paper No. 1639.
- Bover, O., M. Schurz, J. Slacalek, and F. Teppa. 2015. "Eurosystem Household Finance and Consumption Survey—Main Results on Assets, Debt and Saving."
- Brown, M., A. Haughwout, D. Lee, and W. van der Klaauw. 2010. "The Financial Crisis at the Kitchen Table: Trends in Household Debt and Credit." Staff Report No. 410, Federal Reserve Bank of New York.
- Browning, M., and A. Lusardi. 1996. "Household Saving: Micro Theories and Micro Facts." *Journal of Economic Literature* 34 (4): 1797–1855.
- Carneiro, P., and S. Lee. 2011. "Trends in Quality-Adjusted Skill Premia in the United States, 1960–2000." *American Economic Review* 101 (6): 2309–49.
- Carroll, C. 1994. "How Does Future Income Affect Current Consumption?" *Quarterly Journal of Economics* 109 (1): 111–48.
- . 1997. "Buffer-Stock Saving and the Life Cycle/Permanent Income Hypothesis." *Quarterly Journal of Economics* 112 (1): 1–56.
- Chang, Y. 1994. "Saving Behavior of U.S. households in the 1980s: Results from the 1983 and 1986 Survey of Consumer Finances." *Financial Counseling and Planning* 5: 1–21.
- Deaton, A. 1991. "Saving and Liquidity Constraints." *Econometrica* 59: 1221–48.
- Devaney, S. A., S. T. Anong, and S. E. Whirl. 2007. "Household Savings Motives." *Journal of Consumer Affairs* 41 (1): 174–96.

- Disney, R., C. Emmerson, and M. Wakefield. 2010. "Tax Reform and Retirement Saving Incentives: Take-Up of Stakeholder Pensions in the UK." *Economica* 77 (306): 213–33.
- Dynan, K., J. Skinner, and S. Zeldes. 2004. "Do The Rich Save More?" *Journal of Political Economy* 112 (2): 397–444.
- Eurofound. 2013. "Household Over-Indebtedness in the EU: The Role of Informal Debts." Publications Office of the European Union.
- European Commission. 2006. "Report by the Indicators Subgroup of the Social Protection Committee."
- . 2012. "Ageing Report."
- . 2013. "Confronting Homelessness in the European Union." Staff Working Document 2013-42 (Final).
- Feldstein, M. 1980. "International Differences in Social Security and Saving." *Journal of Public Economics* 14 (2): 225–44.
- Fisher, P. 2010. "Gender Differences in Personal Saving Behaviors." *Journal of Financial Counseling and Planning* 21 (1): 14–24.
- Fisher, P., and C. Montaldo. 2010. "Effect of Saving Motives and Horizon on Saving Behaviors." *Journal of Economic Psychology* 31 (1): 92–105.
- Frade, C. 2003. "Desemprego e Sobreendividamento Dos Consumidores: Contornos de uma Ligao Perigosa [Unemployment and Indebtedness of Consumers: Contours of a Dangerous Liaison]." Centro de Estudos Sociais, Universidade de Coimbra, Portugal.
- Friedman, M. 1975. *A Theory of the Consumption Function*. Princeton, NJ: University Press.
- Gale, W. 1998. "The Effects of Pensions on Household Wealth: A Reevaluation of Theory and Evidence." *Journal of Political Economy* 106 (4): 706–23.
- Gourinchas, P., and J. Parker. 2002. "Consumption over the Life Cycle." *Econometrica* 70 (1): 47–89.
- Guiso, L., T. Jappelli, and J. Terlizzese. 1992. "Earnings Uncertainty and Precautionary Saving." *Journal of Monetary Economics* 30 (2): 307–37.
- Hayashi, F., T. Ito, and J. Slemrod. 1988. "Housing Finance Imperfections, Taxation, and Private Saving: A Comparative Simulation Analysis of the United States and Japan." *Journal of Japanese and International Economies* 2 (3): 215–38.

- Horioka, C. Y., and W. Watanabe. 1997. "Why Do People Save? A Micro-analysis of Motives for Household Saving in Japan." *Economic Journal* 107 (442): 537–52.
- Household Finance and Consumption Network. 2013a. "The Eurosystem Household Finance and Consumption Survey—Methodological Report." ECB Statistics Paper No. 1.
- . 2013b. "The Eurosystem Household Finance and Consumption Survey — Results from the First Wave." ECB Statistics Paper No. 2.
- Hubbard, R., J. Skinner, and S. Zeldes. 1995. "Precautionary Saving and Social Insurance." *Journal of Political Economy* 103 (2): 360–99.
- Hurd, M. 1987. "Savings of the Elderly and Desired Bequests." *American Economic Review* 77 (3): 298–312.
- Hurd, M., P. Michaud, and S. Rohwedder. 2012. "The Displacement Effect of Public Pensions on the Accumulation of Financial Assets." *Fiscal Studies* 33 (1): 107–28.
- International Institute for Management Development. Various Years. "World Competitiveness Yearbook." Report (published annually).
- International Monetary Fund. 1997. "Empirical Determinants of Household Saving: Evidence from OECD Countries." IMF Working Paper No. 97/181.
- Jappelli, T. 1995. "Does Social Security Reduce the Accumulation of Private Wealth? Evidence from Italian Survey Data." *Ricerche Economiche* 49 (1): 1–31.
- Katona, G. 1975. *Psychological Economics*. New York: Elsevier.
- Katz, L., and K. Murphy. 1992. "Changes in Relative Wages, 1963–87: Supply and Demand Factors." *Quarterly Journal of Economics* 107 (1): 35–78.
- Kennickell, A., and A. Lusardi. 2005. "Disentangling the Importance of the Precautionary Saving Motive." CFS Working Paper No. 2006/15.
- Keynes, J. M. 1936. *The General Theory of Employment, Interest and Money*. London: Macmillan.
- Koskela, E., and M. Viren. 1983. "Social Security and Household Saving in an International Cross Section." *American Economic Review* 73 (1): 212–16.

- Leland, H. 1968. "Saving and Uncertainty: The Precautionary Demand for Saving." *Quarterly Journal of Economics* 82 (3): 465–73.
- Lindqvist, A., C.-R. Julander, and B. Fjaestad. 1978. "Development of Behavioral Scientific Indicators on Saving." Report 2 of the project "Saving and Saving Behaviour." Economic Research Institute (EFI), Stockholm School of Economics.
- Lusardi, A., P. C. Michaud, and L. Mitchell. 2015. "Using a Life Cycle Model to Evaluate Financial Literacy Program Effectiveness." Working Paper No. 2, Pension Research Council.
- Lusardi, A., and L. Mitchell. 2007. "Baby Boomer Retirement Security: The Roles of Planning, Financial Literacy, and Housing Wealth." *Journal of Monetary Economics* 54 (1): 205–24.
- Magee, L., A. Robb, and J. Burbidge. 1998. "On the Use of Sampling Weights when Estimating Regression Models with Survey Data." *Journal of Econometrics* 84 (2): 251–71.
- Modigliani, F., and R. Brumberg. 1954. "Utility Analysis and the Consumption Function: An Interpretation of Cross-section Data." In *Social Cognitive Development Frontiers and Possible Futures*, ed. J. H. Flavell and L. Ross. Cambridge, NY: University Press.
- Organisation for Economic Co-operation and Development (OECD). 2010. *Taxing Wages 2009–2010*. Paris: OECD Publishing.
- Palumbo, M. 1999. "Uncertain Medical Expenses and Precautionary Saving Near the End of the Life Cycle." *Review of Economic Studies* 66 (2): 395–421.
- Poterba, J., ed. 1994. *International Comparisons of Household Savings*. Chicago, London: University of Chicago Press.
- Rubin, D. B. 1987. *Multiple Imputation for Nonresponse in Surveys*. New York: John Wiley & Sons.
- Schunk, D. 2009. "What Determines Saving Behavior? An Examination of Saving Motives and Saving Decisions." *Journal of Economics and Statistics* 229 (4): 467–91.
- Skinner, J. 1988. "Risky Income, Life-Cycle Consumption and Precautionary Saving." *Journal of Monetary Economics* 22 (2): 237–55.
- Smith, J. 1999. "Inheritances and Bequests." In *Wealth, Work, and Health: Innovations in Measurement in the Social Sciences*:

- Essays in Honor of F. Thomas Juster*, ed. J. P. Smith and R. J. Willis. Ann Arbor, MI: University of Michigan Press.
- Solomon, L. 1975. "The Relation Between Schooling and Savings Behavior: An Example of the Indirect Effects of Education." In *Education, Income, and Human Behavior*, ed. F. T. Juster, 253–94 (chapter 10). New York: McGraw-Hill.
- Tinbergen, J. 1974. "Substitution of Graduate by Other Labour." *Kyklos* 27 (2): 217–26.
- Verbist, G., and F. Figari. 2014. "The Redistributive Effect and Progressivity of Taxes Revisited: An International Comparison across the European Union. EUROMOD Working Paper No. EM6/14.
- Willi, L., J. Thornton, and A. Bibee. 1997. "Taxation and Economic Performance." Working Paper No. 176, OECD Economics Department.
- Yuh, Y., and S. Hanna. 2010. "Which Households Think They Save?" *Journal of Consumer Affairs* 44 (1): 70–97.
- Xiao, J., and F. E. Noring. 1994. "Perceived Saving Motives and Hierarchical Financial Needs." *Journal of Financial Counseling and Planning* 5: 25–44.

The Distribution of Debt across Euro-Area Countries: The Role of Individual Characteristics, Institutions, and Credit Conditions*

Olympia Bover,^a Jose Maria Casado,^a Sonia Costa,^b
Philip Du Caju,^c Yvonne McCarthy,^d Eva Sierminska,^e
Panagiota Tzamourani,^f Ernesto Villanueva,^a
and Tibor Zavadil^g

^aBanco de España

^bBanco de Portugal

^cNational Bank of Belgium

^dCentral Bank of Ireland

^eCEPS/INSTEAD Research Institute

^fDeutsche Bundesbank

^gNational Bank of Slovakia

The aim of this paper is twofold. First, we present an up-to-date assessment of the differences across euro-area countries in the distributions of various measures of debt conditional on household characteristics. We consider three different outcomes: the probability of holding secured debt, the amount of secured debt held, and the interest rate paid on the main mortgage. Second, we examine the role of legal and economic institutions in accounting for these differences. We use data

*This paper is a shortened version of Bover et al. (2013). The original version studies the determinants of both secured and unsecured debt. The methods used in the working paper version include quantile regression models. Furthermore, the working paper examines additionally the response of debt profiles to the prevalence of interest-only mortgages and to measures of country-level financial literacy. The views expressed here are those of the authors and do not necessarily reflect those of the respective national central banks or the European Central Bank. We would like to thank Åsa Johansson for providing data on pre- and after-tax mortgage interest rates and Richard Blundell and an anonymous referee for helpful comments. All remaining errors are our own. Corresponding author (Bover) e-mail: bover@bde.es.

from the first wave of a new survey of household finances, the Household Finance and Consumption Survey. Adjusting for household composition, we find substantial cross-country variation in secured debt outcomes and in their distribution across age and income groups. Among all the institutions considered, the length of asset repossession periods best accounts for the differences across countries in the distribution of secured debt. In countries with longer repossession periods, the fraction of people who borrow is smaller, the youngest group of households borrow lower amounts (conditional on borrowing), and the mortgage interest rates paid by low-income households are higher. Regulatory loan-to-value ratios, the taxation of mortgages, and the prevalence of fixed-rate mortgages deliver less robust results.

JEL Codes: D14, G21, G28, K35.

1. Introduction

New micro data reveal striking differences in the incidence, amount, and cost of debt held by comparable households across countries in the euro area. For example, nearly half of all Dutch households hold secured debt, while only one in ten Italian households do. Debt-to-income ratios of Austrian debtholders are three times smaller than those of Dutch households. The age-cohort profile of debt holding itself varies markedly across countries, being flat in Italy, steeply decreasing in Spain, and increasing in the Netherlands. The purpose of this paper is to document these differences and to find out to what extent they are associated with cross-country differences in legal and economic institutions.

We use the new Household Finance and Consumption Survey (HFCS), a harmonized survey that contains information on household demographics, debt, wealth, and income across euro-area countries. We also use quantitative indicators of institutions and credit conditions in the different countries. We proceed in two steps. In the first step we run country-specific regressions of secured debt outcomes on a parsimonious set of household characteristics that includes age, schooling, labor status of core household members, and household income and size. We examine three secured debt outcomes: the fraction of households with debt, the average amount

borrowed, and the interest rate on the mortgage that financed the house of residence.¹ In a second stage, we relate some key country-specific estimates to various institutions and credit conditions. The country-specific estimates we focus on are measures of the age-cohort and income profiles.²

We emphasize those institutions that capture the legal or regulatory framework faced by borrowers and lenders. Hence, we examine legal enforcement of contracts—measured by the time needed to repossess a house, several indicators of the tax treatment of mortgage payments, regulatory loan-to-value (LTV) ratios at origination, the share of fixed-rate mortgages, and depth of information about borrowers.³

We note three advantages of our strategy. Firstly, the two-step approach we follow leads to effects of the institutional variables on differential household debt outcomes by age and income that allow for endogeneity with respect to unobserved country effects, both additive and interacting with the remaining household characteristics. We argue that this strategy is less restrictive than alternatives that pool the data across countries and interact key household characteristics and institutional variables.

Secondly, we consider many institutions. We conduct one-by-one analyses of the impact of institutions on various debt outcomes. This permits both an empirical assessment of the merits of each institution in accounting for age and income profiles of borrowing, and an explicit comparison to the theoretical and quantitative papers in the literature, which typically deal with one institution at a time. We also propose a multivariate analysis to establish which institutions matter most. This latter analysis is quite informative. When considered in isolation, certain institutions may correlate with the debt

¹ Among others, Crook and Hochguertel (2007) and Georgarakos, Lojschova, and Ward-Warmedinger (2010) study the country-specific determinants of financial distress in EU countries (the former) and of the probability of loan rejections and the amount of debt (the latter, in a subset of euro-area countries but also including the United States).

² The HFCS is a cross-section, so in the remainder of the paper we use the shorthand age profile for what really is an age-cohort profile.

³ Andrews and Caldera Sánchez (2011), European Central Bank (2009), and World Bank (2012) report the substantial heterogeneity of these institutions across countries in the euro area.

profiles we consider. However, this correlation may not hold in a multivariate setting when we consider the importance of a number of institutions simultaneously.

Finally, we assess the explanatory power of each institution by examining its impact on three debt outcomes: the fraction of households who borrow secured (the extensive margin); the amount of secured debt borrowed, conditional on borrowing (the intensive margin); and the cost of secured debt. By comparing the impact of an institution on the cost, incidence, and amount of debt held, we obtain indications about the channel through which each institution affects borrowing behavior. For example, consider the impact of the time length of foreclosure procedures on borrowing outcomes. If shorter reposessions increase the incidence of secured borrowing while diminishing the relative cost of borrowing among one demographic group, one would expect that reposessions affect borrowing through a supply-side effect.

On the downside, our second stage is based on correlations using a sample of eleven countries. This is necessarily so, because this is the variation available in the data—and the situation would be exactly the same in a pooled regression.

The findings of the first stage suggest that the age and income of household members are important determinants of debt outcomes. In that context, we find evidence of a hump-shaped profile of secured debt holding over age-cohort groups. Specifically, the propensity to borrow peaks for cohorts aged thirty-five to forty-four at the time of the survey, before the (cross-sectional) income profile peaks, possibly suggesting a role for secured debt in smoothing household consumption. Nevertheless, cross-country differences in the age and income profiles of borrowers are substantial. There is also substantial heterogeneity in how mortgage interest rates are related to income across countries.

Our findings from the second stage suggest that among all the institutions we consider, the length of repossession periods best explains the heterogeneity in differential debt by age and income across countries. In countries with fifteen months longer (one standard deviation longer) repossession procedures, and holding the rest of the characteristics constant at those of the reference group, the fraction of borrowers is 16 percent smaller, the amount borrowed by the youngest set of households (conditional on borrowing)

is 12 percent lower, and the interest rates paid by low-income (high-income) households are 0.3 percentage point higher (lower).⁴ These results are robust to the inclusion of other institutions. The analysis of the remaining institutions—regulatory LTV ratios, the taxation of mortgages, the availability of information about borrowers, and the prevalence of fixed-rate mortgages (FRMs)—delivers less robust results. We interpret these results as suggesting that the supply of secured debt is affected by legal processes that delay the recovery of collateral in the case of non-repayment and, furthermore, that banks react to expected losses due to longer repossession periods by pricing secured debt differently across income groups.

Theoretical and quantitative models have stressed the role of each of the institutions we consider in shaping the distribution of debt outcomes among age or income groups. In particular, the models of Chambers, Garriga, and Schlagenhauf (2009) and Ortalo-Magné and Rady (1999, 2006) analyze the impact of LTV ratios on the chances of young and low-income households holding debt. Another strand of the literature discusses how the supply and distribution of debt is affected by bank losses in the event of non-repayment, measured as the opportunity and uncertainty costs of longer repossession processes (Jappelli, Pagano, and Bianco 2005), or by the presence of the bankruptcy option—Chatterjee et al. (2007) and Livshits, MacGee, and Tertilt (2007). Gervais (2002) uses an overlapping-generations (OLG) model to show that tax exemptions for the implicit rents of owner-occupied housing and mortgage payments lead mid- and high-income households to anticipate housing consumption over the life cycle. Finally, regarding the role of depth of information, Edelberg (2006) discusses the consequences of the increased possibilities of credit scoring that occurred during the 1990s in the United States on the pricing of default risk and, ultimately, on the distribution of debt.

In sum, the theoretical literature stresses that legal enforcement, taxation of mortgages, or credit market regulation affects the composition of borrowers and the distribution of the (individual-specific) price of debt. Hence, our analysis of how institutions correlate with

⁴The reference group is a two-person household with the median income in the country, where both members are aged between thirty-five and forty-four years and have mid-level schooling, where the core member with the highest earnings is an employee, and where the other core member works.

different age or income profiles of debt outcomes extends previous empirical studies that disentangle the relative importance of law enforcement or of information about borrowers by using cross-country regressions of total private-sector debt-to-GDP ratios on indicators of law enforcement (Djankov, McLiesh, and Shleifer 2007; Jappelli, Pagano, and Bianco 2005).

An alternative empirical approach pools observations from different provinces or states within the same country to test if more generous state-level bankruptcy exemptions in the United States—Gropp, Scholz, and White (1997)—or lengthier repossession periods across Italian provinces—Fabbri and Padula (2004)—result in a lower amount of debt granted to low-asset households. Those studies interact wealth with the institution of interest. However, the theoretical models mentioned above predict that banks use all available information to price loans so that variation in repossession periods may affect the age or income profile, unlike what is assumed in those empirical studies.

The rest of this paper is structured as follows. The next section presents an overview of the data used in this paper. In section 3 we discuss the predicted impact of the institutions we consider on several debt outcomes. Section 4 discusses the empirical approach employed to examine debt across euro-area countries. Section 5 presents the results from the first part of our empirical investigation. In section 6 we present the results from the second part of the empirical analysis, where we assess the impact of institutions and credit conditions on the first-stage results and compare the economic magnitude of our results with the previous literature. Finally, in section 7, we conclude.

2. Data and Descriptives

This paper uses newly available data from the first wave of the Household Finance and Consumption Survey (HFCS) to study household debt in euro-area countries. The HFCS is a Eurosystem initiative aimed at collecting comparable micro-level information on household balance sheets. It is a unique survey in that it collects information on household income, assets, liabilities, and consumption that is comparable across euro-area countries. The first wave

of the survey was conducted in fifteen countries of the Eurosystem between end-2008 and mid-2011, with the majority of countries conducting the survey in 2010.

The analysis in this paper is based on the HFCS data for eleven of these countries because some of the variables important to this study are missing from the data sets in Cyprus, Finland, Malta, and Slovenia. Full details of the sampling methodology employed for the HFCS are available in Household Finance and Consumption Network (2013).

The HFCS includes a number of questions on household debt, and these form the basis for the analysis. Households are asked to provide detailed information on the quantity and terms of debt secured on the household's main residence, and separately for loans secured on other properties.

Specifically, respondents are asked to provide information about the loan terms at the time of origination as well as current information such as the amount outstanding, the current interest rate, and the monthly repayment. We focus on the current outstanding balance of debt secured against the main residence or some other property, as well as the current interest rate applying to the most important loan collateralized on the house of residence.

Table 1 shows the proportion of households with secured debt, the secured-debt-to-income ratio, and the current interest rate charged on the main mortgage, across the countries in the HFCS data set.⁵ The proportion of households with secured debt ranges from a low of around 10 percent in Italy and Slovakia to a high of almost 45 percent in the Netherlands. Households in the Netherlands hold the largest amount of secured debt as a proportion of their income, while households in Austria hold the lowest secured-debt-to-income ratio.

Finally, table 1 also presents an overview of the debt holdings, and socioeconomic and demographic characteristics of households in the sample. As discussed below, the summary statistics refer to the respondent when that person is single. In the case of a couple, the age reported is that of the eldest person in the couple, the education is that of the member with the highest level of schooling, and the

⁵In table 1 we do not control for differences in fieldwork periods across countries (but do so in our econometric analysis).

Table 1. Summary Statistics (% of households, unless otherwise stated)^a

Countries											
	AT	BE ^a	DE	ES	FR	GR	IT	LU	NL ^a	PT	SK
Variables ↓ Sample Size →	2,380	2,327	3,565	6,197	15,006	2,971	7,951	950	1,301	4,404	2,057
Holding Debt (%)	18.4	30.5	21.5	32.5	24.4	17.5	10.8	38.8	44.7	26.7	9.6
Secured Debt to Income (median rate in %)	74.3	132.7	132.6	195.0	129.8	145.0	145.3	157.6	253.7	221.6	185.9
Interest Rate (median) of the HMR Mortgage	2.6	4.1	4.6	5.0	4.4	5.0	4.0	2.4	4.8	2.0	5.0
Age (%)											
16-34	17.7	16.0	17.9	12.0	18.1	18.0	8.0	16.9	12.7	8.8	20.9
35-44	17.4	19.0	16.7	22.6	18.9	20.9	19.1	21.9	20.8	20.1	19.1
45-54	20.2	20.0	20.8	21.0	16.8	16.8	20.7	22.6	22.6	19.3	22.5
55-64	19.2	17.1	15.1	16.0	19.3	17.2	18.1	16.3	20.6	20.0	17.0
Over 64	25.5	27.9	29.5	28.3	26.9	27.1	34.0	22.3	23.3	31.8	20.4
Age Difference (median)	0	0	0	1	0	2	1	1	0	2	1
Education (%)											
No Education or Primary	13.4	20.6	10.6	49.3	31.3	39.6	47.9	30.4	24.4	73.5	5.5
Secondary	70.3	35.6	54.4	19.9	40.8	36.0	37.9	40.2	39.2	13.9	74.0
Tertiary	16.2	43.8	35.0	30.8	27.9	24.4	14.2	29.4	36.4	12.6	20.5
Education Difference	15.7	25.5	21.6	25.1	25.0	21.8	24.5	24.0	22.8	20.9	11.0
Labor Status (%)											
Employee	47.0	46.7	51.5	44.9	47.5	39.2	42.8	59.0	39.3	44.5	56.6
Self-Employed	9.4	5.2	7.2	10.7	7.3	18.9	12.8	5.6	6.7	10.2	10.7
Retired	36.4	33.5	30.1	23.8	34.3	32.6	32.2	26.6	25.2	35.7	25.3
Inactive or Unemployed	7.3	14.6	11.1	20.7	11.0	9.3	12.2	8.8	28.8	9.6	7.3
Other Core Member Working	27.6	28.3	27.5	31.2	28.7	23.1	22.7	29.6	24	32.4	37.7
Household Size											
No. of Adults (median)	2	2	2	2	2	2	2	2	2	2	2
Couple (%)	51.6	56.3	52.4	66.7	55.1	63.7	63.5	58.9	51.3	69.8	58.6
Total Income (median in thousand euros)	32.3	33.7	32.5	24.8	29.2	22.0	26.3	64.8	40.6	14.6	11.2

^aSome observations in Belgium and the Netherlands had no information on labor status and were dropped from our estimations (22 in Belgium and 140 in the Netherlands).

employment status is that of the person with the highest individual income. Table 1 reflects the substantial cross-country heterogeneity in variables likely to correlate with debt outcomes, such as income levels or the age of household members.

3. Institutions

3.1 Modeling Background and the Impact of Institutions

The permanent-income hypothesis predicts that a consumer's desired non-durable consumption is proportional to his or her stream of future earnings, discounted at the lending or borrowing rate—with a proportionality factor that depends on preferences.⁶ Holding such preference shifters constant, the desired amount of debt is then determined by a household's current income and by the discounted stream of future earnings. These basic results highlight the need to control for variables like the household's current income as well as the age, level of education, and employment status of "core" household members when modeling debt outcomes.⁷

However, uncertainty about the borrower's ability to repay makes it likely that the pricing of debt is also affected by the bank's assessment of the borrower's risk, as reflected by age, earnings capacity, or current assets. Furthermore, cross-country differences in the degree of legal enforcement or in access to past information about borrowers will affect how the bank's assessment of risk is transmitted into risk pricing and, ultimately, the distribution of debt outcomes across groups of the population.

There is a wide dispersion across euro-area countries in the availability of information needed to screen borrowers—such as the existence of credit bureaus, for example—and also in the costs banks incur in the case of non-repayment of a loan, measured in terms

⁶See Dynan and Kohn (2007) for a related discussion. Note that those predictions are not specific to models without housing consumption. For example, if housing consumption could be adjusted costlessly, and preferences for non-durable goods and for housing services were homothetic, the desired amount of both goods would also depend on the discounted stream of future income.

⁷Preference factors are likely to vary across countries—impatience or the curvature of the utility function. Unfortunately, self-reported information on the degree of patience or risk aversion was not collected in all countries.

of the time needed to repossess an asset that serves as mortgage collateral. Both factors are likely to affect a bank's cost of granting loans, thus altering the supply of credit. On the other hand, the taxation on mortgage interest rate payments is also quite different across countries, generating dispersion in a household's effective discount rate when borrowing. Finally, to mitigate macroprudential risks, countries in the euro area may set different regulatory LTV ratios. The cross-country variation in these institutions is likely to change households' demand for mortgages. We briefly review the potential impact on each of these institutions on debt outcomes.

3.1.1 Time to Repossess

A longer repossession period generally increases the cost of a lender's asset recovery process in the event that a borrower does not repay a mortgage, thus shifting inwards the lending supply curve. However, we may expect that longer repossession periods make access to loans especially tight for groups who, from the perspective of lenders, have higher ex ante chances of not repaying their loans. Empirically, these are typically low-income individuals or younger households, who have had less time to accumulate assets over the life cycle—see Duygan and Grant (2009).⁸

As an illustration, in the context of unsecured lending, simulations of general equilibrium models, calibrated to reproduce the distribution of debt in the United States, suggest that lenders react to the increase in uncertainty about loan repayment by charging higher group-specific interest rates on loans granted to young and to low-income households. In equilibrium, these groups hold lower amounts of debt. Hintermeier and Koeniger (2011) and Livshits, MacGee, and Tertilt (2007) present simulations illustrating how the existence of bankruptcy lowers debt holdings and increases interest rates paid by younger households, while Chatterjee et al. (2007) also examine low-income households.⁹

⁸Duygan and Grant (2009) explore the determinants of falling into arrears using panel data on European households. They find that the probability of paying behind schedule falls with household income and with age—the latter, once non-linearities are taken into account.

⁹We focus on the time required to foreclose on secured debt. In terms of the expected impact of these institutions on our results, it is important to bear in

In sum, we expect that in countries with shorter repossession periods, the fraction of mortgage borrowers and secured-debt-to-income ratios will be higher, especially among young and low-income households, while interest rates on the mortgages granted to those groups are likely to be relatively lower.

3.1.2 Taxation

The (partial) tax exemption on mortgage interest rate payments raises the return on housing purchases financed with secured loans, relative to other financial investments. These fiscal incentives are especially strong in countries where owner-occupied housing consumption is not taxed. Hence, we expect that generous tax incentives to borrowing will increase the demand for secured debt.

Mortgage tax incentives are especially attractive for young households, who find it advantageous to anticipate secured borrowing to benefit from a high return to investment early in the life cycle. Furthermore, if downpayments are necessary to obtain a mortgage, high-income households should be especially responsive to tax incentives. This is because high-income households are most likely to accumulate the funds necessary for the downpayment, and thus benefit from tax incentives (see Gervais 2002). However, tax-induced increases in the demand for loans can be partially captured by banks in the form of higher interest rates. For example, Devereux and Lanot (2003) document that mortgage tax relief in the United Kingdom was passed through to borrowers via higher interest rates, due to a limited degree of competition in the lending market.

Overall, in countries where a higher fraction of mortgage payments are tax exempt, one should observe a greater fraction of indebted households and, among these, higher debt-to-income ratios. Again, these impacts are expected to vary by age and income and should be strongest among young and high-income households.

mind that the existing literature (mentioned above) focuses on unsecured debt holding, rather than secured debt. Our implicit assumption to take these predictions to the data is that long time periods to repossess make secured debt look like unsecured debt.

3.1.3 *Regulatory Loan-to-Value Ratios*

An increase in the regulatory LTV ratio can be modeled as an increase in the demand for secured debt borrowing.¹⁰ This is because higher regulatory LTV ratios relax the need to accumulate funds prior to a house purchase, making secured borrowing especially attractive for individuals with a lower ability to save for a down-payment, such as the young and those with lower income levels. The increase in the demand for housing among these groups can be met by property sales of older agents, thus flattening the age profile of borrowers (see Ortalo-Magné and Rady 1999, 2006). In addition, the relaxation of the LTV ratio allows younger households to hold higher debt amounts.

As is the case with any demand-induced boost in lending, these effects may be dampened if lenders react to the increased demand for loans by raising the interest rate charged to borrowers (see Chambers, Garriga, and Schlagenhaut 2009).

In sum, in countries with higher regulatory LTV ratios, young and low-income households are relatively more likely to hold secured debt and to have larger debt-to-income ratios, at the cost of paying higher interest rates on their secured loans.

3.1.4 *Information about Borrowers*

Access to past credit information can be viewed as a factor that expands the supply of loans. Access to credit bureaus allows banks to discriminate among borrowers and, possibly, to price in, at higher interest rates, consumers who may otherwise have their credit applications rejected—see Edelberg (2006).¹¹ Without information on borrowers, banks may use “one-size-fits-all” mortgages, whereby they reject the applications from riskier profiles. Improved access to borrowers’ information allows banks to develop better scoring

¹⁰In practice LTV regulations are often implemented as increases in the cost of provisioning when granting a loan that exceeds a threshold. In that sense, these regulations also affect the supply of loans by altering the cost of granting loans. In the discussion we mainly follow the theoretical literature that models loan-to-value ratios as mainly a demand factor that allows new borrowers to access the credit market.

¹¹See Magri and Pico (2010) for application of Edelberg’s insights to Italy.

mechanisms, so that riskier profiles can now be observed borrowing but paying above-average interest rates.

As argued above, young and low-income individuals are more likely to run into loan arrears, so we could expect that better borrower information would increase both the interest rate paid by these groups (reflecting their relative risk) and their chances of borrowing (because their applications would be otherwise rejected). It is less clear how borrower information might impact the amount of debt held once a borrower's credit application has been accepted; the high interest rate faced by these potentially risky borrowers may depress the amount borrowed, thus lowering the average amount borrowed.

Finally, a potentially important institution that varies across countries is the prevalence of fixed- or adjustable-rate mortgages (FRMs vs. ARMs). Such heterogeneity poses problems in comparing the price of debt across countries because interest rates in FRMs may reflect risks associated with the evolution of aggregate interest rates, on top of considerations about the borrower's repayment probability. Given the relevance of that institution, we condition for the share of FRMs in the multivariate analysis below.

3.2 Data on Institutions

We review now how the institutions described above vary across euro-area countries (for sources and measurement of the institutions used, see table 2A). Turning first to the length of repossession, in the event that a mortgage is not repaid, the average time needed to repossess the collateral is short in the Netherlands, Spain, Germany, and Austria (where it takes less than ten months), is somewhat longer in Belgium and France (twenty months), and reaches fifty-six months in Italy (see the first row of table 2B). Figure 9, panel A (in the appendix) shows that the fraction of households with secured debts is indeed lower among countries with longer repossession periods. Furthermore, the median debt-to-income ratio held by indebted households is slightly smaller in countries where repossession periods are longer.

Countries in the euro area vary substantially in the taxation of secured debt repayments. All countries in the euro area, with the exception of Germany and Slovakia, feature some form of tax exemption on mortgage repayments for the house of residence.

Table 2A. Institutions and Credit Conditions: Definitions and Sources

Variable	Definition	Source
<i>Legal Enforcement</i>		
Foreclosure Procedures Duration of Foreclosure	The period typically required for the completion of foreclosure proceeding, taking into account the time needed for the completion of court proceedings, the sale of the asset, and the distribution of the proceeds to the creditors; measured in number of months.	ESCB ^a
<i>Regulation: Fiscal and Macroprudential Framework</i>		
Taxation of Mortgage Financing Deductibility of Payments	Main features of the deductibility of mortgage payments (interest and/or principal) from personal income tax, measured as the (non) existence of such deductibility.	ESCB ^a
Limit on Deductibility	Limitations to the deductibility above, in terms of time and/or amount (fixed amount, percentage, or ceiling), measured as the (non) existence of such a limit.	ESCB ^a
Regulatory Loan-to-Value Ratio Existence of LTV Limit	Formal restrictions, threshold loan-to-value ratios above which banks are required to provision more capital under Basel II, or limits applying for loans to be eligible as collateral for covered bonds or mortgage bonds, measured as the (non) existence of such limits.	ESCB ^a
LTV Limit	The value of the limit above, measured as a percentage of the value of the property.	ESCB ^a

(continued)

Table 2A. (Continued)

Variable	Definition	Source
<i>Credit Conditions</i>		
Prevalence of Fixed Interest Rates Fixed-Rate Mortgages	The prevalence of housing loans with a longer-term fixation of interest rates. Because of the variability over time of the share of variable-rate loans (rate fixation up to one year) and loans with relatively short periods of fixed rates, this variable is measured as the share of loans with very long periods of fixed rates (over ten years), as a percentage of all housing loans. As such, fixed-rate countries are Belgium, Germany, France, and the Netherlands.	ESCB ^a
Financial Development Credit Information	The depth of credit information on borrowers, i.e., the rules and practices affecting the coverage, scope, and accessibility of credit information available through either a public credit registry or a private credit bureau, measured on a scale from 0 to 6.	WB ^b
Sources: European System of Central Banks (ESCB), World Bank (WB). ^a The information comes from the structural issues report by the Task Force of the Monetary Policy Committee of the ESCB “Housing Finance in the Euro Area,” ECB Occasional Paper No. 101, March 2009, and from the replies from national central banks and commercial banks to ad hoc questionnaires that alimented this report. Data refer to originations in 2007. ^b Data are from chapter 5.5 on financial access, stability, and efficiency in the World Bank’s <i>World Development Indicators 2012</i> . The indicator is based on information from banking supervision authorities and surveys on the public credit registry’s or private credit bureau’s structure, laws, and associated rules, administered to the entity itself. It refers to 2011.		

Furthermore, these exemptions have no caps in the Netherlands and Austria. Panel B of figure 9 suggests that the fraction of households with secured debt is larger in countries with a higher mortgage tax relief. However, debt-to-income ratios vary little with tax relief measures.

The regulation of LTV ratios also varies across the euro zone. There are no explicit maximum LTV thresholds in Austria, Belgium, the Netherlands, or Luxembourg, although actual bank practices vary across these countries. All other countries specify a maximum threshold above which lenders usually need to provide extra capital or, in some instances, cannot make the loan eligible as collateral for covered or mortgage bonds. Such thresholds vary from 60 percent in Germany and France to 80 percent in Spain and Italy. Panel C of figure 9 shows that the fraction of indebted households is greater in countries where regulatory LTV ratios are higher or non-existent.

According to a World Bank index, which ranges from 0 to 6, information about borrowers is greatest in Germany and Austria (six points) and least complete in Belgium, France, Portugal, and Slovakia (four to six points). The index is not available for Luxembourg. Panel D in figure 9 suggests that variation in depth of information does not correlate much with the fraction of indebted households or with the debt-to-income ratio.

Finally, most countries in the euro area can be classified as mostly issuing FRMs—in the case of Belgium, France, and the Netherlands—or mostly ARMs—in the case of Austria, Spain, Greece, Portugal, and Slovakia. Only Germany and Italy are intermediate cases, where FRMs accounted for 58 percent and 48 percent of originations in 2007, respectively. See table 2B for details.

3.2.1 Summary

The arguments reviewed above suggest that longer repossession periods, lower tax relief for mortgage interest payments, stricter regulatory LTV ratios, or limited information about borrowers may reduce the overall probability of holding secured debt and amount of debt held. Most importantly, these effects vary across age and income groups. On the other hand, each institution has very different implications for the distribution of interest rates across groups.

Our reduced-form approach in the first step regresses the three outcomes of interest (the incidence of debt, the amount of debt held, and the cost of debt) on the set of demographics and socioeconomic variables mentioned above. The previous discussion suggests that country-specific estimates of the age and income profile of debt reflect the impact of the institutions reviewed above, among other factors. Similarly, the constants of these regressions (or the fitted probability, in the case of the incidence of debt) reflect the impact of country characteristics on the probability of holding debt, the amount of debt held, or the interest rate for a reference group, holding household characteristics constant.

The second step of our analysis examines how the specific country-level institutions reviewed affect those coefficients separately. The impacts on the age or income coefficients inform about how the specific institution affects the relative chances of holding debt among the young or the low-income groups relative to the reference group in that country. The impact on the intercept identifies instead how each institution affects the probability that a household in the reference group holds debt, the amount of debt held, or the interest rate paid. Arguably, unobserved country-level characteristics may be more likely to bias the estimates of the impact of institutions on the intercept than the estimates of the impact on age or income coefficients from the first step. However, the previous discussion has highlighted that most institutions reviewed affect the overall chances of having secured debt and the amount of debt held, so we report the impact of institutions on intercepts. Furthermore, intercepts capture the outcomes of relatively young households (aged thirty-five to forty-four) with median income—among other characteristics, described below. That is a group likely affected by all the institutional differences reviewed above.¹²

¹²Our analysis deliberately ignores variables like household wealth because they are mechanically linked to household collateralized borrowing, where such loans require owning or purchasing a house (in the case of real wealth) or systematically vary around house purchases (the case of financial wealth; see Ejarque and Leth-Sorensen 2009). In a similar vein, we do not include housing price dynamics, as variation in the institutions we analyze in the second step has a separate impact on house prices through the credit market—see Ortalo Magné and Rady (1999, 2006).

4. Empirical Strategy

This paper has two aims. The first is to identify differences across euro-area countries in the relationship between household characteristics and three debt outcomes: the incidence of secured debt holding, the amount borrowed, and the cost of debt. This is examined by estimating country-specific equations, thus allowing for country effects both in the intercepts and in the slopes. The second aim is to examine the role of institutions in accounting for these differences. In this second part, we regress a selection of the first-step coefficients—in particular, those relating to age and income—on relevant country-level legal and financial institutions.

Our first step is to run separate regressions on the micro data of each country to obtain estimates $\hat{\beta}_{0c}, \hat{\beta}_{1c}, \hat{\beta}_{2c}$ for each country c in an equation of the following form (here there are only two household characteristics x_{1hc}, x_{2hc} for the sake of simplicity):

$$y_{hc} = \beta_{0c} + \beta_{1c}x_{1hc} + \beta_{2c}x_{2hc} + \varepsilon_{hc} \quad (c = 1, \dots, C),$$

where y_{hc} denotes one of three different outcomes in three different sets of regressions. In the first model, the outcome is $1(D_{hc} = 1)$, a dummy variable indicating the ownership of debt for household h in country c (where $c = AT, BE, DE, \dots, SK$). The model is a logit and we focus on the odds ratio for each variable of interest, as that parameter is invariant to different values of the covariates. We also examine the probability of a common reference group holding debt across the countries in our sample. That group is formed by households comprising two core members in a couple and no other adults in the household, where the relevant core members are aged thirty-five to forty-four years, have a medium education level, are both employed, and the household has the median income level in their country. Comparisons of the outcome of this group in different countries are free of composition bias.

In the second model, the outcome is the logarithm of the amount of secured debt held, conditional on having secured debt. We use OLS regression techniques to assess the effect of the independent variables on the mean of the log of secured debt. Furthermore, we also examine the cross-country variation in the log amount of debt

held by the reference group. We make no adjustment for the fact that the amount of debt cannot be negative.¹³

The third and final model in this first step of the analysis is identical to that of the log of the amount of debt, but uses the interest rate payable on the mortgage for the household's principal dwelling as the dependent variable.¹⁴

Our second step is to run a sequence of regressions on country-level data (eleven observations), one for each β of interest in the first step. For example, we obtain estimates $(\hat{\gamma}_{20}, \hat{\gamma}_{21})$ from a regression of the $\hat{\beta}_{2c}$ on z_c , our measure of country-specific legal and financial institutions or credit conditions.

$$\hat{\beta}_{2c} = \gamma_{20} + \gamma_{21}z_c + \nu_{0c},$$

where ν_{0c} is an error term that captures unobserved country-level variables as well as possible specification errors. In this stylized example, x_2 denotes the household characteristics we focus on (income and age) and x_1 denotes other household-level controls.

Inference about $(\hat{\gamma}_{20}, \hat{\gamma}_{21})$ can be performed by decomposing standard errors into two parts—one associated with the variance of ν_{0c} , a source of error that arises if we interpret the second stage as estimating regressions in an underlying super population of countries. The second part takes into account the first-step estimation error $\hat{\beta}_c - \beta_c$.

However, in a separate specification, we regress on as many as five institutions (measured using seven variables). In that case, we

¹³Sample-selection corrections would rely heavily on functional form assumptions, which may or may not be convincing. In Bover et al. (2013) we examine whether quantile regression models of the logarithm of the debt amount capture non-linearities in the responses that could signal strong sample-selection biases. We also examine if responses are heterogeneous using a location-scale model—i.e., a model where we regress the absolute value of OLS residuals on the same regressors, providing the effects on the variance of log secured debt. In both cases, we find that, with some exceptions, the age and income coefficients vary little over the distribution of outcomes.

¹⁴To correct for differences in fieldwork periods across countries, we make some adjustments to the specifications when using the log debt amount and the interest rate as dependent variables. In the case of the debt amounts specification, we convert all monetary amounts to 2010 values by adjusting by the country-specific HICP index. In the case of interest rates, we adjust the reported interest rate by the change in the EURIBOR rate between the fieldwork period and the first quarter of 2010, multiplied by the country-specific share of adjustable mortgages.

present standard errors that take into account only the sampling variability due to estimated $\hat{\beta}_c - \beta_c$, implicitly assuming that the moment of interest is the within-sample regression of the first-step coefficients on a set of country-specific institutions—not the relationship in the population of countries; see appendix 1 in Bover et al. (2013). A related point has been made in a recent paper by Abadie et al. (2014).

4.1 Modeling of Core Household Members and the Reference Group

We define the core household members as the respondent to the survey and his or her partner (if any). When there is only one core member we include his/her characteristics, but in the case of couples we include information on both core members and relate their characteristics to each other. We do this by first defining the person of interest in the couple as that person with the highest value of the relevant independent variable and then capturing the difference between the two core members. This is a parsimonious way of modeling the characteristics of both members of the couple that focuses on the traits of the household as a group without requiring the definition of a “reference person,” all of whose characteristics would be emphasized relative to other members.

The covariates included are as follows: four age dummies for the age of the oldest core member (the omitted group is thirty-five to forty-four years of age) as well as the age difference between core members, two schooling dummies (the omitted group being secondary education) as well as an indicator of whether the core members have different schooling levels, four indicators of the labor status of the highest income earner (the omitted group being employee), an indicator of the presence of a partner, whether the partner works and, finally, the logarithm of the number of adults (minus the log of 2) and the logarithm of income (minus the log of the median income in the country).

4.2 A Digression: Alternative Modeling Methods

The estimates ($\hat{\gamma}_{20}, \hat{\gamma}_{21}$) are identical to the estimates one would obtain from running a regression at household level, pooling all

the countries, including country fixed effects not only as intercepts but also interacted with x_{1ic} . Such a pooled regression would be as follows:

$$y_{hc} = \beta_{0c} + \beta_{1c}x_{1hc} + \gamma_{20}x_{2hc} + \gamma_{21}z_cx_{2hc} + u_{hc}. \quad (1)$$

This regression (and our second-step estimates) takes into account that the institutional variables z_c may affect the impact of other socioeconomic characteristics simultaneously. Those effects are subsumed within the country effects β_{0c} and β_{1c} , which capture all country differences (both observed and unobserved) in the relationship, except for those operating through x_{2hc} . In a nutshell, estimates of γ_{21} in (1) control not only for additive country fixed effects but also for slope country fixed effects interacted with x_1 .

An alternative to our two-step approach would be a pooled regression with, for example, additive country fixed effects but constraining $\beta_{kc} = \gamma_{k0}^* + \gamma_{k1}^*z_c$, where $k = 1, 2$.

$$y_{ic} = \beta_{0c}^* + \gamma_{0c}^*z_c + \gamma_{10}^*x_{1hc} + \gamma_{11}^*z_cx_{1hc} + \gamma_{20}^*x_{2hc} + \gamma_{21}^*z_cx_{2hc} + u_{hc}^*. \quad (2)$$

Note that equation (2) is a special case of equation (1) but subject to the additional restriction $\beta_{1c} = \gamma_{10}^* + \gamma_{11}^*z_c$. In this case the estimated effects $\hat{\gamma}_{11}^*$ and $\hat{\gamma}_{21}^*$ will have causal validity only under more restrictive conditions than $\hat{\gamma}_{11}$ or $\hat{\gamma}_{21}$. For example, $\hat{\gamma}_{11}^*$ and $\hat{\gamma}_{21}^*$ allow for additive country-effect endogeneity but not for country-effect endogeneity operating interactively through other household characteristics.¹⁵

4.3 Interpretation of the Coefficients

The weakest interpretation of our estimates $\hat{\gamma}_{01}$, $\hat{\gamma}_{11}$, $\hat{\gamma}_{21}$ is that these reflect unbiased predictive (not causal) effects of the corresponding β 's. In our view, assessing the predictive ability of institutional

¹⁵On a related note, Bryan and Jenkins (2013) recommend using a two-step approach similar to ours to analyze the impact of country-level variables on household-level outcomes. Using a series of Monte Carlo simulations conducted on a sample based on the European Union Statistics on Income and Living Conditions, the authors show that even single-step methods tailored to dealing with multi-level data deliver severely understated standard errors when the number of countries is around ten.

variables in explaining differences in debt held by comparable households across euro-area countries is in itself of considerable economic interest.¹⁶

However, an alternative and stronger claim is that γ_{21} reflects the causal impact of the institution z_c on the borrowing profile defined by x_{2hc} . That interpretation requires ruling out endogeneity with respect to interacted country effects, arguably present in an observational cross-sectional setting such as ours. We note two points here. Firstly, as mentioned above, the two-step procedure we follow implies that each individual coefficient γ_{21} would be biased if an omitted institution were correlated with the interaction $z_c x_{2hc}$ but not if it were correlated with other country fixed effects or country slope effects. In that sense each individual estimated effect has a stronger claim to causal validity than any effect estimated from, for example, the pooled regression (2). Secondly, we check for the relevance of confounding country-specific factors by regressing $\hat{\beta}_{2c}$ on several institutions z_c at the same time. By comparing the estimated impact of z_c on $\hat{\beta}_{2c}$ across univariate and multivariate specifications, we obtain indications of whether the estimated γ_{21} is causal.¹⁷

4.4 *Issues Related to Timing*

Finally, it should be noted that while we examine cross-country variation in debt outcomes as of 2009–10, the institutions are measured as of 2007. Arguably, we would need to measure institutions at the time the representative mortgage was signed. We mitigate this timing problem in two ways.

¹⁶To fix ideas, assume that there is a country-specific omitted characteristic like “thrift” that results both in a lower regulatory LTV and in a smaller response of the debt amount of young households to LTVs. In this scenario, our estimate of γ_{21} would not reflect a causal impact of LTVs on the indebtedness of the youth. However, the statement that “holding income and a wide set of demographics constant, in euro-area countries with lower LTV ratios, indebted youths borrow relatively less” would still be correct.

¹⁷As noted above, eight of eleven countries specialize in one type of mortgage, implying that the country-specific first-step coefficients we estimate are identified for a given interest rate fixation regime. Hence, the coefficients in the second-step regressions, when we include the share of FRMs as an independent variable, are informative about how variation in FRMs across countries accounts for cross-country variation in the distribution of the cost of debt or in debt outcomes.

Firstly, to the extent that the institutions have been stable over time, the problem of different time periods is lessened by modeling the presence of an institution—such as the existence of tax deductibility of tax payments—instead of its extent—following the example, the exact measure of the amount of tax relief. The reason is that the presence of an institution is a much more stable feature of the legislation than its extent.

Secondly, in discussing the impact of institutions on age profiles, we focus mainly on those age profiles up to fifty-four years of age and, in some instances, below forty-four years of age. The reason is that these groups will arguably have borrowed using secured debt originated under current regulations.

Finally, an additional reason to focus on cohorts below age forty-four is that theory predicts differential debt responses at different stages of the life cycle, but little is known about cohort-specific responses. As groups below forty-four years have had a similar exposure to the institutions that affect credit markets, and our regressions hold variables like income and schooling constant, the focus on age groups alleviates the biases associated with interpreting age-specific responses as life-cycle responses.

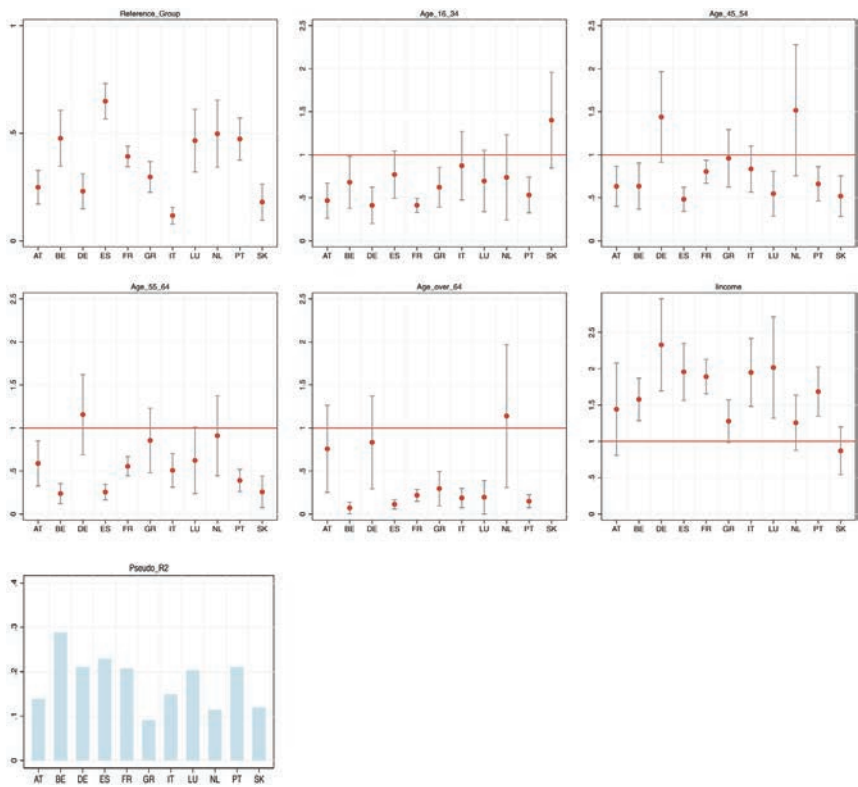
5. First-Stage Results: The Association between Debt Holdings and Household Characteristics

5.1 The Probability of Holding Debt

The results of the first specification, where the dependent variable is binary and captures people who hold secured debt versus those who do not have secured debt, are shown in figure 1 and table 3. We present the probability of holding debt for the reference group, the country-specific odds ratios, and the associated confidence intervals only for the age and income coefficients—while the results of the rest of the conditioning variables are presented in the appendix. The odds ratios should be interpreted relative to the omitted category for each group.¹⁸

¹⁸For example, in the case of the Netherlands, the odds ratio for the “age forty-five to fifty-four” variable is 1.52. Since the omitted category here is “age thirty-five to forty-four,” this implies that the odds of holding secured debt among

Figure 1. Has Secured Debt: Logit Regressions, Odds Ratios



Notes: Odds-ratio estimates and standard errors are shown in table 2. The first panel on the left plots the predicted probability of holding secured debt for the reference group in each country. Aside from the covariates shown, we include as control variables educational level, labor and marital status, and household size as detailed in table 1.

The chart in the top left corner of figure 1 shows the probability of holding debt among the reference group specified earlier. The probability is highest for this type of household in Spain, where the probability of holding secured debt is approximately 65 percent, and

households where the eldest core member is between forty-five and fifty-four years is about 1.5 times that of households where the eldest core member is between thirty-five and forty-four.

lowest in Italy, where this type of household has about a 10 percent probability of holding secured debt.

In keeping with the existing literature on household debt, the relationship between secured debt holding and age cohort displays a humped shape, where the likelihood of holding secured debt generally increases up to the ages of thirty-five to forty-four years and decreases thereafter—see table 3 or figure 1. However, the age profiles vary across countries. In the case of Austria, France, or Germany a head of household who is aged between sixteen and thirty-four years has a much lower chance of holding secured debt relative to the reference group (which is thirty-five to forty-four years of age); the odds ratio in these cases is below 0.5. However, the odds of the sixteen to thirty-four age group holding debt in Netherlands, Spain, or Slovakia are not statistically different from 1, which implies that the probability of holding debt is very similar between both groups.

The probability of having secured debt increases with income in almost all countries, consistent with the notion that mortgages are a derived demand of owner-occupied housing consumption, which is a normal good—see the fifth row of table 3. The rate at which the probability of borrowing increases with income is, however, modest in the Netherlands, Greece, and Slovakia, where the null hypothesis of no change in the odds of holding secured debt along the income distribution cannot be rejected. On the other hand, the odds of holding secured debt responds strongly to household income in Italy, Spain, and Germany.

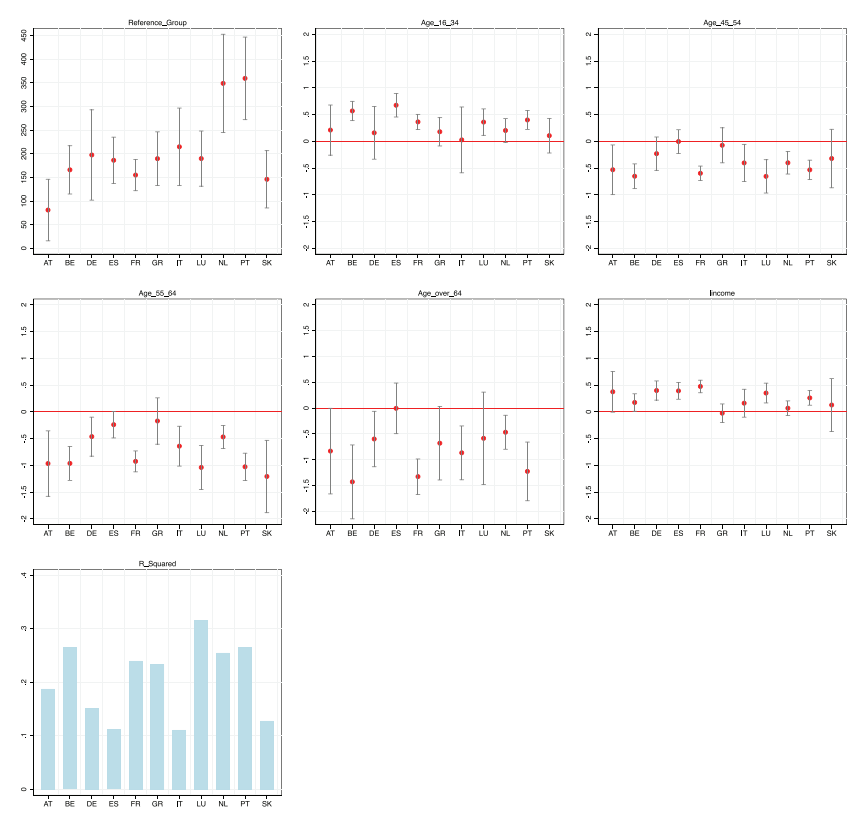
The differences in the coefficients discussed above are statistically significant. We conducted an F-test of equality of the coefficients of the age sixteen to thirty-four dummy across countries and, separately, another one on the equality of the income coefficient. In both cases, the null of identical coefficients across countries is rejected at the 1 percent confidence level—see the last column of table 3.

We show the pseudo R-squared value from our estimated regressions in the final chart in figure 1 and in table 3. It is relatively high in Belgium, at a value of close to 0.3, and lowest in Greece, at just under 0.1.

5.2 *The Amount of Debt Held*

The country-level results for the OLS regressions for the amount of debt are presented in figure 2, where we show the estimated

Figure 2. Debt Balance of Secured Debt



Notes: OLS estimates and standard errors are shown in table 3. The first panel on the left plots the mean of the debt-to-income ratio for the reference group in each country. Aside from the covariates shown, we include as control variables educational level, labor and marital status, and household size as detailed in table 1.

average debt-income ratio held by indebted households in the reference group as well as the estimated age and income coefficients and their confidence intervals—a subset of the full set of covariates.¹⁹ The omitted categories for the dummy variables are detailed

¹⁹Given the definition of the covariates, the constant of the OLS regression reflects the estimated log debt amount of the reference household. We take the

in section 4.2. The first chart on the top row of figure 2 reports the results for the reference group.

The chart in the top left corner of figure 2 shows the average debt-income ratio among the reference group specified earlier. The predicted ratio for this type of household is around 200 percent in most countries except in the Netherlands and Portugal—where it is around 350 percent—or in Austria and Slovakia—where it lies at or below 150 percent.

Across all countries, the log amount of secured debt holdings is highest for households where the reference person is aged sixteen to thirty-four years—see table 4, first row. Households with heads older than forty-five years hold lower amounts of debt relative to the omitted group, thirty-five to forty-four year olds.

Relative to the reference group, the amount of debt held by young adults is largest in Belgium, Spain, and Portugal, where the sixteen to thirty-four age group holds at least 40 percent higher debt amounts than the reference group. Conversely, indebted youths in Italy, Greece, and Germany hold an amount of debt that is less than 18 percent higher than that of the reference group.

As is the case with the probability of holding debt, the elasticity of the amount of debt with respect to household income is positive in all countries—but well below 1, indicating that debt-income ratios fall over the income distribution. As mentioned above, a positive elasticity of the amount of debt with respect to income is consistent with the idea that secured borrowing is tied to housing—a normal good. The elasticity of the debt amount with respect to income is highest in Germany, Spain, and France, but it is relatively modest in Greece, the Netherlands, and Slovakia. The cross-country differences in the income profile of the amount of secured debt held are relatively similar to those corresponding to the fraction of borrowers.²⁰

exponential of the constant and normalize it by the median household income in the country—we ignore in the computation the variance of the errors that would arise in a log-normal distribution. Confidence intervals were computed using the delta method.

²⁰The location-scale model described in footnote 13 suggests that the within-country dispersion of the logarithm of secured debt increases with age, a finding that could be explained by differences in the speed of mortgage repayment across countries—see Bover et al. (2013).

The absence of cross-country differences in the aged sixteen to thirty-four dummy or in the coefficient of household income is rejected at usual confidence levels (see the last column of table 4). Finally, we show the R-squared value for the estimated regressions in the final chart of figure 2 and table 4, which varies from a low of .11 in Italy and Spain to a high of .32 for Luxembourg.

5.3 *Cost of Secured Debt*

The interest rate payable by the reference group varies from a low of about 2.4 percent in Luxembourg to a high of 4.6 percent in Germany (see the second-to-last row of table 5 and figure 3).

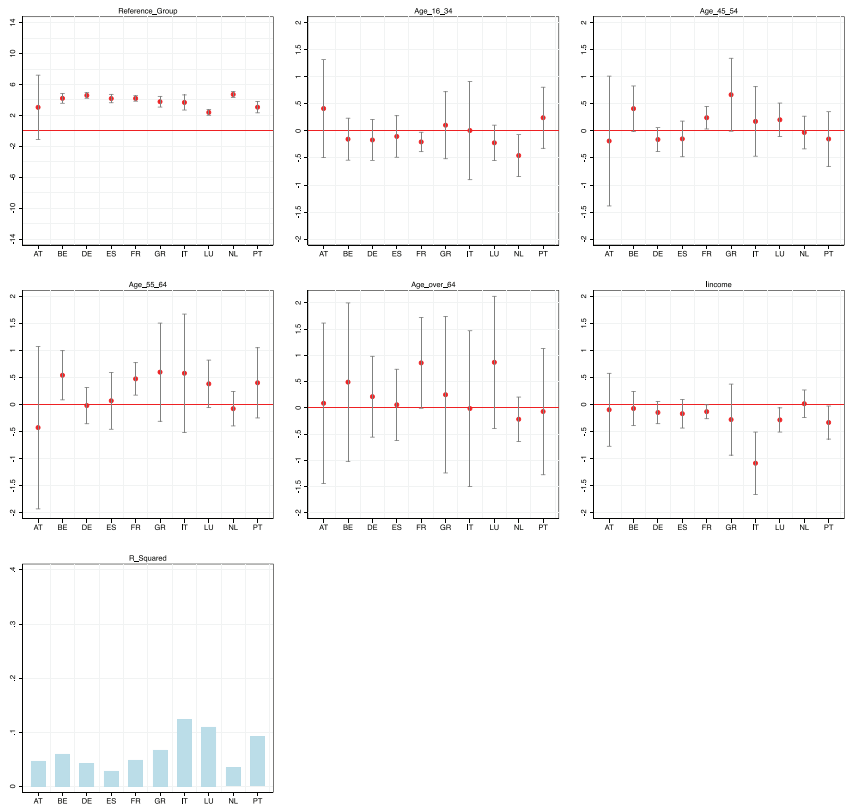
The youngest households pay higher interest rates on their mortgages than the reference group in Austria, Portugal, and Greece but lower ones in the Netherlands, France, and Luxembourg. However, an F-test does not reject the null hypothesis that coefficients are equal in all countries.

Regarding household income, the cost of debt falls smoothly along the income distribution in all countries, but it is most precisely estimated in France, Italy, Portugal, and Luxembourg, countries where the semi-elasticity of interest rates to household income is larger than in the rest of the countries and statistically different from zero (see table 5). An F-test rejects the null hypothesis of equality of coefficients of income across countries at the 10 percent confidence level. The negative relationship between interest rates and income is consistent with the hypothesis that banks price in a relatively higher expected probability of default among low-income households by increasing the borrowing costs. Furthermore, the magnitudes can be substantial: the country-specific income coefficients imply that, holding the rest of the covariates constant, the predicted difference in the interest rate paid by households in the 10th centile of the income distribution and those in the 90th centile amounts to 202 basis points in Italy, 69 in Portugal, and 54 in Luxembourg and in Greece. Finally, the R-squared value is typically small, ranging from about .03 in Spain to .12 in Italy.

5.4 *Summary*

The results thus far suggest that age and income are important determinants of debt holdings. A possible interpretation of the

Figure 3. Current Interest Loan of HMR Mortgage



Notes: OLS estimates and standard errors are shown in table 4. Aside from the covariates shown, we include as control variables educational level, labor and marital status, and household size as detailed in table 1.

general tenor of the results is that secured debt is a derived demand of housing, as it correlates strongly with income and age in most countries. In contrast, the probability of holding unsecured debt has much weaker income or schooling profiles—see Bover et al. (2013). The results in Arrondel et al. (2014) and Le Blanc et al. (2015) also point in the same direction, the former showing that the demand for real assets grows strongly with income while the latter finds a counterbalancing negative effect of income in the case of consumption debt. However, those profiles vary across countries.

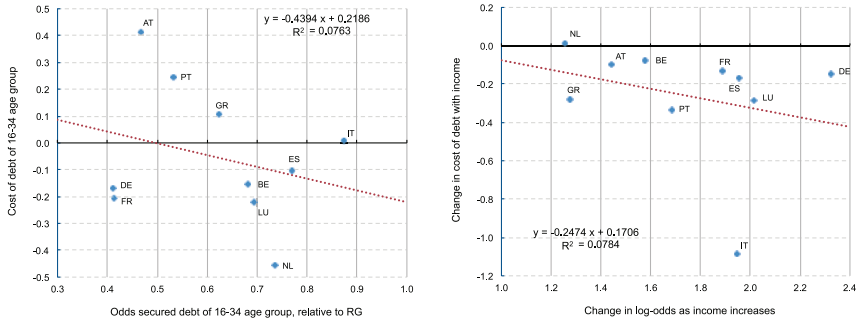
We now examine the expected effects of the institutions discussed in section 3 on the heterogeneity detected in the magnitude and the sign of the first-step coefficients. Assume that variation in the taxation of mortgage interest rates, in regulatory LTV ratios, or in the degree of information about borrowers were key explanatory factors accounting for the differences in figures 1–3. As explained in section 3, we should then expect, in the case of higher LTVs or a more generous tax treatment of mortgage payments, that young households borrow comparatively more than prime-age households do, and that such high demand for mortgages leads banks to charge a higher interest rate for the loans granted to these groups. On the other hand, in countries with more credit information about borrowers, lenders charge higher interest rates to the younger households who borrow and whose applications would be rejected in the absence of such information. In other words, in those cases, the cross-country correlation between the odds that young households hold secured debt and the interest rate they pay should be positive.

Alternatively, imagine that the differences in the banks' expected cost of lending account for the heterogeneity in borrowing outcomes across countries. That is, in countries with long repossession periods, banks end up charging higher interest rates to households more prone to default (younger households), who would end up borrowing comparatively less. In such a scenario, the cross-country correlation between the incidence and amount of debt borrowed by young households and the differential interest rate they pay—both magnitudes relative to the reference group in the country—would be negative.

In the left panel in figure 4, we plot in the vertical axis the first-step coefficient of the “age sixteen to thirty-four group” in the regression with interest rates as a dependent variable (the coefficients displayed in the first row of table 5). The horizontal axis contains the chances that the youngest group of households have secured debt, relative to the reference group (i.e., the coefficients displayed in the first row of table 3).

In countries like Austria and Portugal, young households pay about 20 basis points higher interest rates than the reference group in those countries and have lower odds of holding secured debt relative to the reference group. Conversely, the youngest set of households in Spain and the Netherlands pay lower interest rates than the reference groups in their countries, while their odds of having

Figure 4. Relative Chances of Holding Debt vs. Relative Cost



secured debt are similar to the reference group. That is, the relationship between the cost of debt and the odds of holding debt is negative, consistent with the hypothesis that the variation in the repossession periods accounts for cross-country differences in debt outcomes.

Furthermore, the right panel of figure 4 plots the country-specific change in the interest rate when household income increases (table 5) against the country-specific change in the odds of holding secured debt when household income increases (table 3). The relationship is also negative: in countries where interest rates fall with household income, the odds of holding secured debt increase with income. Again, the pattern in figure 4 is inconsistent with the notion that variation in the tax relief accounts for the variation in debt outcomes, because in that case high-income households would borrow relatively more and pay higher interest rates—resulting in a positive correlation between the elasticity of borrowing to income and the semi-elasticity of interest rate to income. However, it is consistent with the notion that higher costs of repossession lead banks to charge higher rates to low-income borrowers, who end up borrowing less.²¹

²¹A negative relationship between the change in the chances of borrowing with household income and the semi-elasticity of interest rates with respect to household income is also consistent with the notion that LTVs explain the variation in the odds of holding debt across countries in the euro area. The reason is that countries with higher LTV ratios would feature both a low sensitivity of the

Overall, figure 4 suggests that variation in the banks' expected cost of debt associated with longer repossession periods may be more important than tax relief of mortgage payments, LTV ratios, or the depth of information about borrowers in accounting for cross-country differences in the odds of holding debt in the euro zone. The second step of the analysis examines the role of particular country-level institutions in driving the differences in the first step.

6. Second-Stage Results: The Influence of Institutions and Credit Conditions

6.1 *The Effect of Institutions*

Figures 1–3 highlight the varying impacts of the socioeconomic and demographic factors in explaining household debt behavior across euro-area countries. This section examines the role of institutions and credit conditions in driving the heterogeneity in these patterns. To do this, we regress each of the estimated effects from the first-step covariates on each of the institutional variables of interest.

In keeping with the presentation of the first-stage results, we present the results of this stage in graphical form where we group the charts into three columns. In all of the figures that follow, the first column of the charts shows the impact of the institutional variables on the odds of holding debt—the dependent variable corresponds to the estimated coefficients from the first step shown in table 3 and in figure 1.²² The second column of the charts reports the effect of institutions on the amount of debt held (the dependent variable is the estimated OLS coefficients from the first step). The third and final

odds of borrowing to household income and a low sensitivity of interest rates to household income. Conversely, countries with low LTVs would feature a high sensitivity of the odds of borrowing to income and a negative correlation between interest rates and income. The overall correlation would then be negative, as in figure 4. However, variation in LTVs shown in the left panel of figure 4 cannot account for the negative relation between the relative chances that very young households borrow and the interest rate they pay.

²²The constant from the first-step logit model was changed to a probability before running the second-step regressions.

column of the charts reports the effect of institutions on the interest rate on the household's primary mortgage. The charts show the point estimates from the regressions and the 95 percent confidence intervals associated with these estimates. These estimates and their standard errors are also reported in table 6.

We focus on the effects of institutions on the intercept, age, and income differentials because those are the ones that the discussion in section 3 suggests should respond to changes in the demand and supply of debt. Moreover, the results of the first step show that the differences are most salient for those coefficients.

We consider four main institutions: duration of foreclosure, taxation of mortgage payments, regulatory loan-to-value ratios, and information about borrowers. As mentioned above, there is a literature providing insights on how these institutions affect the distribution of debt. In addition, the first three institutions relate to the legal system where banks operate and are, in that sense, exogenous to the decisions of lenders or borrowers.²³

6.1.1 *Duration of Foreclosure*

Table 6 and the first chart in figure 5 show that a one-month delay in the time to repossess leads to a 0.7-percentage-point reduction in the chances of holding secured debt for the reference group, and this result is statistically significant at the 95 percent confidence level. However, an increase in the duration of foreclosure tends to lead to a modest reduction in debt amounts held.²⁴

Conditional on borrowing, the results in the second row of figure 5 show that the youngest households borrow lower amounts than the reference group in countries where the repossession period is longer.

²³In Bover et al. (2013), we examine the explanatory power of other country-specific institutions, such as the prevalence of fixed-rate mortgages, financial literacy, and the prevalence of interest-only mortgages. These institutions turned out to have very limited explanatory power when accounting for the variation in debt outcomes or their distribution across sociodemographic groups of the population. In the case of the prevalence of fixed-rate mortgages, note that we include below a multivariate regression model where we hold that institution constant when examining the impact of the four main institutions.

²⁴Du Caju, Rycx, and Tojerow (2016) use methods similar to ours to document that in countries with costlier foreclosure procedures, the reference group has a significantly lower probability of being over-indebted.

Table 6. Summary of the Effects of Institutions (one institution at a time; secured debt)

	Duration of Foreclosure (Number of Months)			Taxation of Mortgage Payments					
	Hold	Level	Cost	Hold		Level		Cost	
				Existence	No Limit	Existence	No Limit	Existence	No Limit
Reference Group	-0.0073* (0.0025)	-0.0014 (0.0058)	-0.0037 (0.0194)	0.1740 (0.1770)	-0.0509 (0.2050)	0.2920 (0.2830)	0.5420 (0.3700)	-0.6490 (0.6490)	0.1140 (0.6150)
Age									
Age 16-34	0.0061 (0.0034)	-0.0084* (0.0033)	0.0055 (0.0065)	-0.1630 (0.2750)	-0.0497 (0.3150)	0.2080 (0.2210)	-0.1390 (0.2500)	0.0822 (0.1720)	-0.0265 (0.2290)
Age 45-54	0.0000 (0.0057)	-0.0022 (0.0048)	0.0100 (0.0073)	-0.3610 (0.2330)	0.2040 (0.3060)	-0.1610 (0.2490)	-0.0606 (0.2820)	0.3110 (0.2780)	-0.2430 (0.2400)
Income	0.0014 (0.0057)	-0.0046 (0.0030)	-0.0168* (0.0037)	0.0352 (0.3490)	-0.4530 (0.3960)	0.0190 (0.1790)	-0.0518 (0.2090)	-0.0897 (0.2560)	0.2080 (0.2210)

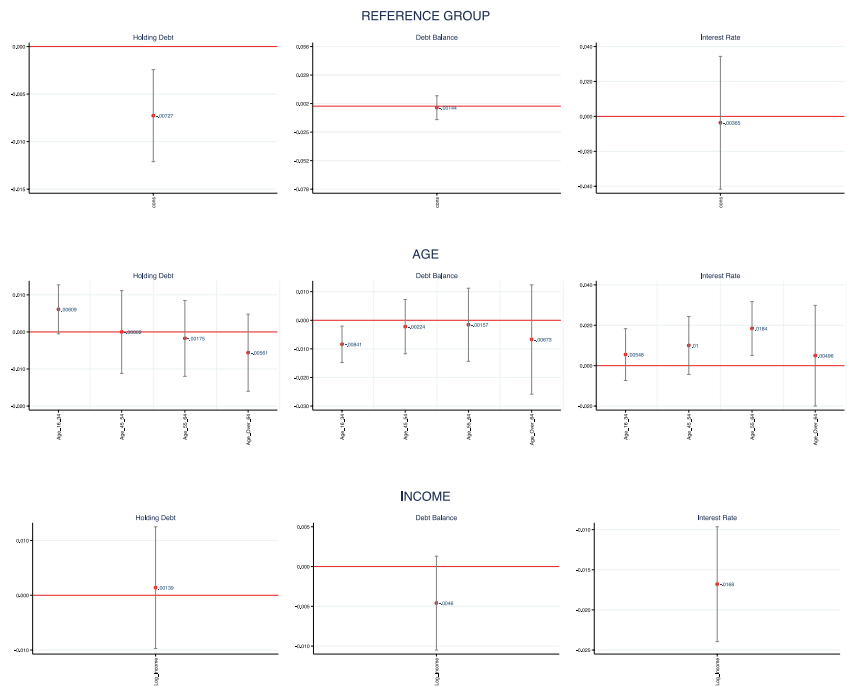
(continued)

Table 6. (Continued)

	Information on Borrowers			Regulatory LTV					
	Hold	Level	Cost	Hold		Level		Cost	
				Existence	Limit	Existence	Limit	Existence	Limit
Reference Group	-0.0695 (0.0794)	0.0926 (0.1530)	0.1270 (0.2380)	-0.1220 (0.2160)	0.0000 (0.0068)	-0.6700 (0.3720)	-0.0050 (0.0117)	-0.0098 (0.6110)	-0.0238 (0.0257)
Age 16-34	0.0316 (0.1230)	-0.0916 (0.0973)	0.0406 (0.1060)	0.1240 (0.2400)	0.0191* (0.0075)	-0.1210 (0.2700)	-0.0007 (0.0084)	0.3250* (0.1420)	0.0103 (0.0091)
Age 45-54	0.1480 (0.1210)	0.1790* (0.0901)	-0.1700 (0.1100)	-(0.1910) (0.3240)	-0.0118 (0.0100)	0.3420 (0.2330)	0.0144* (0.0071)	-0.1950 (0.2680)	-0.0072 (0.0115)
Income	0.1030 (0.1580)	-0.0465 (0.0785)	-0.0041 (0.1090)	0.1950 (0.4060)	-0.0060 (0.0124)	0.0221 (0.1560)	-0.0117* (0.0050)	-0.2820 (0.2120)	-0.0115 (0.0087)

Notes: Each cell shows the OLS estimate and the standard error (in parentheses) of an OLS regression where the dependent variable is the country-specific constant (first row) or selected first-step coefficients described in the row. The independent variable is the institution described in the column. For a given institution, each outcome (hold, level, or cost) denotes a different regression. In the cases of “Taxation of Mortgage Payments” and “Regulatory LTVs,” the institution is measured using two variables, and the coefficients of the bivariate regression are shown in adjacent columns. The sample contains eleven countries for the analysis of taxation of mortgage payments and regulatory LTV and ten countries for the other institutions. This table is a summary of figures 5-8. * indicates a statistically significant coefficient at the 5 percent confidence level.

Figure 5. Duration of Foreclosure (number of months)



Notes: Each graph shows the OLS coefficient and its 95 percent confidence interval in a regression of the first-step coefficient of the variable in the horizontal axis on the institution that gives title to the figure. The estimates and standard errors are shown in table 6.

Namely, a month’s delay in the time to repossess leads to a 0.84-percentage-point reduction in the relative amount of debt held by the youngest group of households (see table 6).

As discussed in section 3, one would expect that when repossession costs are higher, banks tend to lend more to “safe,” high-income households and charge relatively lower rates to this group. The results confirm the intuition; a one month longer repossession period increases the relative chances of holding debt among high-income households, albeit the result is not statistically different from zero. At the same time, a one month longer repossession period is associated with a relatively lower interest rate among

high-income households (when the difference between high- and low-income households is measured by the coefficient of log-income). The latter effect is precisely estimated.

6.1.2 *Taxation of Mortgage Payments*

To quantify tax relief on mortgage payments, we define two dummies. A first dummy variable equals one if such an exemption exists, and zero otherwise. Secondly, for those countries where an exemption exists, we define a dummy variable which equals one if there is no limit on the amount of interest payments subject to deductibility, and zero if a limit exists. We then regress the first-step coefficients on both dummy variables in a bivariate regression. The results are presented in figure 6, where the top panel presents the results with the dummy that denotes that an exemption exists, while the bottom panel presents the results for the indicator “no limit exists.”

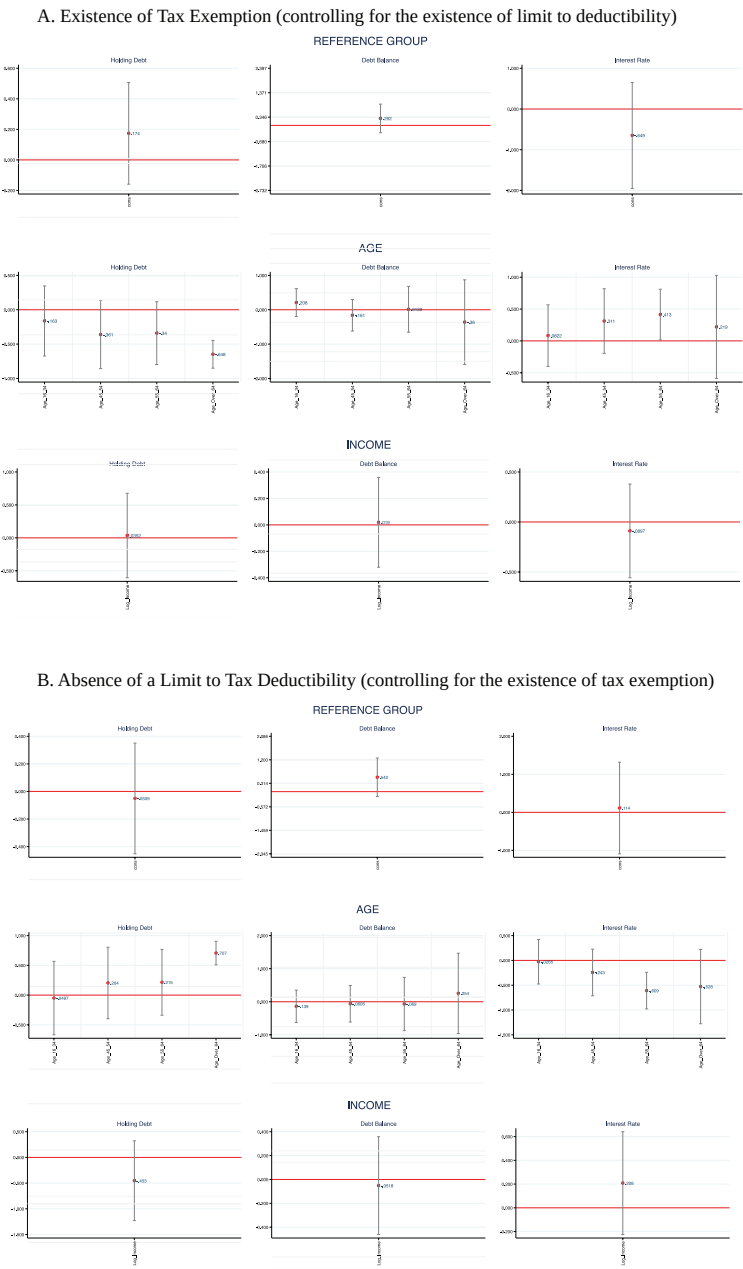
The results shown in figure 6 and table 6 suggest that interest payment tax deductibility increases the chances that the reference household will hold secured debt by 17 percentage points, a large but imprecisely estimated coefficient.

Turning to the amount of debt held by the reference group, the existence of interest payment deductibility increases the amount of debt held by a considerable 34 percent ($=\exp(.29)-1$), but the effect is again imprecise. Furthermore, among countries where there is no limit in tax deductibility, the reference group holds 52 percent higher debt amounts ($.52=\exp(.54)-1$). However, the estimate is not very precise.

In countries with tax relief for mortgage interest payments, older households are less likely to hold secured debt, relative to the reference group. Furthermore, some age profiles can also be detected in the response of the debt amount, where the youngest group of households tends to hold more debt than the reference households, while older households tend to hold less. However, no further response is noticeable within the set of countries without any limit to tax deductibility.

On the contrary, there is no evidence of an income profile in the results. This is contrary to Gervais' predictions, as any tax incentive

Figure 6. Taxation of Mortgage Payments



Notes: Each graph shows the OLS coefficient and its 95 percent confidence interval in a regression of the first-step coefficient of the variable in the horizontal axis on the institution that gives title to the figure. The estimates and standard errors are shown in table 6.

would reinforce the role of higher marginal taxes in shaping debt outcomes.²⁵

6.1.3 *Financial Regulation*

To capture regulatory LTV ratio differences across countries, we define two dummies. The first takes a value of one if a threshold exists above which banks must do extra provisioning, and zero otherwise. As mentioned above, such a threshold exists in all but four countries—Austria, Belgium, the Netherlands, and Luxembourg. Second, for those countries that have a regulatory LTV limit, we examine if the level of that limit helps to explain the variation in the effects of the socioeconomic and demographic variables from the first-stage regression.²⁶ The results are shown in figure 7 and in table 6.

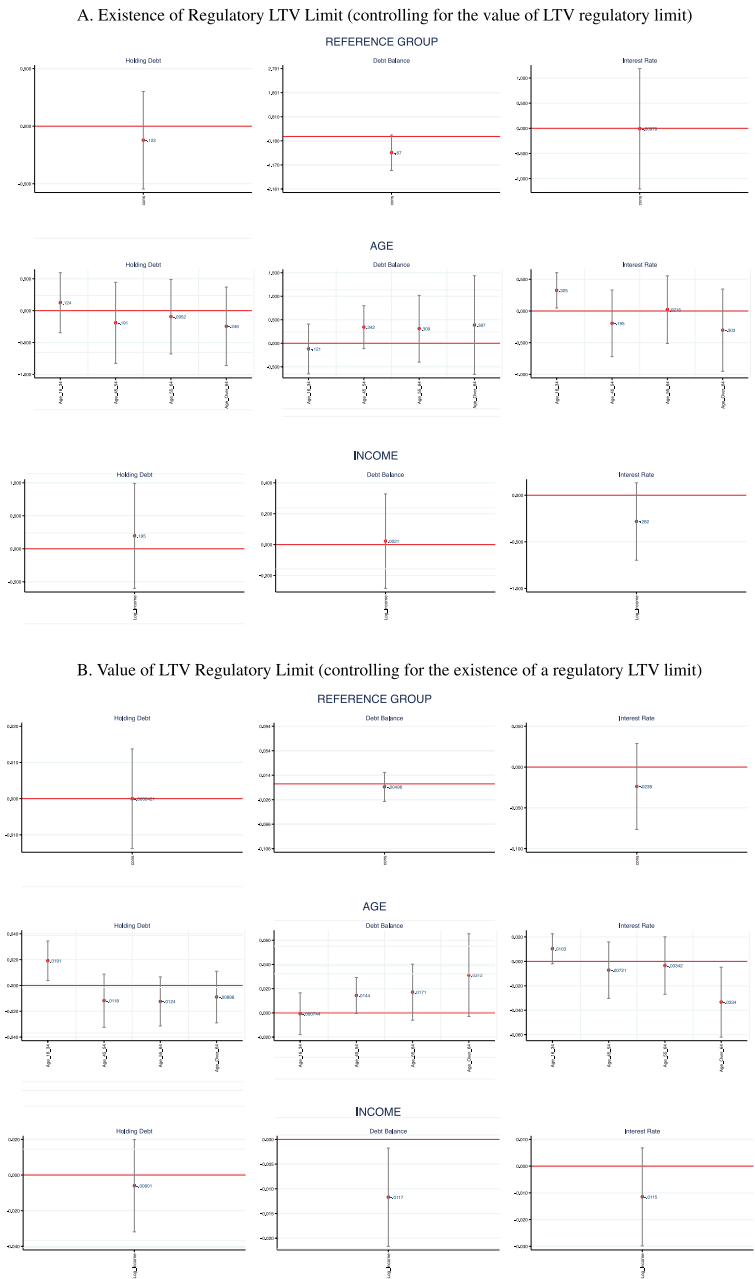
Looking at the reference group, the existence of a regulatory LTV does not affect the probability of borrowing but reduces the amount of secured debt borrowed by 67 percent. However, when an LTV exists, higher limits do not affect either of those outcomes.

Among countries that do have a regulatory LTV, a higher limit increases the relative chances of holding secured debt among very young households while reducing those of older age groups. That result is consistent with the idea that maximum LTVs are most binding early in the life cycle. However, the same logic would predict a negative impact of a higher regulatory LTV on the odds ratio of income, because a lower downpayment would allow low-income households to borrow. Our results do not support that basic prediction.

²⁵We have redone the exercise using a quantitative measure in Andrews, Caldera Sánchez, and Johansson (2011). The results on the probability of holding debt were similar and more precise than the ones we show, but some of the results—like the young borrowing more in countries with more generous tax exemptions—did not hold using that variable. In addition, we found that the income profiles obtained in the data were at odds with the hypothesis that a more generous treatment of mortgage payments increases the odds that high-income households hold debt. We decided to present the results based on dummies because the measure of tax relief in Andrews, Caldera Sánchez, and Johansson (2011) already includes the cost of mortgage debt, one of the outcome variables we examine.

²⁶We normalize this variable by subtracting 80 from the LTV value of each country.

Figure 7. Regulatory Loan-to-Value Ratio



Notes: Each graph shows the OLS coefficient and its 95 percent confidence interval in a regression of the first-step coefficient of the variable in the horizontal axis on the institution that gives title to the figure. The estimates and standard errors are shown in table 6.

Finally, there is very limited evidence that changes in regulatory LTVs alter the cost of borrowing among those countries with a maximum LTV ratio. In fact, a higher LTV ratio is associated with a *drop*, not an increase, in the interest rate charged to the reference group. Hence, we cannot really argue that a general equilibrium effect dampens the impact of this institution on the distribution of debt outcomes.

6.1.4 *Information on Borrowers*

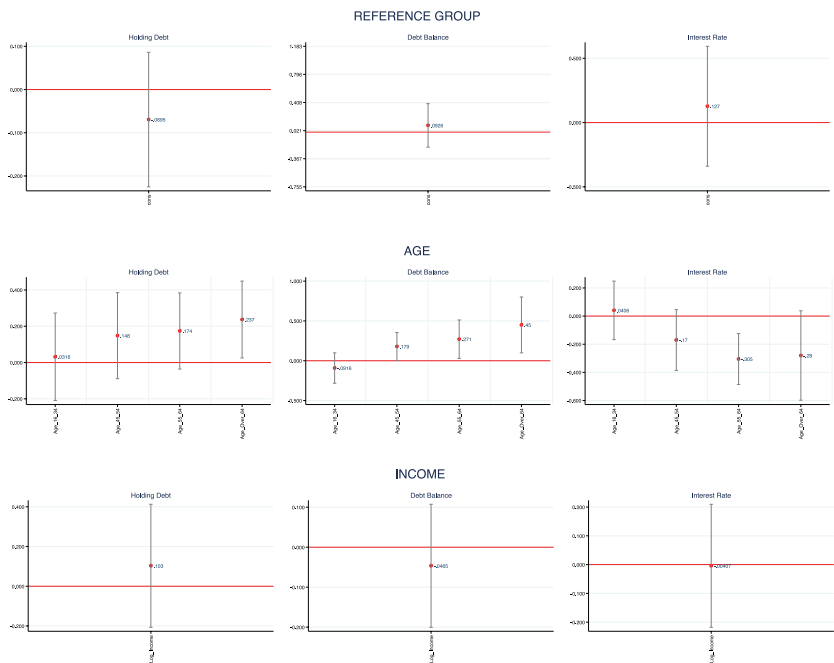
The impacts of credit information on borrowers on the age and income profiles of debt holdings and debt amounts are shown in figure 8 and table 6. In section 3, we argued that better information allows lenders to “price in” riskier borrowers—i.e., information allows banks to grant loans at high interest rates to risky borrowers whose applications would otherwise be rejected. Figure 8 presents evidence consistent with that hypothesis. In countries where more information about borrowers is available, we do observe that older (and possibly less risky) borrowers between forty-five and fifty-four face lower borrowing costs than in other countries where less information is available. For example, a 1-point increase in the depth of information raises interest rates charged to young households by 4 basis points and lowers those charged to forty-five to fifty-four year olds and fifty-five to sixty-four year olds by 17 and 31 basis points, respectively—all estimates are relative to the impact on the reference group.

When we turn to the chances of borrowing, however, the estimates are weak. For example, age groups that are charged lower rates borrow relatively more, but the coefficients for prime-age groups are not statistically different from zero at the 95 percent confidence level. Finally, we do observe, however, that older households borrow significantly more in countries where better information about borrowers is available. Overall, we cannot reject the hypothesis that, in countries with more information about borrowers, interest rates serve as a screening mechanism.

6.2 *Which Institutions Matter the Most?*

We conduct a robustness analysis including the four institutions considered thus far, namely “time to repossess,” “taxation,”

Figure 8. Information on Borrowers: Depth of Credit Information Index (0–6)



Notes: Each graph shows the OLS coefficient and its 95 percent confidence interval in a regression of the first-step coefficient of the variable in the horizontal axis on the institution that gives title to the figure. The estimates and standard errors are shown in table 6.

“loan-to-value ratios,” and “depth of information,” as well as an indicator for “fixed-rate mortgages” to control for differences in the cost of debt associated with the interest rate fixation mode as argued in section 3.1 and footnote 23. This is done by regressing each of the coefficients of interest on the set of five institutions at the same time. We report the standard errors that take into account the estimation error from the first step only. The results are shown in table 7.

Variation in time to repossess correlates strongly with many of the patterns of interest even after holding the remaining institutions constant. Namely, a one month longer repossession period

Table 7. Multivariate Analysis

Control Variables	RG	Age		Income
		16_34	45_54	
A. Has Secured Debt				
Duration of Foreclosure	−0.011* (0.001)	0.002 (0.004)	0.006* (0.003)	0.001 (0.005)
Existence of Tax Exemption	0.061 (0.142)	0.182 (0.356)	−0.860 (0.502)	−0.261 (0.621)
Absence of Limit to Deductibility	0.033 (0.206)	−0.012 (0.608)	0.833 (0.876)	−0.122 (0.530)
Existence of Regulatory LTV Limit	0.321 (0.206)	0.397 (0.608)	0.573 (0.875)	0.538 (0.532)
Value of LTV Regulatory Limit	0.019 (0.206)	0.033 (0.607)	0.020 (0.877)	0.013 (0.531)
Fixed Interest Rate	0.158 (0.207)	0.391 (0.608)	0.484 (0.875)	0.376 (0.532)
Depth of Credit Information Index	−0.109 (0.206)	0.103 (0.609)	−0.089 (0.876)	0.108 (0.529)
B. Secured Debt Balance				
Duration of Foreclosure	0.005 (0.004)	−0.013* (0.006)	−0.009* (0.004)	−0.004 (0.003)
Existence of Tax Exemption	−0.817 (0.507)	0.273 (0.417)	0.349 (0.356)	0.196 (0.243)
Absence of Limit to Deductibility	1.380* (0.446)	−0.394 (0.329)	−0.256 (0.348)	−0.015 (0.228)
Existence of Regulatory LTV Limit	0.572 (0.446)	0.037 (0.328)	0.558 (0.347)	0.068 (0.228)
Value of LTV Regulatory Limit	0.031 (0.446)	0.011 (0.327)	0.024 (0.347)	−0.011 (0.227)
Fixed Interest Rate	0.430 (0.447)	0.072 (0.329)	0.267 (0.348)	0.015 (0.228)
Depth of Credit Information Index	−0.338 (0.446)	−0.033 (0.329)	0.306 (0.348)	0.047 (0.228)
C. HMR Interest Rate				
Duration of Foreclosure	0.005 (0.013)	0.002 (0.015)	0.008 (0.011)	−0.019* (0.009)
Existence of Tax Exemption	1.578 (1.358)	−0.320 (0.749)	0.923 (0.711)	0.120 (0.472)
Absence of Limit to Deductibility	−0.324 (0.777)	−0.143 (0.514)	−0.715 (0.485)	−0.120 (0.358)
Existence of Regulatory LTV Limit	1.517 (0.778)	−0.785 (0.513)	−0.423 (0.485)	−0.275 (0.359)
Value of LTV Regulatory Limit	0.060 (0.778)	−0.037 (0.514)	−0.013 (0.484)	−0.013 (0.358)
Fixed Interest	2.262* (0.778)	−0.985 (0.513)	0.254 (0.485)	−0.064 (0.359)
Depth of Credit Information Index	0.949 (0.779)	−0.129 (0.512)	0.292 (0.485)	−0.054 (0.360)
Notes: Each column shows the OLS estimates and the standard error (in parentheses) of an OLS regression where the dependent variable is the probability of holding secured debt by the reference group (RG) in panel A, the secured debt balance of the RG in panel B, and the HMR interest rate of the RG in panel C. Covariates are the institutions in the rows. A constant is included in all regressions but not reported. The sample contains ten countries in panels A and B and nine in panel C. * indicates a statistically significant coefficient at the 5 percent confidence level.				

diminishes the chances that the reference group has secured debt by 1 percent. Longer repossession periods diminish less the borrowing chances of households above forty-five years of age than the chances of the thirty-five to forty-four group. Finally, in terms of the amount borrowed (conditional on borrowing), a one-month increase in repossession periods reduces the amount granted to the youngest households—with the rest of the covariates held constant at those of the reference group—by 0.008 log points (0.005–0.013). Our results also show that longer repossession periods affect the pricing of loans; in countries with longer repossession periods, banks charge relatively higher interest rates to low-income households, which, in principle, are most likely to default.

Mortgage tax exemptions do not robustly predict differences in the probability of holding debt. Nevertheless, conditional on borrowing, the average debt amount held by the reference group is 1.38 log points larger in countries without a limit on mortgage tax exemptions.

The role of the remaining institutions is less clear-cut. While a literature has stressed the role of the variation in LTVs in introducing quantity rationing in the credit market, our results suggest that the absence of regulatory LTVs diminishes the chances of borrowing and the amount borrowed by the reference group. As expected, the prevalence of FRMs correlates with higher interest rates charged to the reference group—the effect is 200 basis points. Finally, while information about borrowers accounts for the distribution of the cost of debt across age groups in the univariate analysis, that is no longer the case in the multivariate setting. Those results emphasize the value of the multivariate analysis: some institutions that appear to account for the distribution of debt when considered alone turn out to have a weaker impact when additional institutions are considered.

6.2.1 The Magnitude of the Estimates

Variation in the time to repossess seems to account for most of the variation in the chances of borrowing within the reference group. The standard deviation of time to repossess is fifteen months in our sample. Fifteen months longer repossession periods decrease the probability of holding secured debt by between 10 and 16 percentage

points, depending on whether we focus on our univariate or on the multivariate estimate. The overall standard deviation of the predicted probability of holding secured debt by the reference group is 16 percentage points, slightly above the 15 percentage points estimated impact.

Using a cross-country and a cross-Italian province panel data set, Djankov, McLiesh, and Shleifer (2007) and Jappelli, Pagano, and Bianco (2005) respectively assess the impact of various measures of legal enforcement, for which time to repossess is a proxy, on private-sector debt-to-GDP ratios. Djankov, McLiesh, and Shleifer control, at the same time, for depth of information about borrowers. The authors document that a one-year increase in the time to enforce a contract increases debt-to-GDP ratios by more than 7 percentage points.

While those previous results are hard to compare with ours since we only consider household debt and use different dependent variables, the finding that a one month longer repossession period increases the fraction of borrowers by 1 percentage point does not seem at odds with the previous ones.

On the other hand, Djankov, McLiesh, and Shleifer (2007) find that, in a subsample of rich countries like ours and holding contract enforcement constant, “depth of information” does not explain differences in private debt-to-GDP ratios. The results in tables 6 and 7 and in Bover et al. (2013) are qualitatively similar, as they suggest that “depth of information” does not correlate with the incidence, amount, or cost of debt when we hold contract enforcement constant in the multivariate analysis.

Regarding the cost of debt, we compare the predicted interest rate paid by households in the bottom income decile—with the rest of the covariates held constant at those of the reference group—in two countries: one with a twenty-month repossession period (say, France) and another with a five-month repossession period (like the Netherlands).²⁷ In the country with fifteen month longer repossession periods, the household in the lowest income decile and with the

²⁷To that end, we replace the country-specific first-stage income coefficient with interest rates in the left-hand side by its projection on a constant and on the number of months to repossess—i.e., the fitted value in the second stage.

rest of the covariates held at those of the reference group pays a 0.30-percentage-point-higher interest rate.

Finally, previous studies, like Chiuri and Jappelli (2003), have emphasized the role of quantity restrictions (the downpayment) in shaping the age profile of homeownership. Using a pool of countries, Jappelli, Pagano, and Bianco (2005) document a close-to-zero correlation between average mortgage interest rate spreads and judicial costs. However, using household-level data on borrowing costs, we find that banks price in the risk of non-repayment by charging relatively higher mortgage interest rates to low-income households.

7. Conclusions

This paper has studied the distribution of household secured debt outcomes across euro-area countries and examined the role of institutions in explaining the heterogeneity in the impact of household socioeconomic and demographic characteristics on these debt outcomes. In particular, we analyze the role of legal enforcement of contracts, tax treatment of mortgage payments, regulatory loan-to-value ratios, and information about borrowers in shaping the distribution of the fraction of borrowers with secured debt, the amount borrowed, and the mortgage interest rate paid. To that end, we use a novel household data set—the Household Finance and Consumption Survey, a coordinated effort of fifteen countries to collect *ex ante* harmonized data on household wealth, debt, and income.

Our results show that the age and income level of household members are important determinants of debt. In this context, we find evidence of a hump-shaped profile of secured debt holding over age-cohort groups. The chances of borrowing peak for cohorts aged thirty-five to forty-four years, before the (cross-sectional) income profile peaks, possibly suggesting a role for secured debt in smoothing household consumption. However, there is considerable heterogeneity in the relative importance of these factors across the countries in our sample.

We find that the length of repossession periods best explains the features of the distribution of debt that we analyze. In countries with one standard deviation longer repossession procedures, we

find that the proportion of households with debt is 16 percentage point smaller, the amount borrowed by the youngest set of households (conditional on borrowing) is 12 percent lower, and the interest rates paid by low-income households are 0.3 percentage point higher when we evaluated impacts with the rest of the covariates evaluated for the reference group. These results are robust to the inclusion of other institutions. Cross-country variation in regulatory LTVs, taxation of mortgage payments, or information about borrowers delivers less robust results. This lack of robustness highlights the importance of analyzing the impact of several institutions at a time.

One interpretation of our results is that the supply of secured credit is affected by legal processes that delay the recovery of collateral in the case of non-repayment. In this case, banks react to expected losses due to longer repossession periods not necessarily by rationing quantities or rejecting applications, but also by pricing secured debt differently across income groups and charging relatively higher interest rates to low-income households.

Appendix

Figure 9. Fraction of Indebted Households and Median Debt-to-Income Ratio by Institution

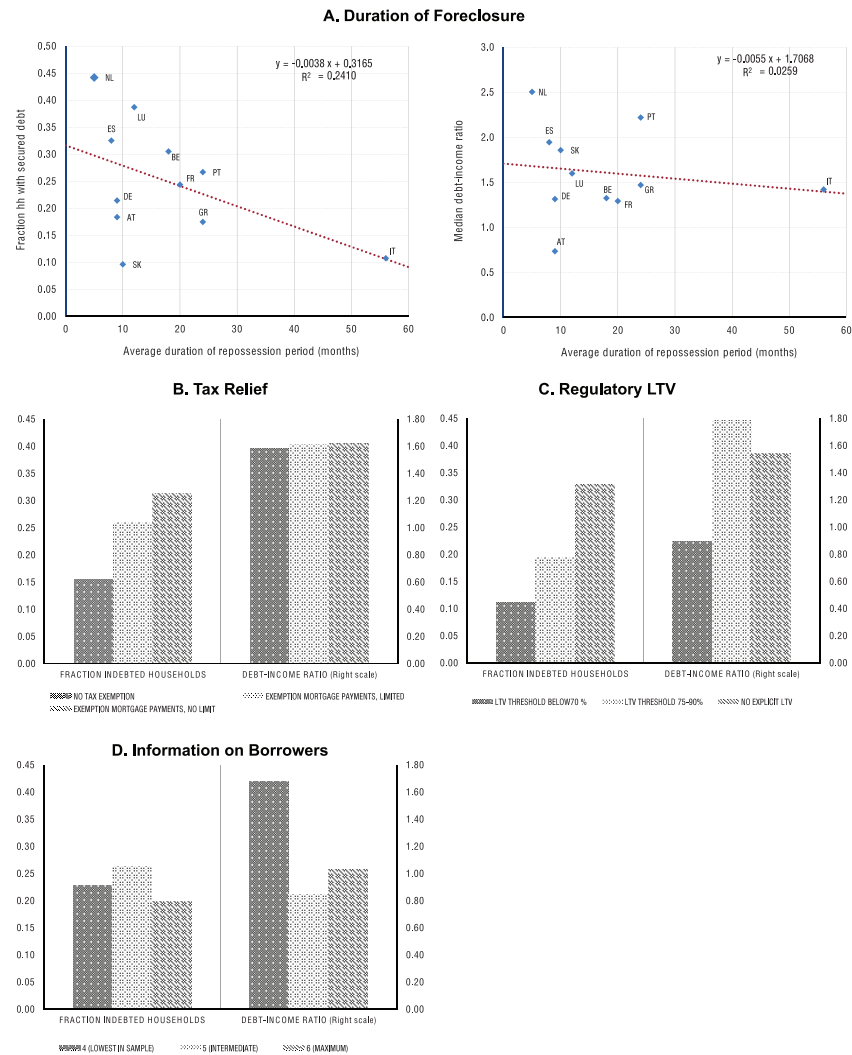


Table 9. Debt Balance of Secured Debt (OLS estimates)

Control Variables	Countries										
	AT	BE	DE	ES	FR	GR	IT	LU	NL	PT	SK
Age_16_34	0.209 (0.239)	0.566 (0.092)	0.157 (0.251)	0.673 (0.112)	0.362 (0.072)	0.177 (0.135)	0.026 (0.314)	0.358 (0.126)	0.201 (0.114)	0.398 (0.090)	0.104 (0.165)
Age_45_54	-0.533 (0.237)	-0.654 (0.118)	-0.232 (0.159)	-0.006 (0.113)	-0.599 (0.069)	-0.076 (0.167)	-0.405 (0.177)	-0.656 (0.159)	-0.403 (0.107)	-0.535 (0.093)	-0.323 (0.279)
Age_55_64	-0.967 (0.312)	-0.964 (0.162)	-0.464 (0.186)	-0.241 (0.126)	-0.926 (0.100)	-0.172 (0.221)	-0.642 (0.190)	-1.040 (0.210)	-0.470 (0.110)	-1.028 (0.130)	-1.209 (0.345)
Age_Over_64	-0.833 (0.423)	-1.429 (0.365)	-0.599 (0.274)	-0.005 (0.250)	-1.328 (0.175)	-0.680 (0.363)	-0.867 (0.266)	-0.586 (0.457)	-0.468 (0.168)	-1.226 (0.290)	-
Age_Differ	0.030 (0.024)	0.040 (0.015)	0.023 (0.013)	0.018 (0.014)	0.050 (0.007)	0.013 (0.018)	0.037 (0.017)	0.022 (0.017)	-0.007 (0.016)	0.018 (0.015)	0.039 (0.035)
Low_Educ	-0.227 (0.453)	0.090 (0.190)	-0.367 (0.503)	0.027 (0.117)	-0.093 (0.099)	-0.492 (0.156)	0.054 (0.156)	0.059 (0.158)	-0.166 (0.101)	-0.062 (0.094)	0.333 (0.784)
High_Educ	0.125 (0.314)	0.165 (0.099)	0.238 (0.131)	0.023 (0.111)	0.146 (0.059)	-0.140 (0.128)	0.401 (0.167)	0.075 (0.136)	0.258 (0.095)	0.196 (0.094)	0.238 (0.190)
Educ_Differ	-0.248 (0.249)	-0.194 (0.107)	-0.107 (0.142)	-0.101 (0.095)	-0.073 (0.058)	-0.011 (0.129)	-0.115 (0.168)	0.026 (0.144)	-0.220 (0.091)	-0.021 (0.082)	-0.277 (0.281)
Self_Employed	0.046 (0.259)	0.308 (0.140)	0.189 (0.154)	0.193 (0.115)	0.244 (0.077)	0.076 (0.130)	0.024 (0.210)	0.534 (0.228)	0.316 (0.336)	0.493 (0.096)	-0.097 (0.242)
Retired	-0.426 (0.330)	0.538 (0.294)	0.061 (0.223)	-0.099 (0.235)	-0.278 (0.131)	-0.649 (0.263)	-0.111 (0.246)	-0.178 (0.287)	-0.236 (0.140)	-0.210 (0.239)	0.175 (0.372)
Inactive_	-0.221 (0.382)	-0.018 (0.231)	0.172 (0.286)	0.139 (0.112)	-0.245 (0.153)	-0.081 (0.197)	-0.196 (0.337)	-0.685 (0.309)	-0.166 (0.123)	-0.049 (0.164)	0.226 (0.376)
Unemp	-0.121 (0.221)	0.208 (0.136)	0.191 (0.174)	0.219 (0.098)	-0.136 (0.068)	0.075 (0.146)	0.098 (0.152)	0.276 (0.179)	0.100 (0.093)	-0.100 (0.094)	0.217 (0.269)
Working	0.666 (0.279)	-0.203 (0.196)	-0.293 (0.238)	-0.352 (0.141)	-0.044 (0.123)	0.106 (0.172)	-0.251 (0.231)	-0.175 (0.219)	0.030 (0.176)	-0.127 (0.146)	-0.007 (0.340)
Couple	-0.306 (0.272)	-0.063 (0.167)	-0.244 (0.177)	0.085 (0.134)	-0.076 (0.113)	-0.321 (0.194)	0.002 (0.219)	-0.252 (0.178)	0.137 (0.184)	0.076 (0.131)	-0.230 (0.278)
LnAdults	0.374 (0.194)	0.174 (0.083)	0.398 (0.092)	0.391 (0.080)	0.474 (0.060)	-0.027 (0.089)	0.161 (0.133)	0.351 (0.094)	0.067 (0.070)	0.260 (0.070)	0.127 (0.252)
Cons	10.840 (0.481)	10.720 (0.156)	10.770 (0.222)	10.390 (0.152)	10.670 (0.089)	10.750 (0.169)	10.690 (0.175)	11.540 (0.198)	11.890 (0.144)	10.740 (0.128)	9.693 (0.347)
R ²	0.188	0.265	0.152	0.112	0.240	0.234	0.111	0.316	0.255	0.266	0.128
Notes: Each column shows the country-specific estimates and standard errors (in parentheses) of an OLS model where the logarithm of the amount of secured debt is the dependent variable and the covariates in the rows are the independent variables. The sample includes only the households that report holding secured debt. All estimates are weighted by population weights and averaged across the five implicates.											

Notes: Each column shows the country-specific estimates and standard errors (in parentheses) of an OLS model where the logarithm of the amount of secured debt is the dependent variable and the covariates in the rows are the independent variables. The sample includes only the households that report holding secured debt. All estimates are weighted by population weights and averaged across the five implicates.

References

- Abadie, A., S. Athey, G. Imbens, and J. Wooldridge. 2014. "Finite Population Causal Standard Errors." NBER Working Paper No. 20325.
- Andrews, D., and A. Caldera Sánchez. 2011. "The Evolution of Homeownership Rates in Selected OECD Countries: Demographic and Public Policy Influences." *Economic Studies* (OECD)(1): 1–37.
- Andrews, D., A. Caldera Sánchez, and Å. Johansson. 2011. "Housing Markets and Structural Policies in OECD Countries." Working Paper No. 836, OECD Economics Department.
- Arrondel, L., L. Bartiloro, P. Fessler, P. Lindner, T. Mathä, C. Rampazzi, F. Savignac, T. Schmidt, M. Schürz, and P. Vermeulen. 2014. "How Do Households Allocate Their Assets? Stylised Facts from the Eurosystem Household Finance and Consumption Survey." ECB Working Paper No. 1722 (August).
- Bover, O., J. M. Casado, S. Costa, P. Du Caju, Y. McCarthy, E. Sierminska, P. Tzamourani, E. Villanueva, and T. Zavadil. 2013. "The Distribution of Debt Across Euro Area Countries: The Role of Individual Characteristics, Institutions and Credit Conditions." Working Paper No. 1320, Banco de España.
- Bryan, M., and S. Jenkins. 2013. "Regression Analysis of Country Effects Using Multilevel Data: A Cautionary Tale." IZA Discussion Paper No. 7583.
- Chambers, M., C. Garriga, and D. Schlagenhauf. 2009. "Accounting for Changes in the Homeownership Rate." *International Economic Review* 50 (3): 677–726.
- Chatterjee, S., D. Corbae, M. Nakajima, and J. Ríos-Rull. 2007. "A Quantitative Theory of Unsecured Debt with Risk of Default." *Econometrica* 75 (6): 1525–1989.
- Chiuri, C., and T. Jappelli. 2003. "Financial Market Imperfections and Home Ownership: A Comparative Study." *European Economic Review* 47 (5): 857–75.
- Crook, J., and S. Hochguertel. 2007. "US and European Household Debt and Credit Constraints: Comparative Micro Evidence from the Last 15 Years." Discussion Paper No. 07-087/3, Tinbergen Institute.

- Devereux, M., and G. Lanot. 2003. "Measuring Tax Incidence: An Application to Mortgage Provision in the UK." *Journal of Public Economics* 87 (7–8): 1747–78.
- Djankov, S., C. McLiesh, and A. Shleifer. 2007. "Private Credit in 129 Countries." *Journal of Financial Economics* 84 (2): 299–329.
- Du Caju, P., F. Rycx, and I. Tojerow. 2016. "Unemployment Risk and Over-indebtedness: A Micro-econometric Perspective." Working Paper No. 294, National Bank of Belgium.
- Duygan, B., and C. Grant. 2009. "Household Debt Repayment Behaviour: What Role Do Institutions Play?" *Economic Policy* 24 (57): 107–40.
- Dynan, K., and D. Kohn. 2007. "The Rise in U.S. Household Indebtedness: Causes and Consequences." FEDS Working Paper No. 2007-37, Board of Governors of the Federal Reserve System.
- Edelberg, W. 2006. "Risk-Based Pricing of Interest Rates for Consumer Loans." *Journal of Monetary Economics* 53 (8): 2283–98.
- Ejarque, J., and S. Leth-Sorensen. 2009. "Consumption and Savings of First Time House Owners." Manuscript, University of Copenhagen.
- European Central Bank. 2009. "Housing Finance in the Euro Area." ECB Occasional Paper No. 101 (March).
- Fabbri, D., and M. Padula. 2004. "Does Poor Legal Enforcement Make Households Credit-Constrained?" *Journal of Banking and Finance* 28 (1): 2369–97.
- Georgarakos, D., A. Lojschova, and M. Ward-Warmedinger. 2010. "Mortgage Indebtedness and Household Financial Distress." ECB Working Paper No. 1156 (February).
- Gervais, M. 2002. "Housing Taxation and Capital Accumulation." *Journal of Monetary Economics* 49 (7): 1461–89.
- Gropp, R., K. Scholz, and M. White. 1997. "Personal Bankruptcy and Credit Supply and Demand." *Quarterly Journal of Economics* 112 (1): 217–51.
- Hintermeier, T., and W. Koeniger. 2011. "Debt Portfolios." IZA Discussion Paper No. 5653.
- Household Finance and Consumption Network (HFCN). 2013. "The Eurosystem Household Finance and Consumption Survey—Methodological Report for the First Wave." Available at http://www.ecb.int/home/html/researcher_hfcn.en.html.

- Jappelli, T., M. Pagano, and M. Bianco. 2005. "Courts and Banks: Effects of Judicial Enforcement on Credit Markets." *Journal of Money, Credit and Banking* 37 (2): 223–44.
- Le Blanc, J., A. Porpiglia, F. Teppa, J. Zhu, and M. Ziegelmeyer. 2015. "Household Saving Behaviour and Credit Constraints in the Euro Area." ECB Working Paper No. 1790 (May).
- Livshits, I., J. MacGee, and M. Tertilt. 2007. "Consumer Bankruptcy: A Fresh Start." *American Economic Review* 97 (1): 402–18.
- Magri, S., and R. Pico. 2010. "The Rise of Risk-Based Pricing of Mortgage Interest Rates in Italy." *Journal of Banking and Finance* 35 (5): 1277–90.
- Ortalo-Magné, F., and S. Rady. 1999. "Boom In, Bust Out: Young Households and the Housing Price Cycle." *European Economic Review* 43 (4): 755–66.
- . 2006. "Housing Market Dynamics: On the Contribution of Income Shocks and Credit Constraints." *Review of Economic Studies* 73 (2): 459–85.
- World Bank. 2012. *World Development Indicators 2012*. Washington, DC: World Bank.

How Do Households Allocate Their Assets? Stylized Facts from the Eurosystem Household Finance and Consumption Survey*

Luc Arrondel,^a Laura Bartiloro,^b Pirmin Fessler,^c
Peter Lindner,^c Thomas Y. Mathä,^d Cristiana Rampazzi,^b
Frédérique Savignac,^e Tobias Schmidt,^f Martin Schürz,^c
and Philip Vermeulen^g

^aCNRS-PSE and Banque de France

^bBanca d'Italia

^cOesterreichische Nationalbank

^dBanque centrale du Luxembourg

^eBanque de France

^fDeutsche Bundesbank

^gEuropean Central Bank

Using the first wave of the Eurosystem Household Finance and Consumption Survey (HFCS), a large micro-level data set on households' balance sheets in fifteen euro-area countries, this paper explores how households allocate their assets. We derive stylized facts on asset participation as well as the

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portfolio shares of asset holdings and investigate the systematic relationships between household characteristics and asset holding patterns. Real assets make up the bulk of total assets. Whereas ownership of the main residence varies strongly between countries, the value of the main residence tends to be the major asset for homeowners and represents a significant part of total assets in all countries. While almost all households hold safe financial assets, a low share of households holds risky assets. The ownership rates of all asset categories generally increase with wealth (and income). The significance of inheritances for homeownership and holding of other real estate is remarkable. We tentatively link differences in asset holding patterns across countries to differences in institutions.

JEL Codes: D1, D3.

1. Introduction

How do households choose to allocate their wealth across available assets? Is there a systematic relationship between underlying household characteristics and asset holding patterns across countries? This paper uses a large data set containing comparable household micro data from fifteen euro-area countries to shed light on these research- and policy-relevant questions.

Recent findings in the household finance literature have emphasized that asset holdings are heterogeneous across households and across countries (see Guiso, Haliassos, and Jappelli 2002, 2003; Sierminska and Doorley 2012, and Christelis, Georgarakos, and Haliassos 2013). Extending the existing literature, this paper documents differences in asset participation and holdings across a broad range of assets for fifteen euro-area countries in a data set consisting of ex ante comparable country surveys representative of the respective total population.

Our analysis is based on the Eurosystem Household Finance and Consumption Survey (Household Finance and Consumption Network 2013a), which provides detailed household-level information on wealth, assets, and debt holding, income, as well as on the household composition for fifteen euro-area countries. We study the determinants of both asset holdings (extensive margin) and the portfolio share invested in each asset by households (intensive margin).

The main components of household wealth considered are housing assets (decomposed into household main residence and other real estate), risky financial assets (mutual funds, bonds, and shares), safe financial assets (defined as deposits, life insurance contracts, and voluntary private pension plans), and business wealth (defined as self-employment participation).

We first document participation rates and portfolio shares (conditional on participation) in these asset categories across wealth quintiles and across euro-area countries. We confirm the standard finding that wealthier households tend to participate in a wider range of asset categories. However, we uncover substantial differences across countries—in particular, for housing wealth.

In a second step, we analyze the household-level determinants of asset participation and of the portfolio shares by estimating, respectively, probit and tobit models. We find considerable overlap in the factors that determine asset participation choices and the portfolio shares invested. We find that a number of household characteristics are robust predictors of household portfolio choices in the sense that, in a majority of countries, their estimated marginal effects are statistically significant and have the same sign, even though their estimated sizes may differ. This points not only to the importance of such factors but also to the conclusion that the variation in institutional, policy, and other environmental factors within the euro area does not seem to reverse or render insignificant the importance of such underlying household characteristics.

Nevertheless, differences remain across countries in the measured effects of demographic variables. Identifying the potential sources explaining those differences is not an easy task. Many factors—including culture, history, welfare state, housing and credit markets, and financial institutions—are likely to affect the wealth accumulation process and portfolio choices of households. To this end, we examine the correlations between the estimated marginal effects of key sociodemographic explanatory variables and selected institutional factors. We find some evidence that suggests the strength of the influence of the sociodemographic factors on the choice of holding real and risky financial assets to be correlated with the institutional framework in a given country.

A brief literature review (section 2) introduces the topic of household portfolio choices and the issues that have evolved in this

field. After presenting the data and the first descriptive analysis of assets composition in section 3, we analyze extensive margins using probit regressions for different asset categories and countries (in section 4). Furthermore, we present results on the intensive margins using tobit regressions (also in section 4). Section 5 investigates the role of institutions as factors altering the impact of certain household characteristics on portfolio choice. Section 6 concludes the paper.

2. International Differences in Asset Holding Behavior

2.1 Existing Research

The first cross-country comparisons of wealth and portfolio choice behavior at the household level on a relatively large scale were provided by Guiso, Haliassos, and Jappelli (2002, 2003). They find substantial differences in stock market participation between major European countries (France, Germany, Italy, the Netherlands, Sweden, and the United Kingdom) and the United States. They also emphasize some regular empirical facts, such as the positive correlation of stockholding with education. More recently, Christelis, Georgarakos, and Haliassos (2013) use SHARE, ELSA, and HRS micro data¹ to document international differences in ownership and holdings of stocks, private businesses, homes, and mortgages among households in the fifty-plus age group in thirteen countries (the United States, the United Kingdom, and eleven continental European countries). They find that households with given characteristics have different probabilities of participating in a given asset category both across the Atlantic and within Europe. U.S. households tend to invest more in stocks and less in homes and tend to have larger mortgages than European households with similar characteristics. Based on counterfactual analysis, they show that these

¹SHARE (Survey of Health, Ageing and Retirement in Europe) is a major survey with standardized information on household behavior, including wealth and portfolio composition. It also includes the ELSA (English Longitudinal Study of Ageing) survey for England and HRS (Heath and Retirement Study) data for the United States. As it focuses on retirement and aging issues, it includes only individuals over fifty years of age and does not provide any information for the rest of the population.

differences in ownership and amounts are primarily linked to differences in economic environments (i.e., institutional factors) rather than related to population characteristics. Furthermore, reported differences seem to be even more pronounced among European countries than among U.S. regions, which according to Christelis, Georgarakos, and Haliassos (2013) suggests potential for more harmonization. From the point of view of this paper, their finding suggests a higher potential for testing the relevance of each household characteristic across euro-area countries than across U.S. regions and more importance of robust effects of any given factor across euro-area countries.

Sierminska and Doorley (2012) extend the Christelis, Georgarakos, and Haliassos (2013) approach in the direction of studying survey data that is representative of the entire population. They use the ex post harmonized data set from the Luxembourg Wealth Study (LWS) to analyze household portfolios for the whole population in five countries (United States, Germany, Italy, Luxembourg, and Spain). Concerning cross-country differences in asset participation, their results confirm the limited role of demographic characteristics for households in the fifty-plus age group, and they also reveal a stronger role of observable demographic characteristics for younger households. They find that the household characteristics helping to explain the amount of assets held change along the wealth distribution. It seems that they do better in explaining the existing cross-country differences in the middle than in the tails of the wealth distribution. All in all, they conclude that institutional and non-observed characteristics are more likely to influence cross-country differences for old and wealthy households.

2.2 Asset Holdings in the Euro Area

Our data is taken from the Eurosystem HFCS.² The net sample of the survey includes 62,521 households from Belgium (BE), Germany (DE), Greece (GR), Spain (ES), France (FR), Italy (IT), Cyprus (CY), Luxembourg (LU), Malta (MT), the Netherlands (NL), Austria (AT), Portugal (PT), Slovenia (SI), Slovakia (SK),

²Here, we only briefly summarize the most basic information regarding the survey. For more details, see HFCN (2013a, 2013b).

and Finland (FI).³ The survey was conducted in each country separately under common guidelines. Households were interviewed in 2010/11 with the exception of France (2009/10), Spain (2008/9), and Greece (2009). They thus provide a snapshot of a single point in time. The reference period for most of the information on wealth is the time of the interview. In particular, when comparing the values of the asset holdings across countries, the differences in the reference years must be kept in mind.⁴ Notwithstanding this, our focus is more on structural determinants of asset holdings, which should fluctuate less over time. The HFCS contains detailed information on asset holdings. We distinguish the following asset categories:

- Household main residence (HMR): owner-occupied housing
- Other real estate (ORE): real estate other than the main residence (including holiday homes/apartments, commercially used real estate, and land)
- Self-employed businesses (BUS): market value of all business assets including property and intangibles minus value of liabilities (net value concept)
- Safe financial assets (SAFE): deposits (sight and savings accounts), life insurance contracts, and voluntary private pension plans
- Risky financial assets⁵ (RISKY): mutual funds, bonds (including public bonds for which the degree of risk is lower), and shares

In the next sections, we document households' wealth composition for each of the fifteen euro-area countries. More specifically, for each of the outlined asset categories, we provide the participation rates (extensive margin) and the median values of the portfolio shares

³The remaining euro-area countries—Estonia, Ireland, and Latvia—did not take part in the first wave of the HFCS.

⁴Although differences in the valuation of real estate are acknowledged, internal calculations by the European Central Bank (ECB) adjusting for price variations show only small variation in the results. Hence in this analysis, we refrain from any adjustment of the collected data.

⁵The separation of safe and risky financial assets is along the lines laid out in Guiso, Jappelli, and Terlizzese (1996), who include long-term government bonds as well as corporate bonds in the category of risky financial assets.

(conditional on participation) (intensive margin) and explore their variations along the wealth distribution.⁶

3. Descriptive Results

3.1 *The Distribution of Net Wealth in the Euro Area*

Before looking at the household wealth composition, table 1 provides an overview of the distribution of household net wealth within and across countries. Net wealth values, defined as real and financial assets minus liabilities, differ substantially within and across euro-area countries. This fact holds for all parts of the wealth distribution. For example, the households' median net wealth is around €109,000 for the euro area as a whole, and it ranges from roughly €51,000 in Germany to €398,000 in Luxembourg.

Common across countries, the distribution of net wealth is very unequal and highly skewed to the right, as illustrated by the difference between the median and the mean values. This concentration of wealth at the top end of the wealth distribution is a well-documented fact (see, for instance, Davies and Shorrocks 1999; Campbell 2006) and is also confirmed by our data across fifteen euro-area countries. In the euro area, 50 percent of households below or just at the median level hold only 12 percent of the net wealth, while the top decile holds 50 percent of net wealth.

3.2 *The Composition of Total Assets*

Household portfolios consist of self-assessed real assets and financial assets. Taking all fifteen countries together, the share of the household main residence in total gross assets is about 51 percent. This means that households in the euro area hold the majority of

⁶The estimations of the results below are based on all five implicates of the multiple imputed data provided in the Eurosystem HFCS. That means that the estimations are done for each implicate separately and then combined using Rubin's rule. All the estimations—including probit and tobit models—are done using the final household weights in order to take the survey design of the underlying data into account. For the calculation of the standard errors in the multivariate analysis, a bootstrap procedure using replicate weights, which are also provided in the HFCS, is applied. Standard errors presented below are based on the first 100 replicate weights in the data set.

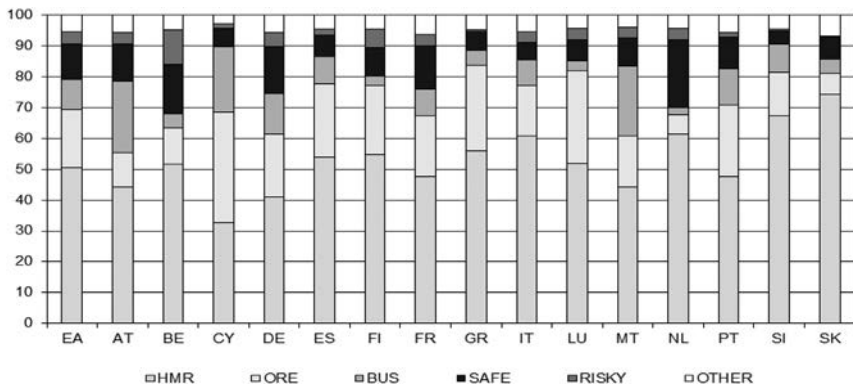
**Table 1. Descriptive Statistics of Net Wealth
(EUR thousands)**

	Obs.	Median	Mean	P5	P95
Euro Area	62,521	109.2	230.8	0.0	762.1
Austria	2,380	76.4	265.0	−0.2	934.6
Belgium	2,327	206.2	338.6	0.3	1,073.4
Cyprus	1,237	266.9	670.9	0.0	2,411.9
Germany	3,565	51.4	195.2	−1.6	661.2
Spain	6,197	182.7	291.4	0.2	878.5
Finland	10,989	85.8	161.5	−8.4	553.6
France	15,006	115.8	233.4	0.4	775.4
Greece	2,971	101.9	147.8	0.0	469.3
Italy	7,951	173.5	275.2	1.0	855.0
Luxembourg	950	397.8	710.1	0.1	2,023.9
Malta	843	215.9	366.0	4.0	1,049.4
Netherlands	1,301	103.6	170.2	−34.6	581.2
Portugal	4,404	75.2	152.9	0.1	482.4
Slovenia	343	100.7	148.7	0.3	434.5
Slovakia	2,057	61.2	79.7	1.5	207.4
Source: HFCS 2013.					
Notes: Estimates—apart from the number of observations—are given in thousands of euros.					

their wealth in the form of their main residence (see figure 1).⁷ Country figures range from 41 percent in Germany to 61 percent in Italy and the Netherlands. All other asset categories account for substantially smaller shares of gross wealth. The share of risky financial assets (4 percent), i.e., the least important category in average terms, ranges from about 1 percent for Cyprus and Slovenia to 11 percent for Belgium. There is also considerable cross-country variation; e.g., while, in the Netherlands, 22 percent of gross wealth is held in safe financial assets, this asset category only represents

⁷The figures reported here are calculated by dividing the total value of all assets of a specific type by the total gross value of all assets. This is a different approach compared with calculating the share of an asset type in the portfolio of each household and then averaging across households.

Figure 1. Shares of Asset Categories Relative to Gross Wealth



Source: HFCS 2013.

Notes: HMR: household's main residence, ORE: other real estate, BUS: self-employment business, SAFE: safe financial assets, RISKY: risky financial assets, OTHER: other real assets (e.g., vehicles) and other financial assets (e.g., money owed to the households, money held in managed accounts). In Finland, information on BUS is only collected in a summary way; estimates are not comparable.

6 percent and 4 percent of gross wealth in Italy and Slovenia, respectively.⁸

These differences in the aggregate wealth composition reflect differences both in the extensive margin (the percentage of households owning a particular asset) and in the intensive margin (the portfolio share of this particular asset held by the household).⁹

In addition to these variations in the composition of household wealth across countries, differences in the composition are also observed along the wealth distribution within countries. In particular, the existing empirical literature shows that the portfolio breadth increases with wealth. We contribute to this literature by comparing the participation rates and median values of asset categories along the net wealth distribution for each of the fifteen

⁸ For safe assets a large part of the heterogeneity may be related to the different role of public pension schemes: where the latter are predominant, voluntary private pension plans are less relevant.

⁹ The figures for the extensive (participation rate) and intensive margin (conditional median) are given in appendix 1 (see tables 14 and 15).

euro-area countries. This confirms the larger variety of assets held as wealth increases and reveals moreover some interesting cross-country differences.

3.2.1 Real Assets over the Net Wealth Distribution

Real assets represent the predominant asset category, accounting for 85 percent of total gross assets on average (HFCN 2013b). And among real assets, the HMR is the most important asset category. Tables 2 and 3 show the share of households owning their main residence and other real estate broken down by quintiles of the net wealth distribution. In the euro area as a whole, 60 percent of households own their main residence and 24 percent own other real estate. As expected, the percentage of households owning either their household main residence (table 2) or other real estate (table 3) increases with net wealth. For the HMR, the participation rate reaches more than 90 percent in the fifth net wealth quintile for every country. However, there are pronounced differences between countries in the lower half of the wealth distribution. Participation is already above 90 percent in the second quintile in Spain; it stays below 10 percent in Austria and Germany and below 15 percent in France.

The conditional portfolio share of the HMR is a high 79 percent in the euro area. The share remains high along the first four quintiles of the net wealth distribution in every country. It falls in the last quintile. However, even in this fifth quintile the average home-owning household has more than 50 percent of its total gross wealth invested in its HMR (i.e., a portfolio share of 55 percent). The conditional portfolio share of other real estate in the euro area is 31 percent. Along the wealth distribution in most countries it is somewhat U-shaped, with portfolio shares that are somewhat higher in the first and fifth quintile than the middle quintiles.

Eleven percent of euro-area households hold business wealth (see table 4); the participation rate also clearly increases with net wealth. In particular, in the top 5 percent of the net wealth distribution almost 50 percent of the households in the euro area hold business wealth, whereas in the first four wealth quintiles ownership is restricted to a maximum of 10 percent of the households (only 2 percent of the households in the first quintile own a business). The pattern of ownership is relatively similar across countries with the

Table 2. Share of Households Owning Their Main Residence and Conditional Median Shares of Gross Wealth

	Participation Rates over Net Wealth Distribution (Percentages)							Conditional Median Share over Net Wealth Distribution (Share)						
	Quintiles							Quintiles						
	Overall	1st	2nd	3rd	4th	5th	Top 5%	Overall	1st	2nd	3rd	4th	5th	Top 5%
Euro Area	60.1	4.8	28.7	78.9	93.4	94.8	94.1	0.786	0.908	0.891	0.865	0.811	0.549	0.346
Austria	47.7	3.1	3.9	52.0	87.9	91.7	90.1	0.783	0.819	0.830	0.864	0.825	0.580	0.308
Belgium	69.6	2.7	60.0	94.8	96.1	95.0	92.8	0.774	0.955	0.873	0.863	0.755	0.444	0.252
Cyprus	76.7	19.3	81.4	94.7	92.7	96.0	98.6	0.634	0.922	0.861	0.686	0.587	0.245	0.118
Germany	44.2	3.8	6.7	39.4	79.0	92.3	91.8	0.719	0.779	0.874	0.802	0.757	0.548	0.326
Spain	82.7	30.6	92.6	96.6	96.9	96.9	96.9	0.832	0.934	0.928	0.892	0.753	0.475	0.302
Finland	69.2	22.5	36.7	91.5	96.8	98.3	98.7	0.739	0.879	0.852	0.857	0.692	0.473	0.365
France	55.3	1.2	13.4	77.5	91.1	93.2	93.7	0.775	0.925	0.920	0.876	0.804	0.505	0.294
Greece	72.4	6.5	73.9	92.8	95.0	94.4	93.8	0.819	0.956	0.932	0.888	0.774	0.493	0.314
Italy	68.7	2.3	54.1	93.2	97.2	97.0	97.3	0.836	0.869	0.885	0.887	0.833	0.636	0.463
Luxembourg	67.1	3.8	48.2	93.9	95.7	94.4	94.5	0.839	0.897	0.899	0.884	0.853	0.466	0.283
Malta	77.7	12.8	85.2	97.0	98.5	95.5	94.5	0.711	0.863	0.839	0.800	0.694	0.383	0.192
Netherlands	57.1	25.0	22.8	55.1	87.3	95.5	96.9	0.782	0.918	0.905	0.860	0.780	0.648	0.528
Portugal	71.5	12.4	66.6	89.2	94.5	94.9	92.5	0.817	0.924	0.901	0.872	0.823	0.512	0.232
Slovenia	81.8	23.7	92.6	97.9	98.8	98.2	95.9	0.902	0.990	0.951	0.912	0.924	0.639	0.338
Slovakia	89.9	52.7	98.7	99.6	99.0	99.5	98.5	0.885	0.949	0.902	0.879	0.884	0.772	0.704
Source: HFCS 2013.														

Table 3. Share of Households Owning Other Real Estate and Conditional Median Shares

	Participation Rates over Net Wealth Distribution (Percentages)							Conditional Median Share over Net Wealth Distribution (Share)						
	Quintiles							Quintiles						
	Overall	1st	2nd	3rd	4th	5th	Top 5%	Overall	1st	2nd	3rd	4th	5th	Top 5%
Euro Area	23.8	2.3	8.7	20.2	28.2	59.8	78.3	0.306	0.569	0.385	0.279	0.266	0.316	0.328
Austria	13.4	1.4	1.9	9.2	18.2	36.6	50.5	0.271	0.657	0.661	0.447	0.257	0.241	0.178
Belgium	16.4	2.0	8.8	6.8	18.0	46.3	61.0	0.329	0.661	0.615	0.288	0.263	0.331	0.337
Cyprus	51.6	13.1	28.8	52.6	71.4	92.5	93.9	0.390	0.663	0.295	0.326	0.364	0.493	0.360
Germany	17.8	3.1	2.2	9.9	21.5	52.4	79.4	0.316	0.702	0.264	0.438	0.328	0.293	0.330
Spain	36.2	8.6	19.6	29.6	47.9	75.4	89.9	0.341	0.516	0.298	0.243	0.311	0.385	0.408
Finland	29.8	2.8	6.3	20.5	45.3	74.2	87.9	0.376	0.373	0.477	0.375	0.355	0.385	0.384
France ¹	28.5	2.4	8.6	25.8	36.6	69.0	86.2	0.270	–	0.370	0.204	0.223	0.299	0.318
Greece	37.9	5.1	26.2	31.6	48.3	78.4	92.0	0.362	0.693	0.409	0.263	0.319	0.422	0.534
Italy	24.9	1.8	16.6	17.3	27.8	61.2	76.6	0.268	0.363	0.427	0.259	0.204	0.285	0.314
Luxembourg	28.2	5.1	23.8	17.2	24.7	70.4	86.6	0.433	0.781	0.777	0.316	0.352	0.431	0.480
Malta	31.4	4.5	14.5	23.7	44.8	69.5	65.2	0.295	0.469	0.204	0.229	0.253	0.338	0.273
Netherlands ²	6.1	–	0.8	2.3	4.7	22.0	41.7	0.334	–	0.586	0.494	0.387	0.311	0.252
Portugal	27.1	3.5	15.1	21.9	31.2	64.1	91.6	0.296	0.872	0.202	0.191	0.282	0.352	0.469
Slovenia ³	23.2	–	17.9	17.9	26.5	54.8	69.5	0.300	–	0.316	0.258	0.181	0.323	0.346
Slovakia	15.3	2.1	8.6	16.1	14.0	35.9	45.2	0.185	0.653	0.128	0.180	0.271	0.209	0.220

Source: HFCS 2013.

Notes: Other real estate is defined as real estate other than the main residence. It includes holiday homes/apartments, commercially used real estate, and land.

¹Missing values in France for owners of other real estate.

²No observation in the Netherlands in the first quintile for some imputates.

³No observation in Slovenia in the first quintile for some imputates.

Table 4. Share of Households Owning Businesses and Conditional Median Shares

	Participation Rates over Net Wealth Distribution (Percentages)							Conditional Median Share over Net Wealth Distribution (Share)						
	Quintiles							Quintiles						
	Overall	1st	2nd	3rd	4th	5th	Top 5%	Overall	1st	2nd	3rd	4th	5th	Top 5%
Euro Area	11.1	2.3	7.3	8.5	10.3	26.9	46.9	0.121	0.159	0.091	0.091	0.100	0.151	0.229
Austria	9.4	1.0	1.8	3.4	5.9	34.7	67.5	0.313	0.004	0.305	0.093	0.098	0.351	0.498
Belgium	6.6	0.4	3.2	4.7	7.5	17.1	27.8	0.090	0.102	0.042	0.050	0.105	0.124	0.254
Cyprus	19.5	4.1	6.3	17.4	20.5	49.5	77.7	0.154	0.046	0.103	0.101	0.141	0.215	0.419
Germany	9.1	1.4	4.9	8.8	7.8	22.7	50.7	0.104	0.318	0.091	0.052	0.100	0.136	0.215
Spain	14.2	5.7	5.9	9.3	16.7	33.7	50.9	0.142	0.115	0.107	0.132	0.108	0.190	0.236
Finland ¹	13.8	3.8	6.3	13.9	18.6	26.6	37.2	0.005	0.282	0.055	0.009	0.004	0.003	0.014
France	8.9	1.0	4.7	6.4	7.2	25.3	42.5	0.182	0.683	0.359	0.127	0.134	0.183	0.212
Greece	9.8	2.5	7.4	7.8	11.0	20.4	22.3	0.232	0.738	0.273	0.160	0.174	0.249	0.258
Italy	18.0	6.7	16.8	12.5	18.1	36.1	52.9	0.067	0.000	0.023	0.101	0.043	0.090	0.112
Luxembourg	5.2	1.0	3.3	1.5	4.7	15.6	32.5	0.095	0.203	0.263	0.253	0.040	0.063	0.087
Malta ²	11.5	–	2.2	4.5	9.3	41.2	73.5	0.213	0.117	0.095	0.114	0.075	0.422	0.587
Netherlands ³	4.8	3.5	–	4.8	6.0	8.5	17.0	0.243	0.326	0.343	0.181	0.588	0.166	0.114
Portugal	7.7	0.2	2.5	4.7	6.6	24.2	35.4	0.186	0.753	0.107	0.247	0.122	0.207	0.301
Slovenia	11.6	1.7	7.0	7.1	9.6	33.5	79.2	0.106	0.208	0.060	0.125	0.032	0.278	0.203
Slovakia	10.7	5.7	5.9	7.9	9.0	25.2	39.8	0.054	0.008	0.019	0.023	0.011	0.155	0.266

Source: HFCS 2013.

¹Finland collects information on business assets only in a summary way; estimates are not comparable.

²No observation in Malta in the first quintile for some implicates.

³No observation in the Netherlands in the second quintile for some implicates.

exception of Cyprus, Finland,¹⁰ Italy, and, to some degree, Spain, where ownership rates start to increase at a lower net wealth quintile than in other countries. The conditional portfolio shares along the net wealth distribution (see table 4) display a very high degree of cross-country heterogeneity.

3.2.2 Financial Assets over the Wealth Distribution

By far the most commonly held assets are safe financial assets. These are held by almost every household, whether rich or poor (see table 5): 93 percent of the households in the euro area in the lowest wealth quintile hold safe financial assets, and this share increases to 99 percent for the highest wealth quintile. The conditional median portfolio share in the euro area is 12 percent. For the poorest 20 percent in the euro area, the portfolio share is, however, much higher at 60 percent. As expected, the picture for risky financial assets is very different (table 6). Overall, only 20 percent of the euro-area households hold such assets, which is an illustration of the “stock market participation puzzle” commonly mentioned in the literature. For each country, this percentage increases with wealth. In the fifth net wealth quintile, it ranges between 8 percent (Slovakia) and 67 percent (Finland). The conditional median portfolio share is low at 5 percent for the euro area.

4. Determinants of Asset Ownership Rates

4.1 Model Specification

We focus on the household main residence, other real assets, and risky financial assets and estimate the ownership and conditional portfolio shares of these assets with a multivariate model. For each of these assets categories, the asset ownership (dummy that equals 1 if the household holds a certain asset category) and the portfolio share is analyzed for the euro area as a whole and each country separately by applying a probit and tobit model, respectively.¹¹ All estimations

¹⁰In Finland, information on business wealth is only collected in a summary way and hence the estimates are not comparable.

¹¹While the former estimator is standard in the participation literature, the latter is used when the data do not include variables that could plausibly influence the participation decision but not the share conditional on participation.

Table 5. Share of Households Owning Safe Financial Assets and Conditional Median Shares

	Participation Rates over Net Wealth Distribution (Percentages)							Conditional Median Share over Net Wealth Distribution (Share)						
	Quintiles							Quintiles						
	Overall	1st	2nd	3rd	4th	5th	Top 5%	Overall	1st	2nd	3rd	4th	5th	Top 5%
Euro Area	96.7	92.8	96.5	96.3	98.4	99.4	99.7	0.115	0.603	0.371	0.068	0.059	0.062	0.045
Austria	99.4	98.6	99.8	99.5	99.9	98.9	99.4	0.209	0.900	0.557	0.187	0.088	0.077	0.031
Belgium	97.9	92.8	99.5	99.0	98.5	99.5	99.3	0.133	0.727	0.117	0.081	0.132	0.103	0.052
Cyprus	85.9	70.1	85.5	87.2	90.9	96.0	97.9	0.056	0.192	0.070	0.049	0.047	0.034	0.025
Germany	99.1	96.8	98.9	99.8	100.0	100.0	100.0	0.278	0.928	0.594	0.313	0.151	0.120	0.070
Spain	98.2	96.7	98.0	97.1	99.5	99.7	99.9	0.032	0.139	0.019	0.021	0.032	0.039	0.042
Finland	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.082	0.992	0.207	0.047	0.050	0.049	0.045
France	99.6	98.4	99.8	99.8	100.0	100.0	100.0	0.130	0.452	0.506	0.060	0.064	0.079	0.085
Greece	73.9	61.5	64.4	74.9	82.2	86.4	92.6	0.048	0.424	0.048	0.034	0.032	0.037	0.032
Italy	91.9	77.8	90.2	94.7	97.7	99.2	99.5	0.051	0.351	0.101	0.040	0.034	0.030	0.018
Luxembourg	98.4	94.8	98.6	99.9	100.0	98.5	98.7	0.071	0.403	0.083	0.047	0.055	0.046	0.020
Malta	96.9	90.6	96.9	97.2	100.0	99.6	100.0	0.096	0.675	0.083	0.070	0.080	0.050	0.034
Netherlands	97.3	92.9	98.8	97.7	97.9	99.1	99.5	0.263	0.483	0.624	0.290	0.161	0.187	0.163
Portugal	94.3	86.1	94.2	95.0	97.4	98.8	100.0	0.072	0.557	0.057	0.042	0.040	0.066	0.058
Slovenia	93.6	85.4	91.2	95.5	98.5	97.7	97.0	0.012	0.105	0.010	0.009	0.007	0.021	0.021
Slovakia	91.5	83.8	88.8	95.4	91.8	97.5	97.4	0.042	0.133	0.037	0.036	0.032	0.039	0.025
Source: HFCS 2013.														

take appropriate household weights as well as the imputation structure into account. In particular, both the probit and the tobit models make use of the final household weights, and the resulting average marginal effects are population estimates. The standard errors are based on 100 replicate weights. Trying to find systematic relationships between socioeconomic characteristics and households' asset composition or investment behavior, there are plenty of traits that could be potentially relevant. In line with the household finance literature, the following determinants commonly used are considered¹²: household composition (household type, gender and marital status of the reference person), age, education, inheritance received, labor market situation (employment status), and resources (net wealth and income distribution quintiles).

Net wealth is an endogenous explanatory variable by construction since each asset component is part of the net wealth definition. However, as demonstrated in the descriptive analysis above, the position in the net wealth distribution is a (very) important factor for the explanation of the portfolio composition, and hence we need to control for the household's position in the distribution of net wealth when investigating the conditional correlations. Addressing this endogeneity, either the indicator for the position of a household in the net wealth distribution can be dropped or, as is sometimes done in the literature, the specific type of asset that is modeled can be excluded and the remaining "aggregate wealth" distribution can be used. The latter approach has the weakness that the household's position in the distribution of the remaining wealth ceases to be a good indicator for its position in the overall net wealth distribution. This problem is particularly pronounced if major wealth components are excluded. Furthermore, one does not condition on the same indicator of the wealth distribution in the different models (i.e., each model for the separated asset types) that are estimated below. Thus, we take the model including the net wealth quintiles and examine systematic correlations between wealth and asset behavior of households, without attributing a causal role to wealth. In appendices 3 and 5, we additionally provide results of the model where the indicator for the household position in the net wealth distribution (and the

¹²See detailed definitions in appendix 6.

indicator for the marital status of the household reference person) is excluded from the explanatory variables. The fundamental results remain unchanged, but this exclusion has an impact on some variables. In particular, variables other than the wealth quintiles gain significance, typically because they act as proxies for the excluded wealth component.

The results presented in the tables refer to average marginal effects derived from the probit models introduced above. Thus, the estimates can be interpreted in terms of a conditional increase in the likelihood of holding a certain asset type in a given country relative to the baseline. For example, we investigate whether conditional on all other factors there are relatively more single parents that own the household main residence compared with the baseline, which in this case is a household with a single occupant. Due to space constraints, we discuss only the results of the specifications¹³ concerning the extensive margin for the household main residence and risky financial assets. Results for other specifications are provided in the tables in appendices 2 and 4 and are discussed only very briefly in the text. All tables contain the estimation results for each individual country as well as the euro area as a whole. The euro-area results are provided as a point of reference.

In what follows, we report stylized facts, i.e., results for variables that exhibit both a fairly systematic cross-country relationship and a significant relationship with respect to the particular asset analyzed. Our informal rule for classifying an observed relationship as a stylized fact is that the empirical result should be statistically significant in the estimation for the euro area as a whole. To make sure that the “stylized fact” is not driven by only a few (large) countries, we require additionally that (i) an analogous (and statistically significant) coefficient estimate is observed in at least eight euro-area countries under consideration (the so-called 50 percent rule), and (ii) there is maximal one country with an opposite significant coefficient estimate (the so-called exception to the rule).

¹³The specification referred to in the main text includes an indicator for the position of the household in the net wealth distribution. Results for an alternative specification of the model excluding net wealth and marital status are provided in appendices 3 and 5.

4.2 Stylized Facts

Fact 1: The probability of ownership of the household main residence, other real estate, risky asset assets, and business ownership is positively related to net wealth and for risky assets that probability is positively related to income as well. The portfolio shares of other real estate, risky assets, and business ownership are increasing in net wealth, whereas that of the household main residence is hump shaped, first increasing in wealth and thereafter decreasing.

The difference in the probability of owning an asset between the first and the fifth quintile of the net wealth distribution (the wealthiest versus the poorest) is substantial in each country and in every type of asset considered (see tables 7 and 8; also see tables 16 and 17 in appendix 2). This implies that wealthier households have more portfolio breadth in all euro-area countries, consistent with Carroll's (2002) report for the United States. Even after controlling for the position in the net wealth distribution, households with higher incomes are more likely to hold risky financial assets. Especially for the highest income quintile, the estimated average marginal effects are positive and statistically significant (exceptions are Greece, Malta, Slovenia, and Slovakia) (table 8). This is consistent with intertemporal portfolio models with fixed costs; higher income and higher wealth are associated with more demand for risky assets and, for given entry or participation costs, a higher probability to overcome the threshold and decide that it is worthwhile to enter the asset market or remain in it.

One observes some differences in the magnitude of the marginal effects of the net wealth and income variables across countries. Such heterogeneities are likely to be due to differences in transaction and information costs and may be driven by institutional specificities (such as the functioning of mortgage markets, housing market conditions, or social security systems). This issue is investigated in section 5. Whereas households higher up the net wealth distribution tend to have a larger portfolio share of other real estate, risky assets, and business ownership, the portfolio share of the household main residence is a striking exception to this rule. Initially increasing with wealth, it ultimately decreases (table 9). The particular

Table 7. Average Marginal Effects from a Probit Model of Participation in the HMR

	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
Household Type (Base: Single)																
Couple w/o Children	0.042*** (0.013)	0.036 (0.031)	0.016 (0.031)	-0.124* (0.069)	0.024 (0.034)	0.035* (0.021)	-0.020 (0.013)	0.021 (0.016)	0.097*** (0.032)	0.005 (0.016)	0.007 (0.042)	-0.042 (0.040)	-0.003 (0.053)	0.037 (0.031)	0.202*** (0.077)	0.048*** (0.023)
>= 3 Adults w/o Children	0.049*** (0.018)	0.050 (0.044)	-0.019 (0.046)	-0.086 (0.086)	0.085** (0.043)	-0.011 (0.027)	-0.007 (0.036)	0.055** (0.025)	0.115*** (0.040)	0.010 (0.024)	-0.095 (0.061)	-0.076 (0.059)	-0.041 (0.116)	0.061 (0.040)	0.186* (0.096)	0.055* (0.032)
Single Parent	0.024 (0.022)	-0.014 (0.046)	0.025 (0.039)	0.016 (0.078)	0.011 (0.068)	0.008 (0.033)	-0.007 (0.021)	-0.005 (0.023)	0.054 (0.043)	0.026 (0.025)	-0.078 (0.063)	-0.027 (0.063)	0.030 (0.077)	0.065** (0.031)	0.112 (0.078)	0.014 (0.026)
Couple with Children	0.065*** (0.013)	0.076** (0.034)	0.048 (0.034)	-0.022 (0.072)	0.044 (0.037)	0.045* (0.023)	0.012 (0.016)	0.066*** (0.018)	0.101*** (0.033)	0.002 (0.018)	0.003 (0.045)	-0.029 (0.052)	0.172** (0.070)	0.076** (0.033)	0.194** (0.094)	0.065** (0.026)
>= 3 Adults with Children	0.060*** (0.020)	0.111* (0.057)	0.046 (0.071)	-0.113 (0.099)	0.088 (0.068)	0.013 (0.031)	-0.022 (0.048)	0.038 (0.028)	0.124*** (0.045)	0.022 (0.027)	0.042 (0.069)	-0.007 (0.060)	0.135 (0.185)	0.058 (0.045)	0.164* (0.087)	0.057* (0.034)
Gender (Reference Person) (Base: Female)																
Male	-0.000 (0.008)	-0.016 (0.027)	-0.011 (0.019)	-0.102** (0.042)	0.002 (0.023)	0.003 (0.014)	0.001 (0.009)	0.007 (0.011)	0.001 (0.017)	-0.004 (0.013)	-0.075*** (0.034)	-0.000 (0.033)	-0.012 (0.035)	-0.007 (0.015)	0.022 (0.019)	-0.000 (0.011)
Age (Reference Person) (Base: Below 40 Years)																
40-64 Years	0.027*** (0.008)	-0.007 (0.021)	0.007 (0.024)	0.012 (0.054)	0.070*** (0.024)	0.004 (0.017)	0.025** (0.12)	0.033** (0.013)	0.073*** (0.023)	-0.017 (0.013)	-0.027 (0.026)	-0.051* (0.030)	-0.112*** (0.041)	0.060** (0.028)	-0.026 (0.024)	0.035*** (0.014)
65 Years and Over	0.024 (0.015)	0.009 (0.034)	-0.066 (0.050)	0.106 (0.094)	0.054 (0.050)	0.009 (0.026)	-0.014 (0.022)	0.020 (0.028)	0.085** (0.042)	-0.005 (0.020)	0.011 (0.052)	-0.075 (0.047)	-0.091 (0.063)	0.079** (0.035)	-0.075 (0.052)	0.031 (0.033)

(continued)

Table 7. (Continued)

	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Marital Status (Reference Person) (Base: Unmarried)</i>																
Married	0.039*** (0.011)	0.030 (0.032)	0.053* (0.030)	0.041 (0.092)	0.108*** (0.038)	0.005 (0.021)	0.035*** (0.013)	0.021 (0.013)	-0.011 (0.029)	0.007 (0.017)	0.007 (0.040)	0.085* (0.052)	0.104* (0.098)	0.020 (0.027)	-0.023 (0.040)	0.001 (0.016)
Divorced	0.003 (0.013)	-0.013 (0.033)	-0.054 (0.036)	-0.105 (0.110)	0.064 (0.039)	-0.023 (0.025)	0.007 (0.014)	-0.006 (0.015)	-0.012 (0.033)	-0.019 (0.022)	-0.054 (0.046)	0.046 (0.052)	0.021 (0.000)	0.002 (0.026)	0.044 (0.030)	-0.008 (0.019)
Widowed	0.007*** (0.013)	-0.018 (0.043)	0.038* (0.032)	-0.148 (0.094)	0.139*** (0.039)	0.012 (0.026)	0.025 (0.017)	0.004 (0.019)	0.045 (0.031)	0.030 (0.019)	-0.019 (0.007)	-0.044 (0.066)	0.009 (0.002)	0.037 (0.025)	0.107*** (0.034)	0.022 (0.023)
<i>Labor Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	-0.072*** (0.014)	-0.015 (0.035)	-0.064 (0.049)	-0.066 (0.058)	-0.017 (0.035)	-0.115*** (0.029)	0.088*** (0.021)	-0.071*** (0.021)	-0.055*** (0.023)	-0.097*** (0.015)	-0.116** (0.056)	-0.079 (0.052)	-0.117 (0.099)	-0.069*** (0.025)	-0.071 (0.067)	-0.005 (0.023)
Unemployed	-0.015 (0.013)	-0.109 (0.067)	-0.008 (0.038)	-0.044 (0.076)	-0.005 (0.047)	-0.013 (0.019)	-0.034** (0.017)	-0.053*** (0.023)	0.027 (0.045)	0.029 (0.028)	-0.009 (0.078)	-0.024 (0.053)	-0.148 (0.120)	-0.053 (0.033)	0.032 (0.042)	-0.109** (0.054)
Retired	0.014 (0.012)	0.012 (0.032)	0.062 (0.041)	-0.030 (0.072)	0.006 (0.043)	0.023 (0.022)	0.057** (0.023)	0.017 (0.021)	0.033 (0.027)	0.010 (0.014)	-0.035 (0.044)	-0.051 (0.041)	-0.105* (0.057)	-0.046** (0.022)	0.126*** (0.040)	0.043* (0.025)
Other	-0.050*** (0.016)	-0.026 (0.060)	0.006 (0.045)	-0.066 (0.093)	-0.056 (0.057)	-0.008 (0.023)	-0.075*** (0.017)	-0.029 (0.022)	-0.029 (0.037)	-0.011 (0.037)	0.094** (0.038)	0.045 (0.044)	-0.127** (0.058)	-0.054 (0.039)	0.044 (0.034)	0.032 (0.022)
Missing	0.015 (0.042)		-0.039 (0.119)	-0.133 (0.153)									-0.089 (0.055)	-0.059 (0.106)		Note 4
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	-0.006 (0.008)	-0.025 (0.024)	-0.016 (0.023)	-0.021 (0.041)	0.019 (0.029)	-0.039*** (0.014)	0.018* (0.011)	0.009 (0.011)	-0.028 (0.020)	-0.017 (0.012)	0.011 (0.027)	0.014 (0.030)	0.001 (0.032)	-0.045** (0.022)	-0.025 (0.064)	-0.024 (0.024)
High (ISCED 4-6)	-0.023** (0.010)	-0.108*** (0.034)	-0.009 (0.024)	-0.030 (0.047)	-0.030 (0.031)	-0.058*** (0.017)	0.024* (0.014)	0.006 (0.013)	-0.089*** (0.026)	-0.016 (0.018)	-0.074* (0.038)	-0.033 (0.041)	0.053 (0.037)	-0.068*** (0.025)	-0.067 (0.055)	-0.031 (0.029)

(continued)

Table 7. (Continued)

	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Inheritance</i>																
Dummy	0.048*** (0.009)	0.033 (0.023)	0.000 (0.017)	0.064* (0.034)	0.080*** (0.024)	0.024 (0.016)	Note 2	-0.019* (0.010)	0.198*** (0.027)	Note 3	0.044* (0.026)	0.055* (0.028)	0.075 (0.063)	0.075*** (0.016)	0.098*** (0.025)	0.076*** (0.014)
<i>Net Wealth Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.256*** (0.010)	0.011 (0.036)	0.573*** (0.036)	0.589*** (0.070)	0.010 (0.024)	0.614*** (0.032)	0.129*** (0.020)	0.134*** (0.015)	0.526*** (0.040)	0.492*** (0.022)	0.435*** (0.058)	0.688*** (0.055)	-0.001 (0.060)	0.482*** (0.030)	0.020*** (0.039)	0.392*** (0.038)
3rd Quintile	0.609*** (0.012)	0.466*** (0.065)	0.910*** (0.021)	0.693*** (0.064)	0.345*** (0.038)	0.670*** (0.032)	0.581*** (0.017)	0.755*** (0.016)	0.733*** (0.041)	0.906*** (0.011)	0.870*** (0.047)	0.823*** (0.043)	0.259*** (0.068)	0.746*** (0.027)	0.732*** (0.040)	0.409*** (0.039)
4th Quintile	0.772*** (0.010)	0.828*** (0.055)	0.913*** (0.028)	0.658*** (0.075)	0.667*** (0.036)	0.678*** (0.032)	0.618*** (0.016)	0.890*** (0.012)	0.768*** (0.041)	0.963*** (0.007)	0.806*** (0.039)	0.848*** (0.055)	0.562*** (0.058)	0.815*** (0.021)	0.747*** (0.033)	0.396*** (0.039)
5th Quintile	0.823*** (0.010)	0.879*** (0.046)	0.901*** (0.030)	0.697*** (0.077)	0.809*** (0.042)	0.691*** (0.033)	0.626*** (0.017)	0.926*** (0.012)	0.772*** (0.043)	0.974*** (0.006)	0.899*** (0.036)	0.823*** (0.055)	0.627*** (0.052)	0.835*** (0.022)	0.743*** (0.033)	0.408*** (0.038)
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	-0.012 (0.012)	-0.024 (0.032)	-0.020 (0.032)	0.062 (0.061)	0.056 (0.043)	-0.021 (0.021)	0.051*** (0.015)	-0.023* (0.012)	-0.028 (0.019)	-0.037*** (0.014)	0.059 (0.054)	-0.009 (0.036)	-0.001 (0.061)	-0.044*** (0.019)	-0.090*** (0.032)	-0.023 (0.015)
3rd Quintile	-0.020 (0.014)	-0.048 (0.035)	-0.009 (0.027)	0.025 (0.066)	0.015 (0.045)	-0.010 (0.020)	0.088*** (0.018)	-0.029 (0.018)	-0.046*** (0.022)	-0.068*** (0.013)	0.087* (0.048)	-0.023 (0.041)	0.026 (0.068)	-0.047*** (0.022)	-0.090*** (0.033)	-0.022 (0.019)
4th Quintile	-0.013 (0.014)	-0.100*** (0.037)	-0.001 (0.029)	0.080 (0.065)	0.014 (0.042)	-0.005 (0.020)	0.143*** (0.024)	-0.009 (0.017)	-0.053 (0.035)	-0.077*** (0.016)	0.126*** (0.055)	-0.031 (0.048)	0.068 (0.068)	-0.067*** (0.031)	-0.012 (0.036)	-0.024 (0.022)
5th Quintile	-0.041*** (0.016)	-0.110*** (0.035)	-0.001 (0.032)	0.107 (0.077)	-0.001 (0.048)	-0.032 (0.025)	0.166*** (0.028)	-0.068*** (0.019)	-0.062* (0.033)	-0.132*** (0.020)	0.060 (0.060)	-0.059 (0.059)	0.065 (0.062)	-0.086*** (0.031)	-0.041 (0.038)	-0.047 (0.029)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³Italy does not collect information on inheritance.

⁴Slovakia has missing observations, but the dummy is dropped due to perfect prediction.

Table 8. Average Marginal Effects from a Probit Model of Participation in Risky Financial Assets

	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children	-0.005*** (0.003)	-0.045* (0.027)	-0.064* (0.035)	-0.137 (0.131)	-0.071** (0.034)	-0.029 (0.032)	0.005 (0.017)	-0.084*** (0.016)	-0.002 (0.022)	-0.087*** (0.027)	-0.096 (0.046)	-0.099 (0.073)	-0.068 (0.093)	-0.088** (0.035)	0.054 (0.068)	-0.000 (0.020)
>= 3 Adults	-0.009*** (0.003)	-0.080** (0.032)	-0.084** (0.035)	-0.164** (0.158)	-0.077** (0.040)	-0.069** (0.034)	-0.034** (0.020)	-0.144*** (0.024)	-0.001 (0.024)	-0.150*** (0.030)	-0.060 (0.069)	0.004 (0.092)	-0.218*** (0.075)	-0.121*** (0.041)	0.072 (0.038)	0.000 (0.038)
Couple w/o Children Single Parent	-0.014 (0.015)	-0.018 (0.032)	-0.019 (0.052)	0.138 (0.138)	0.083 (0.083)	0.034 (0.034)	-0.11 (0.030)	-0.071*** (0.027)	-0.040** (0.016)	-0.065 (0.058)	-0.061 (0.081)	-0.035 (0.172)	-0.172 (0.139)	-0.041 (0.045)	-0.046 (0.086)	0.007 (0.032)
Couple with Children	-0.086*** (0.028)	-0.058 (0.058)	-0.062 (0.062)	0.121 (0.121)	-0.077** (0.039)	-0.049 (0.040)	-0.030 (0.020)	-0.064*** (0.020)	-0.012 (0.028)	-0.132*** (0.031)	-0.127 (0.066)	-0.132* (0.086)	-0.148** (0.085)	-0.101** (0.041)	0.076 (0.077)	0.005 (0.022)
> 3 Adults	-0.106*** (0.015)	-0.034 (0.034)	-0.064 (0.040)	-0.086 (0.123)	-0.077** (0.039)	-0.049 (0.040)	-0.030 (0.020)	-0.064*** (0.020)	-0.012 (0.028)	-0.132*** (0.031)	-0.127 (0.066)	-0.132* (0.086)	-0.148** (0.085)	-0.101** (0.041)	0.076 (0.077)	0.005 (0.022)
Couple with Children > 3 Adults	-0.101*** (0.019)	-0.101*** (0.037)	-0.104* (0.062)	-0.070 (0.173)	-0.150*** (0.045)	0.004 (0.054)	-0.067** (0.032)	-0.133*** (0.024)	-0.002 (0.033)	-0.158*** (0.031)	-0.196** (0.080)	0.025 (0.105)	-0.092 (0.103)	-0.122** (0.041)	0.11 (0.088)	-0.001 (0.032)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	0.015* (0.008)	0.029* (0.016)	0.007 (0.024)	0.065 (0.051)	-0.006 (0.024)	0.016 (0.019)	0.002 (0.012)	0.029** (0.012)	-0.002 (0.016)	0.022 (0.014)	0.022 (0.038)	-0.099* (0.051)	-0.003 (0.033)	0.023 (0.015)	0.036 (0.036)	0.008 (0.013)
<i>Age (Reference Person) (Base: Below 10 Years)</i>																
40-64 Years	-0.016 (0.012)	-0.019 (0.025)	-0.017 (0.037)	0.230*** (0.047)	-0.059** (0.030)	0.036 (0.022)	-0.041*** (0.016)	-0.014 (0.014)	0.010 (0.013)	0.084*** (0.015)	0.004 (0.039)	-0.002 (0.056)	-0.000 (0.046)	-0.014 (0.023)	0.123*** (0.035)	0.002 (0.013)
65 Years and Over	-0.009 (0.016)	-0.049 (0.053)	0.057 (0.060)	0.155 (0.160)	-0.029 (0.050)	0.099** (0.044)	0.002 (0.029)	-0.026 (0.023)	0.043 (0.032)	0.047* (0.026)	0.066 (0.085)	0.022 (0.082)	0.103 (0.065)	-0.016 (0.025)	0.149*** (0.054)	0.007 (0.030)

(continued)

Table 8. (Continued)

	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Marital Status (Reference Person) (Base: Unmarried)</i>																
Married	-0.024** (0.012)	-0.038 (0.026)	0.024 (0.036)	-0.019 (0.143)	-0.041 (0.038)	-0.048 (0.032)	-0.079*** (0.015)	-0.006 (0.017)	-0.000 (0.023)	-0.023 (0.024)	0.056 (0.058)	0.108 (0.075)	0.021 (0.059)	0.071*** (0.020)	-0.241*** (0.072)	-0.011 (0.021)
Divorced	-0.040*** (0.015)	-0.037 (0.027)	0.033 (0.050)	-0.107 (0.105)	-0.070* (0.039)	-0.084** (0.036)	-0.048** (0.020)	-0.007 (0.021)	0.043 (0.045)	-0.044* (0.026)	0.070 (0.056)	0.034 (0.077)	0.071 (0.067)	0.022 (0.024)	-0.297*** (0.081)	0.004 (0.020)
Widowed	-0.042*** (0.016)	-0.065* (0.035)	-0.046 (0.047)	-0.140 (0.100)	-0.039 (0.046)	-0.061* (0.037)	-0.063** (0.025)	-0.005 (0.025)	-0.022 (0.025)	-0.002 (0.027)	0.018 (0.081)	0.170** (0.084)	-0.039 (0.063)	-0.005 (0.018)	-0.284*** (0.082)	0.037 (0.037)
<i>Labour Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	-0.036*** (0.009)	0.009 (0.027)	-0.069 (0.049)	-0.070 (0.062)	-0.067*** (0.026)	-0.032 (0.026)	0.039** (0.017)	-0.043*** (0.016)	-0.016 (0.018)	-0.001 (0.016)	0.026 (0.051)	-0.057 (0.056)	0.004 (0.084)	-0.008 (0.019)	-0.038 (0.080)	0.007 (0.021)
Unemployed	-0.029 (0.020)	0.040 (0.062)	0.001 (0.068)	-0.026 (0.102)	0.004 (0.066)	-0.032 (0.027)	-0.078*** (0.025)	-0.077*** (0.026)	Notes 3	0.032 (0.050)	0.099 (0.084)	0.068 (0.127)	-0.111 (0.111)	0.002 (0.032)	-0.043 (0.045)	-0.028 (0.068)
Retired	0.006 (0.010)	0.038 (0.029)	0.017 (0.047)	0.072 (0.153)	-0.030 (0.035)	-0.007 (0.033)	0.023 (0.025)	-0.041** (0.019)	-0.028 (0.021)	0.083*** (0.017)	-0.033 (0.063)	0.014 (0.070)	-0.104** (0.051)	0.008 (0.020)	-0.026 (0.050)	-0.030 (0.023)
Other	0.036 (0.023)	0.044 (0.065)	-0.040 (0.085)	-0.141 (0.165)	0.061 (0.052)	-0.036 (0.042)	0.008 (0.024)	-0.055 (0.035)	Notes 3	0.077 (0.079)	0.055 (0.125)	-0.081 (0.088)	0.039 (0.066)	-0.037 (0.030)	-0.188*** (0.045)	0.001 (0.061)
Missing	-0.009 (0.041)		-0.087 (0.150)	0.302 (0.296)									0.019 (0.059)	Notes 5		Notes 5
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.037*** (0.007)	0.081*** (0.023)	0.093*** (0.029)	0.007 (0.058)	0.069* (0.036)	0.072*** (0.019)	0.050*** (0.014)	0.025** (0.012)	0.021 (0.013)	0.024*** (0.012)	0.111*** (0.029)	-0.007 (0.045)	0.059 (0.044)	0.052*** (0.016)	0.110** (0.044)	-0.006 (0.056)
High (ISCED 4-6)	0.095*** (0.011)	0.138*** (0.036)	0.139*** (0.034)	0.043 (0.065)	0.169*** (0.043)	0.133*** (0.019)	0.127*** (0.016)	0.060*** (0.015)	0.033** (0.013)	0.013 (0.018)	0.242*** (0.045)	0.028 (0.053)	0.077* (0.043)	0.104*** (0.019)	0.305*** (0.061)	0.038 (0.058)

(continued)

Table 8. (Continued)

	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Inheritance</i>																
Dummy	0.029*** (0.009)	0.023 (0.017)	0.054** (0.022)	0.069 (0.042)	0.002 (0.019)	0.031* (0.016)	Note 2	0.059*** (0.009)	-0.019 (0.011)	Note 4	0.037 (0.032)	0.142*** (0.039)	0.118*** (0.046)	0.037*** (0.012)	0.008 (0.034)	-0.006 (0.013)
<i>Net Wealth Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.063*** (0.008)	0.016 (0.019)	0.103*** (0.039)	0.022 (0.065)	0.051** (0.020)	0.054*** (0.018)	0.138*** (0.019)	0.063*** (0.015)	0.012 (0.008)	0.113*** (0.016)	0.067 (0.058)	0.046 (0.052)	0.050 (0.054)	0.004 (0.022)	0.030 (0.049)	0.007 (0.014)
3rd Quintile	0.145*** (0.012)	0.108*** (0.028)	0.167*** (0.035)	0.046 (0.070)	0.185*** (0.038)	0.102*** (0.022)	0.202*** (0.018)	0.123*** (0.015)	0.020 (0.012)	0.132*** (0.015)	0.124** (0.059)	0.146** (0.060)	0.174*** (0.049)	0.041* (0.024)	0.020 (0.056)	0.029 (0.026)
4th Quintile	0.193*** (0.027)	0.135*** (0.039)	0.265*** (0.077)	0.071 (0.039)	0.203*** (0.032)	0.168*** (0.024)	0.269*** (0.016)	0.179*** (0.017)	0.043*** (0.015)	0.218*** (0.018)	0.145** (0.060)	0.221*** (0.066)	0.231*** (0.053)	0.069*** (0.023)	0.135** (0.065)	0.045 (0.028)
5th Quintile	0.311*** (0.013)	0.243*** (0.034)	0.489*** (0.045)	0.199** (0.087)	0.343*** (0.041)	0.293*** (0.032)	0.426*** (0.020)	0.282*** (0.021)	0.118*** (0.028)	0.283*** (0.019)	0.240*** (0.075)	0.395*** (0.077)	0.358*** (0.051)	0.144*** (0.025)	0.187*** (0.057)	0.070** (0.033)
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.037*** (0.010)	0.019 (0.028)	0.106*** (0.036)	0.101 (0.071)	0.011 (0.033)	0.035 (0.025)	0.060*** (0.022)	0.058*** (0.014)	-0.015 (0.024)	0.073*** (0.010)	0.069 (0.050)	0.073 (0.058)	0.031 (0.057)	-0.006 (0.021)	0.024 (0.057)	-0.002 (0.029)
3rd Quintile	0.089*** (0.014)	0.055* (0.030)	0.167*** (0.042)	0.123 (0.081)	0.098** (0.043)	-0.005 (0.028)	0.117*** (0.023)	0.117*** (0.015)	-0.014 (0.027)	0.149*** (0.015)	0.159*** (0.054)	0.086 (0.061)	0.039 (0.050)	0.018 (0.024)	0.089 (0.058)	-0.000 (0.025)
4th Quintile	0.126*** (0.013)	0.111*** (0.036)	0.156*** (0.035)	0.178** (0.073)	0.107*** (0.039)	0.021 (0.029)	0.168*** (0.026)	0.178*** (0.017)	0.006 (0.025)	0.236*** (0.021)	0.231*** (0.056)	0.129* (0.071)	0.092 (0.057)	0.036 (0.023)	-0.015 (0.061)	-0.033 (0.025)
5th Quintile	0.211*** (0.016)	0.125*** (0.035)	0.155*** (0.039)	0.313*** (0.087)	0.202*** (0.052)	0.101** (0.032)	0.290*** (0.030)	0.296*** (0.023)	0.018 (0.028)	0.345*** (0.026)	0.392*** (0.068)	0.132 (0.082)	0.123** (0.057)	0.122*** (0.027)	-0.033 (0.056)	-0.026 (0.027)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³In Greece coefficients on the labor market status for “unemployed” and “other” cannot be estimated due to perfect prediction.

⁴Italy does not collect information on inheritance.

⁵Slovakia has missing observations, but the dummy is dropped due to perfect prediction.

Table 9. Tobit Model for the Portfolio Share of the Households' Main Residence

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children	0.097*** (0.020)	0.022 (0.043)	0.035 (0.042)	-0.198 (0.121)	0.085 (0.064)	0.034 (0.029)	-0.030 (0.021)	0.056* (0.030)	0.132*** (0.047)	0.021 (0.023)	0.047 (0.063)	-0.009 (0.067)	-0.004 (0.060)	0.002 (0.042)	0.105 (0.092)	0.123*** (0.034)
>= 3 Adults	0.064*** (0.024)	0.014 (0.064)	-0.015 (0.054)	-0.190 (0.138)	0.111 (0.073)	-0.008 (0.034)	-0.071** (0.031)	0.124*** (0.040)	0.120*** (0.055)	0.034 (0.031)	0.005 (0.078)	-0.066 (0.085)	-0.064 (0.157)	0.031 (0.051)	0.146 (0.102)	0.120** (0.047)
Single Parent	0.048 (0.037)	0.008 (0.089)	0.084 (0.074)	0.113 (0.136)	0.016 (0.145)	0.022 (0.044)	-0.016 (0.037)	0.011 (0.044)	0.054 (0.071)	0.094** (0.047)	-0.024 (0.083)	-0.016 (0.138)	0.047 (0.152)	0.094* (0.048)	0.211** (0.096)	0.054 (0.046)
Couple with Children	0.147*** (0.021)	0.120** (0.058)	0.085* (0.048)	-0.066 (0.131)	0.125 (0.067)	0.064* (0.034)	0.070*** (0.022)	0.159*** (0.033)	0.167*** (0.052)	0.039 (0.026)	0.069 (0.070)	-0.017 (0.077)	0.189* (0.099)	0.085* (0.049)	0.122 (0.095)	0.135*** (0.041)
>= 3 Adults with Children	0.115*** (0.027)	0.107 (0.075)	0.075 (0.068)	-0.169 (0.139)	0.205** (0.098)	-0.020 (0.043)	-0.011 (0.043)	0.111** (0.050)	0.140*** (0.063)	0.080** (0.037)	0.154 (0.103)	0.065 (0.081)	0.242* (0.144)	0.075 (0.060)	0.101 (0.086)	0.093* (0.047)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	0.004 (0.012)	-0.022 (0.048)	-0.020 (0.024)	-0.085* (0.046)	-0.006 (0.041)	0.030 (0.019)	-0.009 (0.013)	0.016 (0.018)	-0.019 (0.025)	-0.009 (0.015)	-0.102** (0.046)	0.030 (0.041)	0.002 (0.061)	-0.009 (0.022)	0.028 (0.041)	0.008 (0.018)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	0.043*** (0.013)	-0.016 (0.040)	-0.002 (0.038)	-0.054 (0.053)	0.151*** (0.048)	0.002 (0.025)	-0.010 (0.020)	0.048** (0.023)	0.114*** (0.029)	-0.041 (0.026)	-0.051 (0.046)	-0.027 (0.040)	-0.221*** (0.075)	0.060 (0.039)	-0.027 (0.054)	0.073*** (0.023)
65 Years and Over	0.009*** (0.021)	0.020 (0.053)	-0.037 (0.053)	0.096 (0.136)	0.138* (0.077)	0.032 (0.033)	-0.017 (0.026)	0.020 (0.042)	0.139*** (0.042)	-0.003 (0.032)	-0.039 (0.064)	-0.023 (0.063)	-0.156 (0.106)	0.081* (0.048)	-0.012 (0.076)	0.111*** (0.042)

(continued)

Table 9. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Marital Status (Reference Person) (Base: Unmarried)</i>																
Married	0.075*** (0.017)	0.064 (0.054)	0.095** (0.046)	0.110 (0.132)	0.254*** (0.072)	0.004 (0.034)	0.064*** (0.017)	0.043* (0.025)	-0.023 (0.023)	-0.005 (0.026)	-0.002 (0.062)	0.066 (0.065)	0.161** (0.078)	0.041 (0.040)	0.032 (0.081)	-0.010 (0.035)
Divorced	0.057*** (0.023)	-0.023 (0.069)	-0.034 (0.049)	-0.084 (0.122)	0.196** (0.081)	-0.007 (0.005)	0.047** (0.021)	0.041 (0.029)	0.014 (0.059)	-0.013 (0.035)	-0.099 (0.072)	0.019 (0.077)	0.007 (0.105)	0.019 (0.039)	0.150* (0.087)	0.021 (0.031)
Widowed	0.171*** (0.022)	-0.027 (0.074)	0.103** (0.052)	0.002 (0.104)	0.322*** (0.082)	0.082* (0.035)	0.122*** (0.021)	0.027 (0.032)	0.105*** (0.051)	0.055** (0.027)	0.031 (0.075)	-0.135* (0.074)	0.123 (0.104)	0.069* (0.039)	0.154* (0.084)	0.136*** (0.044)
<i>Labor Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	-0.202*** (0.018)	-0.156** (0.064)	-0.115*** (0.042)	-0.083 (0.062)	-0.110* (0.058)	-0.246*** (0.025)	0.009 (0.025)	-0.229** (0.028)	-0.126*** (0.028)	-0.243*** (0.020)	-0.241*** (0.075)	-0.176*** (0.042)	-0.287*** (0.123)	-0.156*** (0.028)	-0.211 (0.135)	-0.069** (0.028)
Unemployed	0.001 (0.023)	-0.248* (0.137)	-0.030 (0.066)	-0.031 (0.081)	0.009 (0.109)	-0.023 (0.034)	-0.077** (0.031)	-0.092** (0.045)	0.042 (0.093)	0.073 (0.052)	-0.016 (0.477)	-0.073 (0.082)	-0.233 (0.159)	-0.065 (0.045)	0.165*** (0.082)	-0.189 (0.134)
Retired	-0.020 (0.015)	0.008 (0.056)	0.003 (0.040)	-0.023 (0.122)	-0.035 (0.059)	-0.042* (0.025)	0.016 (0.023)	0.007 (0.033)	0.022 (0.033)	-0.012 (0.021)	-0.070 (0.053)	-0.089* (0.048)	-0.151* (0.086)	-0.066** (0.028)	0.212*** (0.055)	0.050 (0.032)
Other	-0.092*** (0.025)	-0.063 (0.124)	0.008 (0.062)	-0.131 (0.139)	-0.189* (0.111)	-0.029 (0.030)	-0.169*** (0.027)	-0.081* (0.045)	-0.040 (0.058)	-0.018 (0.051)	0.103 (0.078)	0.161* (0.087)	-0.188** (0.095)	-0.058 (0.062)	-0.006 (0.139)	0.035 (0.046)
Missing	0.014 (0.070)		-0.026 (0.128)	-0.173 (0.345)									-0.142* (0.074)	-0.228 (0.648)		0.047*** (0.237)
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	-0.023* (0.012)	-0.087** (0.040)	-0.048 (0.032)	-0.047 (0.055)	-0.002 (0.064)	-0.050** (0.023)	0.011 (0.014)	0.005 (0.017)	-0.013 (0.030)	-0.026 (0.016)	-0.012 (0.038)	-0.005 (0.029)	-0.006 (0.051)	-0.063** (0.029)	-0.026 (0.080)	-0.084 (0.032)
High (ISCED 4-6)	-0.043*** (0.014)	-0.232*** (0.060)	-0.033 (0.032)	-0.033 (0.059)	-0.098 (0.064)	-0.049** (0.021)	0.011 (0.017)	0.012 (0.021)	-0.060* (0.035)	-0.033 (0.022)	-0.112** (0.055)	-0.051 (0.038)	0.088* (0.051)	-0.091*** (0.030)	-0.077 (0.072)	-0.169*** (0.057)

(continued)

Table 9. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Inheritance</i>																
Dummy	0.043*** (0.013)	0.040 (0.036)	-0.011 (0.021)	0.004 (0.030)	0.008** (0.043)	-0.072*** (0.017)	Note 2 (0.017)	-0.078*** (0.016)	0.132*** (0.025)	Note 3	0.009 (0.029)	0.004 (0.029)	-0.006 (0.075)	0.015 (0.019)	0.061** (0.030)	0.066*** (0.015)
<i>Net Wealth Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.542*** (0.023)	0.146 (0.316)	0.995*** (0.079)	0.685*** (0.086)	0.078 (0.107)	0.670*** (0.041)	0.224*** (0.030)	0.582*** (0.079)	0.902*** (0.060)	1.020*** (0.051)	0.883*** (0.118)	0.825*** (0.063)	-0.053 (0.108)	0.778*** (0.046)	0.740*** (0.071)	0.372*** (0.030)
3rd Quintile	0.987*** (0.021)	1.143*** (0.309)	1.329*** (0.073)	0.684*** (0.085)	0.795*** (0.097)	0.688*** (0.041)	0.807*** (0.027)	1.441*** (0.068)	1.065*** (0.064)	1.432*** (0.048)	1.352*** (0.107)	0.911*** (0.053)	0.397*** (0.108)	0.993*** (0.044)	0.786*** (0.089)	0.378*** (0.029)
4th Quintile	1.116*** (0.020)	1.521*** (0.296)	1.244*** (0.083)	0.594*** (0.092)	1.169*** (0.085)	0.623*** (0.040)	0.707*** (0.021)	1.518*** (0.072)	1.008*** (0.067)	1.483*** (0.050)	1.342*** (0.107)	0.877*** (0.064)	0.739*** (0.083)	1.006*** (0.048)	0.767*** (0.072)	0.387*** (0.030)
5th Quintile	1.006*** (0.022)	1.428*** (0.294)	1.007*** (0.085)	0.355*** (0.084)	1.148*** (0.098)	0.482*** (0.044)	0.552*** (0.032)	1.379*** (0.078)	0.839*** (0.072)	1.404*** (0.048)	1.132*** (0.111)	0.688*** (0.062)	0.680*** (0.081)	0.844*** (0.049)	0.578*** (0.098)	0.285*** (0.033)
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	-0.045** (0.021)	-0.075 (0.073)	-0.039 (0.047)	0.021 (0.077)	0.116 (0.100)	-0.088*** (0.025)	0.093*** (0.024)	-0.053** (0.026)	-0.089*** (0.030)	-0.106*** (0.028)	0.030 (0.073)	0.003 (0.054)	0.006 (0.102)	-0.084*** (0.031)	-0.122* (0.064)	-0.064* (0.034)
3rd Quintile	-0.067*** (0.022)	-0.129* (0.073)	-0.065 (0.042)	-0.027 (0.077)	0.000 (0.100)	-0.081*** (0.026)	0.127*** (0.027)	-0.070*** (0.034)	-0.170*** (0.035)	-0.183*** (0.024)	0.037 (0.072)	-0.052 (0.061)	0.106 (0.109)	-0.101*** (0.033)	-0.200*** (0.058)	-0.098** (0.039)
4th Quintile	-0.062*** (0.022)	-0.234*** (0.075)	-0.074* (0.041)	0.028 (0.077)	-0.043 (0.095)	-0.090*** (0.028)	0.204*** (0.031)	-0.042 (0.033)	-0.171*** (0.047)	-0.206*** (0.027)	0.046 (0.071)	-0.058 (0.052)	0.162 (0.103)	-0.131*** (0.045)	-0.009 (0.073)	-0.127*** (0.043)
5th Quintile	-0.116*** (0.024)	-0.261*** (0.072)	-0.088** (0.044)	0.022 (0.085)	-0.082 (0.102)	-0.135*** (0.033)	0.173*** (0.034)	-0.157*** (0.037)	-0.174*** (0.044)	-0.280*** (0.028)	-0.025 (0.078)	-0.138** (0.053)	0.139 (0.101)	-0.191*** (0.041)	-0.055 (0.086)	-0.189*** (0.044)
Constant	-0.720*** (0.031)	-0.659*** (0.245)	-0.534*** (0.078)	0.066 (0.132)	-1.044*** (0.114)	0.180*** (0.045)	0.033 (0.033)	-0.871*** (0.066)	-0.399*** (0.053)	-0.043*** (0.054)	-0.466*** (0.088)	-0.136* (0.083)	-0.109 (0.112)	-0.260*** (0.062)	-0.073 (0.106)	-0.431*** (0.061)
Sigma	0.447*** (0.004)	0.450*** (0.029)	0.343*** (0.009)	0.368*** (0.017)	0.485*** (0.013)	0.333*** (0.007)	0.409*** (0.005)	0.408*** (0.009)	0.360*** (0.009)	0.335*** (0.006)	0.363*** (0.014)	0.303*** (0.013)	0.506*** (0.014)	0.414*** (0.011)	0.302*** (0.019)	0.289*** (0.005)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³Italy does not collect information on inheritance.

nature of the household main residence as both an asset and consumption good provides a natural explanation. Whereas there is no natural limit in the value of ownership assets bought for investment or business purposes, the main residence serves a consumption purpose where the law of diminishing marginal utility of the housing services provides a natural limit to the value (and related size) of the main residence. For all countries, we find that households in the fifth quintile of the net wealth distribution do not have a higher portfolio share of the main residence compared with the fourth quintile.

Fact 2: The probability of owning the main residence and other real estate is positively linked to previously having received inheritances. The portfolio share of other real estate is higher for households having received an inheritance in the past.

In the euro area as a whole and in eight countries individually, the inheritance dummy is a positively significant factor in explaining ownership of the household main residence (table 7).¹⁴ This effect is much expected, as clearly some households have inherited their household main residence or have used the proceeds of any bequests and gifts to acquire a dwelling for use as their household main residence. In some countries, the effect can be quite sizable. In Germany, for instance, a country with a low HMR ownership rate (44 percent) overall, having received an inheritance increases households' likelihood to own their main residence by 8 percentage points. In Greece, the average marginal effect is a very large 20 percentage points. Also in nine countries and the euro area as a whole, the inheritance dummy is significant and positively related to other real estate ownership (which includes holiday homes) (table 16). In Spain, a country with a high rate of other real estate ownership (36 percent), probably related to holiday homes, the average marginal effect is largest with 22 percentage points. As family tradition is known to influence bequest behavior (Cox and Stark 2005), these cross-country differences are likely to reflect varying cultural traditions of passing houses down through generations. However, only in four countries

¹⁴France has a small negative coefficient, which is puzzling, as it is the only country with such a negative sign.

does having received an inheritance imply that the portfolio share of the main residence for such a household is higher (table 9). This can be contrasted with the portfolio share in other real estate, which for ten countries is higher for households that received an inheritance (table 22 in appendix 4).

Fact 3: Couples with dependent children both are more likely to own and are more likely to have a higher portfolio share of the household main residence (relative to singles). This coincides with a significantly lower portfolio share of risky assets.

In eight countries and the euro area as a whole, we find that couples with children are significantly more likely to own their household main residence relative to singles (table 7). Similarly, in eight countries and the euro area as a whole, these households hold significantly lower portfolio shares of risky assets (table 10). One possible rationale is that house ownership has large reversibility costs, so it is economically meaningful to wait until family structure is more certain before deciding on homeownership. Singles, especially young ones, are likely to be more uncertain about future family structure. As houses are a major and lumpy investment for households, it is natural that portfolio shares of other assets are necessarily reduced.

Fact 4: The probability of owning and the portfolio share of risky assets is positively related to the educational attainment of the household (head).

Having a higher education increases the likelihood of owning and the portfolio share of risky assets (table 8, table 10). This effect could reflect various underlying factors. It could be linked to a permanent-income effect, if education is positively associated with future income profiles and higher expected wage earnings. It could also be linked to a background risk effect (especially unemployment risk); educated people may face lower unemployment risk, and thus they could be incited to invest in risky financial assets (Guiso, Jappelli, and Terlizzese 1996, Heaton and Lucas 2000). Finally, there is a wide literature on financial literacy which shows that less educated people are less likely to hold stocks (see, for instance, van Rooij, Lusardi, and Alessie 2011).

Table 10. Tobit Model for the Portfolio Share of Risky Financial Assets

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children	-0.080*** (0.014)	-0.093** (0.046)	-0.070*** (0.034)	-0.035 (0.036)	-0.113*** (0.039)	-0.037 (0.023)	-0.021 (0.013)	-0.002*** (0.012)	-0.001 (0.005)	-0.071*** (0.024)	-0.087** (0.038)	0.004 (0.051)	-0.056 (0.060)	-0.140*** (0.040)	0.006 (0.034)	-0.006 (0.040)
>= 3 Adults	-0.135*** (0.016)	-0.151*** (0.056)	-0.070 (0.037)	-0.050 (0.037)	-0.184*** (0.046)	-0.067*** (0.026)	-0.048*** (0.011)	-0.115** (0.021)	-0.011 (0.003)	-0.143*** (0.028)	-0.090** (0.046)	0.016 (0.063)	-0.214** (0.093)	-0.197*** (0.062)	-0.018 (0.041)	0.001 (0.031)
Couple w/o Children Single Parent	0.007 (0.059)	-0.024 (0.087)	-0.130** (0.058)	0.031 (0.034)	0.134 (0.090)	-0.006 (0.030)	-0.041** (0.018)	-0.022** (0.009)	-0.143 (0.044)	-0.063 (0.059)	0.175 (0.372)	-0.069 (0.121)	-0.086 (0.193)	-0.062 (0.127)	-0.131** (0.052)	-0.003 (0.050)
Couple with Children	-0.114*** (0.019)	-0.092* (0.051)	-0.068* (0.037)	-0.050 (0.033)	-0.136*** (0.046)	-0.054* (0.029)	-0.053 (0.014)	-0.082** (0.019)	-0.053 (0.073)	-0.122*** (0.028)	-0.097* (0.040)	0.007 (0.059)	-0.118* (0.063)	-0.156*** (0.059)	-0.007 (0.046)	0.001 (0.045)
>= 3 Adults	-0.157*** (0.022)	-0.201*** (0.076)	-0.120*** (0.059)	-0.053 (0.039)	-0.249*** (0.066)	-0.023 (0.033)	-0.081*** (0.019)	-0.013 (0.023)	-0.028 (0.081)	-0.137*** (0.031)	-0.151*** (0.057)	-0.048 (0.072)	-0.061 (0.086)	-0.059*** (0.055)	0.014 (0.040)	0.020 (0.064)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	0.017* (0.010)	0.043 (0.028)	0.010 (0.023)	0.021 (0.016)	-0.000 (0.028)	0.013 (0.014)	-0.002 (0.009)	0.026*** (0.009)	0.006 (0.040)	0.014 (0.014)	0.024 (0.026)	-0.036 (0.031)	-0.001 (0.036)	0.039 (0.026)	0.025 (0.018)	0.019 (0.023)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	-0.020 (0.013)	-0.027 (0.032)	-0.017 (0.035)	0.057*** (0.018)	-0.068* (0.035)	0.043** (0.019)	-0.028*** (0.010)	-0.010 (0.012)	0.042 (0.040)	0.089*** (0.019)	-0.004 (0.031)	0.011 (0.033)	-0.015 (0.039)	-0.058 (0.039)	0.028 (0.021)	0.007 (0.024)
65 Years and Over	-0.004 (0.019)	-0.048 (0.053)	0.074 (0.050)	0.096* (0.059)	-0.011 (0.062)	0.084*** (0.031)	-0.001 (0.014)	-0.013 (0.018)	0.083 (0.005)	0.076*** (0.027)	0.053 (0.051)	0.036 (0.051)	0.058 (0.057)	-0.050 (0.040)	0.038 (0.026)	0.022 (0.032)

(continued)

Table 10. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Marital Status (Reference Person) (Base: Unmarried)</i>																
Married	-0.026* (0.015)	-0.067* (0.037)	0.024 (0.032)	0.020 (0.035)	-0.044 (0.047)	-0.036 (0.022)	-0.064*** (0.011)	-0.010 (0.010)	-0.037 (0.062)	-0.033 (0.023)	0.031 (0.030)	0.065 (0.052)	0.005 (0.049)	0.127*** (0.035)	-0.115*** (0.036)	-0.010 (0.040)
Divorced	-0.042** (0.019)	-0.070* (0.040)	0.072 (0.049)	-0.027 (0.027)	-0.111** (0.055)	-0.069** (0.027)	-0.060*** (0.014)	-0.005 (0.017)	0.030 (0.062)	-0.044* (0.025)	0.069 (0.043)	0.014 (0.062)	0.134* (0.069)	0.049 (0.048)	-0.159*** (0.050)	0.023 (0.042)
Widowed	-0.050** (0.021)	-0.126** (0.063)	-0.043 (0.045)	-0.043 (0.030)	-0.047 (0.064)	-0.040 (0.030)	-0.057*** (0.017)	-0.003 (0.017)	-0.107 (0.257)	-0.003 (0.027)	-0.001 (0.056)	0.123** (0.054)	-0.036 (0.064)	-0.004 (0.044)	-0.149*** (0.047)	0.039 (0.042)
<i>Labour Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	-0.028*** (0.010)	0.005 (0.039)	-0.044 (0.046)	-0.015 (0.019)	-0.058 (0.039)	-0.028 (0.020)	0.012 (0.010)	-0.035*** (0.012)	-0.037 (0.040)	-0.003 (0.014)	-0.007 (0.028)	-0.031 (0.030)	0.007 (0.066)	-0.015 (0.034)	-0.020 (0.038)	0.003 (0.028)
Unemployed	-0.030 (0.024)	0.091 (0.090)	0.050 (0.068)	-0.016 (0.026)	-0.011 (0.089)	-0.018 (0.023)	-0.047** (0.021)	-0.072*** (0.023)	-1.101*** (0.192)	0.008 (0.044)	0.026 (0.512)	0.118 (0.096)	-0.109 (0.091)	0.014 (0.054)	0.033 (0.047)	-0.050 (0.108)
Retired	0.023* (0.013)	0.064* (0.038)	0.015 (0.039)	-0.039 (0.046)	-0.009 (0.047)	-0.003 (0.021)	0.030** (0.014)	-0.024* (0.013)	-0.047 (0.057)	0.074*** (0.015)	-0.001 (0.034)	-0.003 (0.043)	-0.019 (0.044)	0.010 (0.031)	-0.025 (0.023)	-0.062 (0.044)
Other	0.062** (0.030)	-0.029 (0.089)	-0.016 (0.090)	-0.016 (0.121)	0.121* (0.070)	-0.048 (0.033)	0.039** (0.019)	-0.043 (0.027)	-0.020 (0.552)	0.047 (0.062)	0.025 (0.092)	-0.018 (0.069)	0.058 (0.058)	-0.059 (0.029)	-0.196*** (0.060)	-0.007 (0.083)
Missing	-0.007 (0.061)	-0.056 (0.306)	-0.056 (0.306)	0.253 (0.250)									0.029 (0.638)	-0.919 (0.638)	-0.042*** (0.115)	-0.007 (0.115)
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.036*** (0.009)	0.153** (0.061)	0.070** (0.034)	-0.006 (0.016)	0.082 (0.069)	0.067*** (0.017)	0.034*** (0.010)	0.022** (0.010)	0.061 (0.040)	0.020*** (0.009)	0.084*** (0.028)	-0.001 (0.025)	0.007 (0.045)	0.080*** (0.025)	0.068** (0.031)	0.002 (0.113)
High (ISCED 4-6)	0.094*** (0.011)	0.221*** (0.071)	0.090*** (0.033)	0.009 (0.017)	0.189*** (0.072)	0.103*** (0.017)	0.073*** (0.010)	0.046*** (0.011)	0.081** (0.039)	0.029* (0.016)	0.148*** (0.037)	0.017 (0.024)	0.029 (0.047)	0.164*** (0.043)	0.157*** (0.039)	0.068 (0.117)

(continued)

Table 10. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Inheritance</i>																
Dummy	0.025*** (0.009)	0.020 (0.025)	0.034* (0.019)	0.009 (0.010)	0.003 (0.023)	0.022* (0.012)	Note 2	-0.061 (0.009)	-0.061 (0.032)	Note 3	0.011 (0.021)	0.071*** (0.022)	0.089** (0.036)	0.044*** (0.019)	-0.003 (0.017)	-0.021 (0.021)
<i>Net Wealth Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.113*** (0.022)	0.077 (0.066)	0.118* (0.064)	-0.007 (0.064)	0.125* (0.069)	0.037** (0.025)	0.120*** (0.021)	0.073*** (0.024)	0.089 (0.254)	0.211*** (0.037)	0.017 (0.060)	-0.012 (0.051)	0.007 (0.092)	0.042 (0.069)	-0.015 (0.035)	0.002 (0.042)
3rd Quintile	0.195*** (0.027)	0.237*** (0.062)	0.136*** (0.052)	-0.005 (0.020)	0.329*** (0.088)	0.098*** (0.028)	0.090*** (0.016)	0.091*** (0.023)	0.120 (0.182)	0.170*** (0.029)	0.084 (0.053)	0.026 (0.048)	0.122* (0.065)	0.141* (0.075)	-0.022 (0.040)	0.051 (0.042)
4th Quintile	0.213*** (0.023)	0.252*** (0.068)	0.218*** (0.067)	-0.001 (0.024)	0.298*** (0.076)	0.129*** (0.025)	0.119*** (0.015)	0.129*** (0.025)	0.175 (0.187)	0.229*** (0.031)	0.044 (0.052)	0.089** (0.045)	0.155** (0.064)	0.162*** (0.060)	0.025 (0.030)	0.078** (0.037)
5th Quintile	0.280*** (0.024)	0.365*** (0.105)	0.397*** (0.060)	0.020 (0.018)	0.377*** (0.076)	0.190*** (0.030)	0.185*** (0.017)	0.161*** (0.023)	0.281 (0.198)	0.251*** (0.032)	0.101** (0.050)	0.108** (0.048)	0.242*** (0.059)	0.238*** (0.063)	0.034 (0.024)	0.103*** (0.035)
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.034* (0.020)	0.050 (0.071)	0.063 (0.040)	-0.007 (0.021)	-0.030 (0.072)	0.018 (0.020)	0.038** (0.019)	0.068*** (0.020)	-0.009 (0.114)	0.153*** (0.022)	0.094 (0.064)	0.054 (0.041)	-0.006 (0.087)	0.003 (0.057)	-0.032 (0.031)	-0.000 (0.043)
3rd Quintile	0.097*** (0.023)	0.173 (0.076)	0.143** (0.049)	0.003 (0.023)	0.106 (0.079)	-0.010 (0.026)	0.069** (0.018)	0.117*** (0.023)	-0.015 (0.118)	0.232*** (0.027)	0.135** (0.069)	0.002 (0.045)	-0.022 (0.058)	0.049 (0.075)	-0.004 (0.025)	-0.006 (0.034)
4th Quintile	0.129*** (0.019)	0.196*** (0.077)	0.166*** (0.038)	0.016 (0.023)	0.113* (0.069)	0.008 (0.024)	0.085** (0.023)	0.135*** (0.024)	0.042 (0.111)	0.249*** (0.031)	0.182* (0.061)	0.091 (0.049)	0.040 (0.054)	0.075 (0.046)	-0.042 (0.034)	-0.039 (0.038)
5th Quintile	0.134*** (0.021)	0.206*** (0.041)	0.141*** (0.041)	0.033 (0.024)	0.210** (0.090)	0.030* (0.026)	0.038** (0.019)	0.216*** (0.034)	0.064 (0.113)	0.369*** (0.024)	0.247** (0.063)	0.094 (0.057)	0.070 (0.057)	0.182* (0.085)	-0.042 (0.030)	-0.044 (0.042)
Constant	-0.021*** (0.023)	-0.770*** (0.157)	-0.529*** (0.069)	-0.033*** (0.034)	-0.599*** (0.095)	-0.339*** (0.027)	-0.251*** (0.020)	-0.372*** (0.024)	-0.382*** (0.244)	-0.342*** (0.040)	-0.369*** (0.173)	-0.267*** (0.077)	-0.398*** (0.127)	-0.039*** (0.068)	-0.039*** (0.068)	-0.340*** (0.130)
Sigma	0.254*** (0.010)	0.280*** (0.049)	0.268*** (0.019)	0.004*** (0.018)	0.301*** (0.019)	0.197*** (0.013)	0.225*** (0.008)	0.186*** (0.010)	0.243*** (0.036)	0.251*** (0.012)	0.173*** (0.020)	0.209*** (0.019)	0.250*** (0.050)	0.239*** (0.033)	0.131*** (0.014)	0.161*** (0.027)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³Italy does not collect information on inheritance.

Fact 5: The probability of owning and the portfolio share of risky assets are higher for single households.

In eight countries, and the euro area as a whole, relative to households with at least three adults (with or without children), single households are much more likely to own risky assets. Also, relative to such households and to couples with children, the portfolio share of risky assets is higher for single households. One likely factor is that having responsibilities for children and/or a partner increases the risk aversion. It could also simply reflect that having children implies certain committed expenditures that households may have to meet, so that they are less prone to take additional financial risks when they have children.

Fact 6: Varying labor market statuses have remarkably little effect on ownership and portfolio shares of assets, with the obvious exception of the self-employed being much more likely to own businesses (and to some extent other real estate).

There is little systematic difference between being employed or unemployed and being employed or retired in the ownership of assets (tables 7, 8, 16, and 17). This implies that unemployment (after controlling for income, education, and relative wealth position) has little explanatory power for the asset participation decision. A possible explanation may be that unemployment is considered a transitory and unexpected event in life. Given quasi-universal unemployment insurance in the European Union, the lack of any significant link may indicate the ability of the unemployed to survive the unemployment spell without having to liquidate (at least partially) the assets in question.

4.3 Other Findings

In any cross-country regression analysis that contains a large set of countries, one is prone to identify coefficients that are statistically significant and of the same sign in a subset of countries; however, there are fewer countries than needed to speak of a stylized fact. Such findings may be due to institutional cultural or economic phenomena that are shared by certain groups of countries but not by

others. Alternatively, the absence of statistical significance for some countries might just be due to sampling (i.e., some facts pertain to subgroups of the population which might not be numerous enough to reach statistical significance). And anomalies are present when individual countries have significant opposite coefficients that deviate from the general pattern. Country differences in terms of sign and magnitude of the coefficients (and level of significance) also occur frequently. Besides natural sampling variation, institutional or economic differences play a role. Such country differences will have to be explained in further research projects

An interesting fact in the HFCS data set is that higher education, controlling for income and wealth, seems to indicate a reduction in the likelihood of owning the main residence (statistically significant in only some countries—e.g., Austria, Spain, Greece, and Portugal—but also in the euro area as a whole). This is probably linked to a need for more mobility of more educated people and a delayed decision to settle down and to become a homeowner.

The likelihood of owning the HMR for households with a self-employed reference person is significantly lower than for an employee in the euro area as a whole and in several Southern European countries (e.g., in Spain, Portugal, Greece, and Italy). A possible explanation may be that the “living area” of the self-employed is part of the business assets (think, e.g., a small restaurant or shop owner whose living space is under the same roof as the restaurant or shop).

An interesting result is that households with three or more adults with dependent children tend to have a higher portfolio share for the household main residence compared with single households. The coefficient is statistically significant for Germany, France, the Netherlands, Italy, Greece, and Slovakia. This reflects the obvious need for more space of households with more household members.

5. Cross-Country Differences in Coefficient Estimates and Institutional Factors

Identifying the sources of the differences in the estimated effects of the demographic variables on the conditional mean for certain assets categories across countries is not an easy task. Many societal and institutional factors (culture, history, welfare state, housing and credit markets, financial institutions, etc.) are likely to affect

the wealth accumulation and portfolio choices of households. This section aims to shed some light on these potential sources of cross-country heterogeneity. To this end we focus on real estate and risky financial assets and investigate the interactions between the estimated marginal effects of the key sociodemographic explanatory variables and some institutional factors.¹⁵ Our approach is similar to Christelis, Georgarakos, and Haliassos (2013), Bover et al. (this issue), and Le Blanc et al. (this issue). We estimate multivariate regressions where the estimated marginal effect of a given variable is regressed on a set of institutional variables.¹⁶ We choose to investigate the cross-country heterogeneity concerning the marginal effects of net wealth, income, age, education, and inheritances¹⁷ on housing (section 5.1) and on risky financial assets (section 5.2).

5.1 Cross-Country Differences in Real Estate Holdings

The decision to hold real estate in general and a household main residence in particular results from a dual role of this asset for households: as a generator of housing services, housing satisfies consumption needs, and being an asset, it is also driven by investment decisions. In addition, housing wealth represents household debt collateral, as loans contracted for buying housing assets or for financing other needs (such as acquiring other assets or financing consumption spending) could be guaranteed by the value of the housing asset. This is why, when turning to cross-country comparisons, national specificities about the functioning of mortgage markets; housing market conditions (including transaction costs); wealth taxation; long-term financing needs, such as old-age expenses; or labor mobility are likely to affect household investment decisions concerning real estate via their impact on consumption or investment motives and via the collateral effect. These institutional factors may indeed induce the cross-country heterogeneity in the impact of the sociodemographic

¹⁵See appendix 6 for the definitions of the institutional indicators.

¹⁶Given the limited number of countries available in this analysis, one should interpret results with caution.

¹⁷These variables have been selected according to their significant estimated impacts obtained in the regressions, their relationship with the theoretical role for wealth accumulation and portfolio choices, and according to their potential interactions with institutional factors.

determinants on real estate assets discussed in the previous section. We investigate this link between the institutional context and the cross-country heterogeneity in the estimated average marginal effects by regressing country-specific average marginal effects on institutional indicators related to the buy/rent trade-off, the mortgage market, and the wealth taxation. This analysis is done both for the household main residence and for other real estate.

5.1.1 Mortgage Markets

Household credit conditions vary across the euro area (Bover et al., this issue), and mortgage markets exhibit differences in many aspects (European Commission 2011). In particular, in some countries the use of mortgages to finance purposes other than acquiring the collateralized housing asset is widespread, while in other countries this phenomenon is very rare. According to the ECB (2009), the share of debt secured on housing assets used for purposes other than financing a new home varies from less than 1 percent in Luxembourg to 30 percent in Greece. We use this information as an indicator for the prevalence of the role of housing wealth as debt collateral (table 11 and table 12).

A negative cross-country correlation is obtained between this mortgage market indicator and the marginal effects of net wealth (fourth and fifth quintiles) on the portfolio share of the households' main residence. This result is consistent with the idea that the impact of net wealth (excluding HMR) on investment in HMR is less important in countries where households use contracted mortgages to finance other purposes. It could reflect differences in credit constraints faced by households with respect to home acquisitions (and potentially through differences in downpayment requirement, e.g., Chiuri and Jappelli 2003) and the financing of other spending (consumption, repayment of unsecured debt).

5.1.2 Buy-Rent Trade-Off and Long-Term Financing Needs

Obviously, the housing markets and the relative prices for buying versus renting could lead to cross-country heterogeneity in the participation and in the shares of the household main residence and housing assets. In particular, differences in these market conditions may induce cross-country heterogeneity in the estimated effects of

available household resources (e.g., income and wealth) on the decision to be or not to be a homeowner.

Another source for cross-country heterogeneity in the trade-off between renting versus buying could be the need to finance household consumption in old age. In that respect, one could expect that holding assets in the form of real estate is linked to expectations concerning the evolution of house prices and national features of the pension system.¹⁸ The diversity of national pension systems could lead to the very heterogeneous impacts of age on the portfolio share of the household main residence: a positive increasing effect, a hump-shaped profile, or a decreasing effect depending on the country (table 9).

We investigate these possible underlying factors leading to cross-country differences in the tenancy choice trade-off by considering two indicators, the price-to-rent ratio and the average pension replacement rate, and their links with the determinants of the portfolio shares of the household main residence and other real estate (see tables 11 and 12).

For the portfolio share of other real estate, we find a negative correlation between the price-to-rent ratio and the marginal effects of income (which are estimated to be positive with large cross-country variation in the magnitude of the effects, except in Italy where the income levels are negatively related to the portfolio share of other real estate; see table 22). This could reflect that relative house prices are likely to influence households' investment decisions in housing assets in that an increase in the relative price-to-rent ratio decreases the rent yield and thus may reduce the incentive to invest in other real estate.

Concerning the determinants of the portfolio share of the household main residence, we find some weak indication (not significant) of a negative correlation between the price-to-rent ratio and age (sixty-five and above). This correlation with the age variable indicates that the life-cycle profile of housing wealth (main residence) in a country is related to its housing market conditions, and in particular to house prices; the higher the price-to-rent ratio, the later in life households will own their home. We do not obtain a significant correlation for the age profile of other real estate.

¹⁸One also could think about other institutional factors such as intergenerational cohabitation or housing equity withdrawal.

The differences in correlations between the buy-to-rent ratio on the one hand and the age and income effects on the other hand across the two real estate portfolio shares considered (household main residence and other real assets) can probably be explained by the dual nature of housing assets, the household main residence being more related to housing consumption, and other real estate being more driven by investment decisions.

5.1.3 Inheritance Tax on the Household Main Residence

The regressions show that the magnitude of the marginal effect of net wealth on the portfolio share of housing assets is related to the existence of an inheritance tax on the household main residence. This effect is significant for other real estate; in countries where such a tax exists, the marginal effect of net wealth on the portfolio share of other real estate is higher. Concerning the share of the main residence, the relationship runs in the opposite direction (while not significant). It may reflect that in these countries, wealthy people tend to allocate their wealth in other assets than in the main residence, everything else being equal.

Finally, the negative correlation between the estimated average marginal effects of inheritances and the price-to-rent ratio is unexpected, because in the case of an increase in the price-to-rent ratio, we would have expected a larger positive impact of having past intergenerational transfers on holding of the HMR.

5.2 Cross-Country Differences in Risky Financial Assets Holding

Institutional factors are also likely to affect households' decisions to invest in risky financial assets. In particular, one could suspect that cross-country heterogeneity in the households' capacities to gather and process financial information, local firms' demand for long-term financing, or the existence of country-specific factors affecting risk perceptions and expectations at the household level could induce heterogeneity in the estimated marginal effects of the sociodemographic variables (table 10). Regressions of the estimated average marginal effect of net wealth, income, education, and inheritances on various institutional factors are provided in table 13.

There is a positive interaction between the stock market capitalization in the country and the income marginal effect on the portfolio share invested in risky financial assets. Such a result may reflect a supply effect arising from the financial environment.

We find evidence of a negative cross-country correlation between the share of households with Internet access and the average marginal effects of the controls for the position of the household in the net wealth and income distributions. These results are consistent with the idea that better access to information lowers the entry and transaction costs so that households' own resources play a less important role for the holding of risky financial assets.

The regressions also show that the magnitude of the positive income effect on the portfolio share of risky financial assets varies negatively with the average pension replacement rate, which could reflect that, in countries with a high replacement rate, households are less incited to invest in long-term assets.

In addition, consistent with results reported by Guiso, Sapienza, and Zingales (2008), there is a positive correlation between the level of trust in the country and the positive income and wealth effects on the portfolio share of risky assets.

6. Conclusions

This paper provides stylized facts on the asset composition of households in the euro area. The heterogeneity across euro-area countries is sizable across a number of dimensions, such as income and wealth.

Whereas ownership of the household main residence varies strongly between countries, the value of the main residence is the main asset for those who own it and it represents a significant part of total assets in all countries, including those with relatively low ownership rates. The vast majority of total assets consist of real assets. With regard to financial assets, almost all households hold safe assets, such as deposit or savings accounts, while a rather low share of households holds risky assets, such as stocks, bonds, and mutual funds.

The ownership rates of all asset categories generally increase with households' position in the net wealth and income distribution. Ownership rates of safe financial assets are uniformly high across all euro-area countries. They diverge substantially for ownership of the household main residence. Especially the share of risky financial asset holders rises sharply with the position of the household in the net wealth distribution but stays surprisingly low even for households in the highest net wealth deciles. The significance of inheritances for the wealth accumulation process is remarkable.

Although our stylized facts are derived from survey data obtained in a high-turmoil period (2010–11), we believe they are related to structural factors of asset holdings that are not so much varying over the cycle. A joint analysis of structural determinants and factors that vary over the business cycle will become possible when more waves of the survey become available.

Our analysis of the relationship between institutions and the impact of sociodemographics on asset holdings indicates that institutional factors can moderate the impact of some household characteristics on households' portfolio choices in different countries. Investigating institutional factors in more detail—in particular, uncovering the mechanisms of how they affect portfolio choices—is a promising avenue for future research. The particularly large heterogeneity in homeownership rates across the euro area seems an area worth further research (see, for example, Mathä, Porgiglia, and Ziegelmeyer 2014). House price developments and mortgage indebtedness were key factors in the financial crisis, so homeownership has important macroeconomic implications. Public policies such as mortgage interest tax deductibility, subsidized housing, rent policies, taxation on house-buying transactions, and inheritance tax on homes are not only substantially different across countries but are also factors that are likely to shape financial decisions of households. Disentangling the effects of a multitude of policies on household asset holding choices in a number of ways is certainly not easy. As more household wealth survey data become available, one can hope that the role of public policies can be more vigorously investigated.

Appendix 1. Results on the Extensive and Intensive Margin

Table 14. Participation Rates for Asset Categories, in %

	HMR	ORE	BUS	SAFE	RISKY
Euro Area	60.1	23.8	11.1	96.7	20.2
Austria	47.7	13.4	9.4	99.4	14.6
Belgium	69.6	16.4	6.6	97.9	30.7
Cyprus	76.7	51.6	19.5	85.9	36.3
Germany	44.2	17.8	9.1	99.1	23.0
Spain	82.7	36.2	14.2	98.2	14.0
Finland ¹	69.2	29.8	13.8	100.0	38.7
France	55.3	28.5	8.9	99.6	21.7
Greece	72.4	37.9	9.8	73.9	4.0
Italy	68.7	24.9	18.0	91.9	19.8
Luxembourg	67.1	28.2	5.2	98.4	25.8
Malta	77.7	31.4	11.5	96.9	33.7
Netherlands	57.1	6.1	4.8	97.3	23.9
Portugal	71.5	27.1	7.7	94.3	6.5
Slovenia	81.8	23.2	11.6	93.6	20.3
Slovakia	89.9	15.3	10.7	91.5	4.1

Source: HFCS 2013.

Notes: HMR: household main residence, ORE: other real estates, BUS: self-employment business, SAFE: safe financial assets, RISKY: risky financial assets.

¹Finland collects information on BUS only in a summarizing way; estimates are not comparable.

**Table 15. Conditional Median of Asset Categories,
in EUR Thousands**

	HMR	ORE	BUS	SAFE	RISKY	TOTAL
Euro Area	180.3	100.0	30.0	9.2	12.1	142.0
Austria	200.0	94.0	180.6	11.9	12.3	92.8
Belgium	250.0	174.0	50.0	20.7	20.1	249.9
Cyprus	240.3	202.2	98.8	18.3	2.0	331.9
Germany	168.0	115.0	19.4	13.2	12.1	67.9
Spain	180.3	120.2	50.8	5.1	12.0	210.2
Finland ¹	127.8	107.6	0.9	5.7	3.7	132.7
France	193.8	96.1	53.1	8.9	8.1	150.4
Greece	100.0	61.9	36.2	3.9	7.3	110.2
Italy	200.0	100.0	15.0	7.4	22.4	188.0
Luxembourg	500.0	300.0	97.6	23.1	28.5	494.4
Malta	186.6	120.1	136.5	17.7	21.6	227.4
Netherlands	240.0	165.5	51.7	30.4	8.2	217.3
Portugal	90.0	53.5	47.1	3.8	8.9	93.2
Slovenia	110.9	52.4	25.5	1.1	3.4	105.2
Slovakia	55.9	16.4	4.6	2.3	1.1	64.4

Source: HFCS 2013.

Notes: HMR: household main residence, ORE: other real estates, BUS: self-employment business, SAFE: safe financial assets, RISKY: risky financial assets.

¹Finland collects information on BUS only in a summarizing way; estimates are not comparable.

Appendix 2. Probit Models (Including Net Wealth Indicator)

Table 16. Average Marginal Effects from a Probit Model of Participation in Other Real Estate

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
							<i>Household Type (Base: Single)</i>									
Couple w/o Children	0.001 (0.012)	-0.008 (0.032)	0.023 (0.035)	0.141 (0.107)	-0.036 (0.033)	0.027 (0.029)	0.085*** (0.018)	-0.001 (0.020)	0.006 (0.041)	0.035 (0.024)	-0.063 (0.067)	-0.042 (0.072)	-0.017 (0.049)	0.017 (0.033)	0.031 (0.053)	-0.024 (0.043)
>= 3 Adults w/o Children	0.008 (0.017)	-0.001 (0.049)	0.008 (0.047)	0.236* (0.135)	-0.047 (0.037)	-0.016 (0.035)	0.208*** (0.036)	0.010 (0.030)	0.060 (0.051)	0.092*** (0.030)	-0.030 (0.081)	0.011 (0.091)	-0.021 (0.062)	0.027 (0.038)	0.057 (0.069)	0.052 (0.051)
Single Parent	0.002 (0.020)	0.000 (0.065)	0.032 (0.051)	-0.065 (0.106)	0.031 (0.066)	0.030 (0.055)	0.001 (0.026)	-0.004 (0.027)	0.043 (0.074)	-0.055 (0.042)	-0.000 (0.094)	0.059 (0.178)	-0.018 (0.136)	-0.049 (0.043)	-0.173*** (0.047)	-0.007 (0.064)
Couple with Children	-0.002 (0.015)	-0.021 (0.036)	0.029 (0.042)	0.158 (0.117)	-0.034 (0.037)	0.028 (0.038)	0.051*** (0.017)	0.000 (0.020)	-0.005 (0.048)	0.038 (0.028)	-0.103 (0.066)	0.055 (0.092)	-0.015 (0.061)	-0.001 (0.039)	-0.004 (0.063)	0.011 (0.047)
>= 3 Adults with Children	0.011 (0.019)	-0.008 (0.044)	0.038 (0.080)	0.106 (0.133)	-0.061 (0.045)	0.072 (0.045)	0.103*** (0.037)	0.019 (0.037)	0.048 (0.067)	0.077** (0.037)	-0.074 (0.084)	0.048 (0.088)	-0.086 (0.080)	0.010 (0.047)	0.098 (0.083)	-0.004 (0.056)
							<i>Gender (Reference Person) (Base: Female)</i>									
Male	-0.001 (0.009)	-0.003 (0.018)	0.033* (0.020)	0.028 (0.047)	-0.017 (0.020)	-0.037 (0.023)	0.025*** (0.008)	0.000 (0.012)	0.005 (0.026)	0.004 (0.015)	0.023 (0.041)	-0.033 (0.050)	-0.002 (0.022)	0.010 (0.014)	-0.079** (0.031)	-0.009 (0.024)
							<i>Age (Reference Person) (Base: Below 40 Years)</i>									
40-64 Years	0.039*** (0.009)	0.020 (0.020)	0.028 (0.033)	0.084* (0.040)	0.005 (0.025)	0.055** (0.026)	0.047*** (0.012)	0.027 (0.018)	0.007 (0.026)	0.083*** (0.021)	0.044 (0.045)	0.040 (0.052)	0.068*** (0.024)	0.017 (0.023)	0.192*** (0.028)	-0.012 (0.030)
65 Years and Over	0.039*** (0.014)	0.026 (0.033)	0.021 (0.043)	-0.075 (0.122)	0.010 (0.044)	0.021 (0.039)	0.054** (0.022)	-0.009 (0.030)	0.016 (0.045)	0.093*** (0.029)	0.126 (0.083)	0.107 (0.084)	0.037 (0.035)	0.048 (0.030)	0.312*** (0.059)	-0.071 (0.048)

(continued)

Table 16. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Mental Status (Reference Person) (Basic: Unmarried)</i>																
Married	0.013 (0.013)	-0.000 (0.027)	-0.054 (0.034)	-0.113 (0.095)	0.038 (0.033)	-0.003 (0.032)	-0.033** (0.015)	0.027 (0.020)	-0.012 (0.036)	-0.004 (0.027)	0.117** (0.055)	0.016 (0.059)	0.073* (0.041)	0.003 (0.026)	-0.068 (0.062)	0.001 (0.052)
Divorced	0.003 (0.015)	0.011 (0.035)	0.013 (0.047)	-0.024 (0.089)	0.036 (0.032)	-0.047 (0.038)	-0.011 (0.016)	0.002 (0.023)	-0.003 (0.056)	-0.046 (0.032)	0.065 (0.055)	0.098 (0.103)	-0.001 (0.028)	-0.010 (0.033)	-0.201*** (0.066)	0.065 (0.051)
Widowed	-0.026** (0.013)	0.027 (0.041)	-0.021 (0.053)	-0.109 (0.085)	-0.014 (0.032)	-0.105*** (0.035)	-0.063*** (0.023)	0.011 (0.025)	-0.053 (0.049)	-0.039* (0.024)	0.033 (0.063)	-0.040 (0.084)	-0.016 (0.024)	0.019 (0.034)	-0.171** (0.067)	0.016 (0.055)
<i>Labor Market Status (Reference Person) (Basic: Employee)</i>																
Self-employed	0.055*** (0.015)	0.037 (0.028)	0.104** (0.050)	0.101* (0.057)	0.028 (0.026)	0.032 (0.033)	0.085*** (0.015)	0.059*** (0.020)	0.028 (0.032)	0.093*** (0.021)	0.102* (0.058)	0.059 (0.057)	0.084 (0.089)	0.064*** (0.023)	0.105 (0.068)	0.057 (0.038)
Unemployed	-0.033** (0.016)	0.032 (0.068)	-0.050 (0.042)	0.038 (0.114)	-0.070 (0.059)	0.017 (0.036)	-0.046** (0.021)	-0.095*** (0.025)	-0.076 (0.090)	-0.059 (0.041)	Note 5	-0.073 (0.193)	0.130 (0.169)	-0.022 (0.039)	-0.074 (0.053)	0.012 (0.089)
Retired	0.015 (0.012)	-0.006 (0.023)	0.048 (0.031)	0.048 (0.108)	0.019 (0.032)	0.077** (0.030)	0.018 (0.018)	-0.002 (0.023)	0.002 (0.035)	-0.016 (0.016)	-0.043 (0.053)	0.047 (0.060)	0.016 (0.028)	0.021 (0.021)	-0.056 (0.044)	0.131*** (0.041)
Other	-0.023 (0.017)	Note 2	-0.034 (0.063)	-0.008 (0.090)	-0.012 (0.047)	0.056 (0.034)	-0.012 (0.017)	-0.075*** (0.028)	-0.096 (0.066)	-0.074* (0.045)	-0.199** (0.081)	-0.077 (0.083)	-0.024 (0.007)	0.056 (0.049)	-0.125** (0.064)	0.078 (0.089)
Missing	-0.005 (0.043)		-0.009 (0.076)	0.263 (0.189)												Note 8
<i>Education (Reference Person) (Basic: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	-0.015** (0.006)	-0.016 (0.025)	0.003 (0.029)	0.071 (0.049)	0.059** (0.028)	-0.014 (0.029)	0.007 (0.012)	0.000 (0.012)	-0.075** (0.030)	-0.010 (0.014)	-0.057 (0.039)	0.045 (0.038)	0.001 (0.021)	-0.035* (0.022)	0.000 (0.038)	-0.168** (0.082)
High (ISCED 4-6)	0.017* (0.010)	0.052 (0.034)	-0.009 (0.026)	-0.008 (0.054)	0.099*** (0.034)	-0.032 (0.023)	0.000 (0.012)	0.008 (0.015)	-0.060* (0.033)	0.044** (0.019)	0.025 (0.053)	0.048 (0.053)	0.063** (0.027)	0.033 (0.029)	0.041 (0.060)	-0.056 (0.090)
<i>Inheritance</i>																
Dummy	0.098*** (0.008)	0.104*** (0.015)	0.041** (0.018)	0.171*** (0.037)	0.046*** (0.013)	0.222*** (0.017)	Note 3	0.118*** (0.011)	-0.028 (0.022)	Note 4	0.054 (0.036)	0.072* (0.037)	0.042 (0.030)	0.164*** (0.017)	0.107*** (0.030)	0.030 (0.020)

(continued)

Table 16. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Net Wealth Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.063*** (0.008)	0.001 (0.030)	0.073** (0.031)	0.174*** (0.061)	-0.022 (0.020)	0.099** (0.039)	0.042*** (0.009)	0.062*** (0.014)	0.184*** (0.024)	0.139*** (0.019)	0.171** (0.068)	0.101*** (0.045)	Note 6	0.104*** (0.026)	Note 7	0.092*** (0.031)
3rd Quintile	0.131*** (0.009)	0.067** (0.029)	0.040 (0.024)	0.344*** (0.082)	0.035 (0.027)	0.174** (0.032)	0.186** (0.014)	0.209** (0.017)	0.232** (0.025)	0.143** (0.014)	0.063 (0.062)	0.195** (0.098)		0.154*** (0.027)		0.179** (0.041)
4th Quintile	0.216** (0.013)	0.126** (0.030)	0.133** (0.036)	0.422*** (0.077)	0.110** (0.032)	0.289** (0.035)	0.402** (0.015)	0.284** (0.026)	0.392** (0.040)	0.236** (0.019)	0.138** (0.067)	0.370** (0.037)		0.231*** (0.026)		0.147** (0.036)
5th Quintile	0.403*** (0.015)	0.222*** (0.042)	0.371*** (0.039)	0.660*** (0.077)	0.312** (0.044)	0.517** (0.036)	0.667** (0.015)	0.545*** (0.024)	0.706*** (0.030)	0.528*** (0.023)	0.488** (0.074)	0.586** (0.065)		0.497*** (0.033)		0.532** (0.042)
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	-0.002 (0.011)	0.042 (0.029)	-0.027 (0.035)	0.008 (0.064)	-0.029 (0.029)	0.071*** (0.024)	-0.014 (0.020)	0.008 (0.018)	-0.008 (0.033)	-0.035 (0.023)	0.030 (0.071)	-0.001 (0.056)	0.009 (0.046)	-0.011 (0.028)	0.178*** (0.047)	0.019 (0.035)
3rd Quintile	0.011 (0.013)	0.043* (0.025)	-0.038 (0.038)	0.013 (0.071)	0.030 (0.034)	0.080** (0.023)	0.000 (0.021)	-0.002 (0.024)	0.051 (0.038)	-0.050** (0.025)	0.051 (0.070)	0.040 (0.064)	-0.040 (0.045)	-0.009 (0.031)	0.199*** (0.051)	0.094** (0.045)
4th Quintile	0.033** (0.027)	0.066** (0.044)	0.018 (0.044)	-0.007 (0.074)	0.081** (0.039)	0.127*** (0.035)	-0.005 (0.021)	0.003 (0.022)	0.015 (0.042)	-0.073*** (0.024)	0.072 (0.070)	0.008 (0.059)	-0.011 (0.042)	0.018 (0.033)	0.123*** (0.045)	0.121** (0.050)
5th Quintile	0.051*** (0.016)	0.118*** (0.030)	0.046 (0.046)	0.129 (0.082)	0.087* (0.046)	0.161*** (0.040)	-0.022 (0.021)	0.028 (0.023)	0.025 (0.041)	-0.063** (0.026)	0.102 (0.077)	0.024 (0.069)	0.000 (0.042)	0.038 (0.031)	0.280*** (0.064)	0.142** (0.061)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²In Austria “other” labor status perfectly predicts failure and is dropped from the estimation.

³The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

⁴Italy does not collect information on inheritance.

⁵In Luxembourg “unemployment” labor status perfectly predicts and is dropped from the estimation.

⁶In the Netherlands there are wealth quintiles with no observations that participate, so it is removed from the model.

⁷In Slovenia there are wealth quintiles with no observations that participate, so it is removed from the model.

⁸Slovakia has missing observations, but the dummy is dropped due to perfect prediction.

Table 17. Average Marginal Effects from a Probit Model of Participation in Business Ownership

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children	0.024*** (0.007)	0.017 (0.020)	0.019 (0.018)	-0.035 (0.094)	0.034** (0.016)	0.013 (0.017)	0.028* (0.014)	0.030*** (0.009)	0.007 (0.010)	0.030*** (0.010)	0.026 (0.027)	-0.105 (0.112)	0.031 (0.030)	0.002 (0.021)	Note 12	-0.068** (0.032)
>= 3 Adults w/o Children	0.055*** (0.009)	0.065** (0.029)	0.023 (0.035)	0.022 (0.106)	0.035* (0.019)	0.036 (0.023)	0.017 (0.025)	0.045*** (0.015)	0.036** (0.018)	0.118*** (0.021)	0.008 (0.026)	-0.113 (0.115)	Note 8	0.015 (0.024)		-0.030 (0.037)
Single Parent	0.002 (0.009)	0.003 (0.042)	0.021 (0.044)	-0.081 (0.093)	0.014 (0.030)	-0.042** (0.020)	0.018 (0.027)	-0.007 (0.010)	-0.025** (0.012)	0.008 (0.016)	-0.012 (0.023)	-0.089 (0.143)	-0.007 (0.060)	0.041 (0.047)		-0.010 (0.034)
Couple with Children	0.029*** (0.007)	-0.002 (0.018)	0.012 (0.018)	-0.026 (0.093)	0.032* (0.018)	0.020 (0.020)	0.029* (0.017)	0.044*** (0.010)	0.025* (0.014)	0.053*** (0.015)	0.019 (0.025)	-0.135 (0.112)	-0.002 (0.026)	0.003 (0.022)		-0.065** (0.032)
>= 3 Adults with Children	0.045*** (0.009)	0.046* (0.027)	-0.006 (0.029)	-0.017 (0.096)	0.055* (0.030)	0.023 (0.025)	-0.065*** (0.019)	0.070*** (0.016)	0.034* (0.020)	0.095*** (0.019)	0.060 (0.044)	-0.112 (0.123)	0.048 (0.078)	-0.009 (0.022)		-0.059 (0.038)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	-0.017*** (0.004)	-0.021 (0.013)	-0.013 (0.016)	0.052 (0.032)	-0.015 (0.012)	-0.023** (0.012)	-0.013* (0.008)	-0.024*** (0.006)	-0.029*** (0.010)	-0.011 (0.011)	-0.020 (0.019)	-0.045 (0.034)	0.009 (0.017)	-0.010 (0.012)	-0.054*** (0.019)	-0.018 (0.016)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	-0.010 (0.006)	0.002 (0.017)	-0.014 (0.019)	-0.057 (0.038)	0.020 (0.017)	-0.036*** (0.018)	0.052*** (0.010)	-0.021** (0.008)	-0.023* (0.013)	-0.011 (0.014)	-0.020 (0.027)	-0.014 (0.036)	-0.009 (0.027)	-0.029*** (0.011)	-0.026 (0.022)	-0.017 (0.015)
65 Years and Over	-0.031*** (0.007)	-0.005 (0.025)	-0.034 (0.026)	-0.137 (0.137)	-0.023 (0.019)	-0.047 (0.029)	0.067*** (0.020)	-0.031** (0.012)	-0.029 (0.025)	-0.027 (0.017)	-0.045 (0.034)	-0.066 (0.054)	-0.040 (0.043)	-0.012 (0.024)	-0.053* (0.032)	-0.020 (0.039)

(continued)

Table 17. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Marital Status (Reference Person) (Base: Unmarried)</i>																
Married	0.008 (0.007)	-0.005 (0.018)	0.022 (0.019)	0.039 (0.067)	0.009 (0.017)	0.027** (0.014)	0.024* (0.014)	0.004 (0.008)	0.017 (0.014)	-0.004 (0.020)	0.006 (0.025)	0.107 (0.082)	-0.018 (0.026)	0.032** (0.015)	0.076*** (0.025)	0.021 (0.021)
Divorced	0.012 (0.008)	-0.019 (0.021)	0.038 (0.026)	0.170*** (0.068)	0.021 (0.019)	-0.011 (0.015)	-0.006 (0.011)	0.005 (0.011)	0.010 (0.023)	0.045 (0.032)	0.009 (0.027)	0.058 (0.044)	-0.007 (0.040)	0.028 (0.022)	0.015 (0.018)	-0.016 (0.017)
Widowed	-0.016* (0.009)	-0.020 (0.038)	-0.024 (0.019)	0.125 (0.085)	-0.001 (0.035)	-0.004 (0.020)	0.021 (0.021)	-0.022** (0.010)	-0.024** (0.012)	-0.011 (0.026)	0.068 (0.064)	Note 12 (0.064)	-0.009 (0.104)	-0.004 (0.022)	Note 12 (0.022)	0.046* (0.026)
<i>Labor Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	0.039*** (0.018)	0.349*** (0.057)	0.457*** (0.053)	0.404*** (0.061)	0.539*** (0.050)	0.765*** (0.031)	0.168*** (0.017)	0.629*** (0.030)	0.244*** (0.030)	Note 4 (0.030)	0.318*** (0.075)	0.538*** (0.086)	0.472*** (0.128)	0.272*** (0.031)	0.657*** (0.110)	0.075*** (0.065)
Unemployed	-0.020*** (0.006)	-0.005 (0.060)	-0.004 (0.026)	-0.007 (0.048)	Note 2 (0.015)	-0.032** (0.013)	-0.012 (0.022)	-0.016 (0.014)	0.016 (0.018)	0.034 (0.033)	Note 6 (0.033)	0.034 (0.138)	Note 9 (0.034)	-0.017 (0.016)	0.016 (0.031)	Note 12 (0.033)
Retired	-0.004 (0.006)	-0.028** (0.012)	-0.011 (0.014)	-0.057 (0.121)	0.004 (0.015)	0.003 (0.024)	0.020 (0.018)	-0.019** (0.008)	0.017 (0.017)	0.010 (0.013)	-0.001 (0.018)	0.039 (0.040)	-0.009 (0.025)	-0.025** (0.011)	0.004 (0.027)	0.033 (0.026)
Other	-0.002 (0.010)	-0.010 (0.057)	0.052 (0.055)	Note 12 (0.023)	-0.004 (0.023)	-0.024* (0.024)	-0.024* (0.014)	-0.023** (0.010)	0.042 (0.031)	0.002 (0.028)		Note 12 (0.036)	Note 12 (0.036)	Note 11 (0.280)	Note 12 (0.027)	0.046 (0.058)
Missing	0.068* (0.039)		-0.029*** (0.008)	-0.115* (0.069)												Note 12 (0.199)
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.003 (0.004)	-0.013 (0.018)	0.017 (0.015)	0.003 (0.047)	0.013 (0.016)	0.018 (0.013)	-0.000 (0.011)	0.006 (0.007)	-0.014 (0.012)	-0.003 (0.009)	0.009 (0.017)	0.006 (0.027)	0.023 (0.019)	0.010 (0.013)	0.000 (0.045)	-0.015 (0.029)
High (ISCED 4-6)	0.008 (0.005)	-0.019 (0.024)	0.029* (0.015)	-0.051 (0.044)	0.024 (0.019)	0.002 (0.011)	-0.007 (0.012)	-0.002 (0.009)	-0.033*** (0.012)	0.015 (0.016)	0.006 (0.020)	0.007 (0.031)	0.064** (0.027)	-0.016 (0.011)	-0.027 (0.050)	0.025 (0.037)
<i>Inheritance</i>																
Dummy	0.015*** (0.005)	0.013 (0.010)	0.015 (0.009)	-0.051 (0.035)	0.025* (0.011)	0.016* (0.009)	Note 3 (0.009)	0.000 (0.005)	-0.009 (0.006)	Note 5 (0.006)	0.003 (0.013)	0.033 (0.027)	0.064** (0.028)	0.011 (0.010)	-0.022* (0.013)	-0.019 (0.013)

(continued)

Table 17. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Net Wealth Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.030*** (0.006)	0.012 (0.019)	0.033 (0.022)	0.001 (0.042)	0.054*** (0.021)	-0.001 (0.012)	0.033*** (0.012)	0.034*** (0.011)	0.025*** (0.008)	0.033** (0.016)	0.008 (0.024)	Note 7	Note 10	0.031*** (0.011)	0.009 (0.019)	0.007 (0.016)
3rd Quintile	0.034*** (0.005)	0.025 (0.018)	0.044* (0.024)	0.118** (0.052)	0.046*** (0.017)	0.014 (0.012)	0.050*** (0.014)	0.051*** (0.010)	0.023** (0.009)	0.022** (0.011)	0.002 (0.026)			0.043*** (0.011)	0.015 (0.029)	0.008 (0.016)
4th Quintile	0.035*** (0.006)	0.045*** (0.019)	0.055*** (0.020)	0.130** (0.061)	0.020 (0.016)	0.040*** (0.013)	0.108*** (0.013)	0.061*** (0.011)	0.030*** (0.008)	0.012 (0.009)	0.044* (0.025)			0.056*** (0.010)	0.037 (0.027)	0.016 (0.022)
5th Quintile	0.087*** (0.008)	0.179*** (0.041)	0.114*** (0.031)	0.405*** (0.068)	0.064*** (0.018)	0.089*** (0.023)	0.143*** (0.014)	0.146*** (0.016)	0.052*** (0.013)	0.052*** (0.014)	0.109** (0.044)			0.172*** (0.025)	0.124* (0.072)	0.060** (0.027)
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.002 (0.007)	-0.011 (0.024)	0.018 (0.019)	0.030 (0.053)	0.003 (0.025)	0.023 (0.015)	-0.002 (0.014)	-0.011 (0.014)	0.000 (0.006)	0.006 (0.010)	0.012 (0.028)	0.047 (0.041)	-0.021 (0.045)	0.015 (0.018)	-0.002 (0.023)	0.004 (0.019)
3rd Quintile	0.013 (0.008)	0.011 (0.027)	0.062*** (0.024)	0.107* (0.056)	0.008 (0.022)	0.039** (0.013)	-0.008 (0.015)	-0.029** (0.013)	0.011 (0.012)	0.028** (0.011)	0.020 (0.028)	0.036 (0.043)	0.020 (0.042)	0.013 (0.019)	0.015 (0.021)	0.034 (0.024)
4th Quintile	0.016** (0.007)	0.008 (0.024)	0.039** (0.019)	0.059 (0.058)	0.017 (0.022)	0.061*** (0.016)	0.007 (0.016)	-0.037*** (0.013)	0.023** (0.012)	0.038*** (0.011)	0.017 (0.023)	0.068 (0.048)	-0.010 (0.036)	0.003 (0.019)	0.026 (0.019)	0.048 (0.029)
5th Quintile	0.034*** (0.008)	0.008 (0.024)	0.042** (0.020)	0.083 (0.057)	0.054** (0.028)	0.047*** (0.017)	0.065*** (0.020)	-0.037*** (0.013)	0.041*** (0.014)	0.087*** (0.015)	0.027 (0.029)	0.127*** (0.056)	0.004 (0.039)	0.009 (0.018)	0.029 (0.033)	0.076** (0.039)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²In Germany “unemployment” labor status perfectly predicts and is dropped from the estimation.

³The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

⁴In Italy “self-employment” labor status perfectly predicts success and is dropped from the estimation.

⁵Italy does not collect information on inheritance.

⁶In Luxembourg “unemployment” and “other” labor status perfectly predict and are dropped from the estimation.

⁷In Malta in the first wealth quintile there is no observation in some imputates, so it is removed from the model.

⁸In the Netherlands “three or more adults without children” household type perfectly predicts and is dropped from the estimation.

⁹In the Netherlands “unemployment” labor status perfectly predicts and is dropped from the estimation.

¹⁰In the Netherlands there are wealth quintiles with no observations that participate, so it is removed from the model.

¹¹In Portugal “other” labor status perfectly predicts and is dropped from the estimation.

¹²Various indicators in several countries are perfect predictors and hence are dropped from the model.

Appendix 3. Probit Models (Excluding Net Wealth Indicator)

Table 18. Average Marginal Effects of Probit Model of Participation in Households' Main Residence

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children	0.096*** (0.014)	0.181*** (0.027)	0.135*** (0.037)	-0.015 (0.056)	0.098*** (0.031)	0.058*** (0.025)	0.034** (0.014)	0.074*** (0.022)	0.126*** (0.024)	0.040** (0.020)	0.036 (0.047)	0.113** (0.055)	0.171*** (0.054)	0.104*** (0.027)	0.284*** (0.068)	0.104*** (0.029)
>= 3 Adults	0.097*** (0.020)	0.244*** (0.063)	0.127* (0.071)	0.070 (0.079)	0.164*** (0.048)	0.008 (0.039)	0.044 (0.037)	0.102*** (0.035)	0.150*** (0.044)	0.025 (0.032)	-0.107 (0.087)	0.063 (0.080)	0.160 (0.148)	0.120*** (0.035)	0.345*** (0.069)	0.155*** (0.038)
Single Parent	-0.008 (0.025)	0.037 (0.059)	0.006 (0.057)	0.026 (0.094)	-0.018 (0.072)	0.040 (0.044)	-0.023 (0.026)	-0.061** (0.031)	0.079 (0.067)	0.025 (0.043)	-0.002 (0.079)	-0.021 (0.117)	-0.026 (0.107)	-0.012 (0.043)	0.214** (0.096)	0.042 (0.034)
Couple with Children	0.147*** (0.014)	0.233*** (0.037)	0.164*** (0.038)	0.079 (0.057)	0.135*** (0.042)	0.110*** (0.025)	0.087*** (0.019)	0.145*** (0.023)	0.147*** (0.026)	0.070*** (0.022)	0.046 (0.048)	0.235*** (0.059)	0.382*** (0.058)	0.149*** (0.030)	0.353*** (0.070)	0.141*** (0.032)
>= 3 Adults with Children	0.100*** (0.023)	0.229*** (0.070)	0.208** (0.084)	-0.038 (0.103)	0.249*** (0.067)	-0.011 (0.043)	0.058 (0.064)	0.016 (0.042)	0.145*** (0.041)	0.033 (0.037)	0.081 (0.074)	0.193** (0.078)	0.324* (0.196)	0.098** (0.044)	0.408*** (0.073)	0.146*** (0.042)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	-0.005 (0.010)	0.002 (0.034)	-0.043 (0.026)	-0.036 (0.046)	-0.004 (0.028)	-0.003 (0.020)	0.023** (0.011)	0.004 (0.013)	0.008 (0.018)	-0.014 (0.014)	-0.080** (0.038)	-0.026 (0.040)	0.042 (0.040)	0.014 (0.018)	-0.022 (0.037)	-0.015 (0.016)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	0.183*** (0.009)	0.145*** (0.023)	0.161*** (0.034)	0.065 (0.055)	0.191*** (0.025)	0.115*** (0.024)	0.232*** (0.013)	0.250*** (0.018)	0.188*** (0.019)	0.170*** (0.022)	0.083** (0.030)	0.036 (0.045)	0.030 (0.050)	0.208*** (0.030)	0.136*** (0.048)	0.196*** (0.028)
65 Years and Over	0.233*** (0.014)	0.181*** (0.040)	0.069 (0.075)	0.134 (0.123)	0.239*** (0.053)	0.134*** (0.037)	0.257*** (0.027)	0.266*** (0.028)	0.242*** (0.049)	0.237*** (0.032)	0.238*** (0.069)	0.024 (0.060)	0.145** (0.069)	0.251*** (0.039)	0.113 (0.089)	0.234*** (0.047)

(continued)

Table 18. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Labour Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	0.042** (0.016)	0.149*** (0.043)	0.050 (0.063)	-0.042 (0.078)	0.074 (0.047)	-0.041 (0.036)	0.155*** (0.023)	0.126*** (0.027)	0.040 (0.026)	0.006 (0.024)	-0.131* (0.067)	0.055 (0.053)	-0.069 (0.113)	0.031 (0.027)	0.101 (0.091)	0.035 (0.032)
Unemployed	-0.091*** (0.020)	-0.136*** (0.068)	-0.095* (0.050)	-0.042 (0.084)	-0.113* (0.061)	-0.076** (0.034)	-0.073*** (0.027)	-0.126*** (0.027)	0.042 (0.066)	0.055 (0.048)	-0.192 (0.183)	0.041 (0.099)	-0.074 (0.157)	-0.132*** (0.034)	-0.016 (0.060)	-0.208** (0.091)
Retired	0.103*** (0.013)	0.072* (0.038)	0.237*** (0.049)	-0.049 (0.112)	0.099* (0.052)	0.091*** (0.029)	0.133*** (0.024)	0.141*** (0.028)	0.147*** (0.038)	0.177*** (0.024)	0.088 (0.060)	-0.027 (0.059)	-0.112* (0.065)	-0.018 (0.031)	0.262*** (0.060)	0.056 (0.034)
Other	-0.014 (0.020)	-0.061 (0.092)	-0.096 (0.063)	-0.208 (0.133)	-0.051 (0.067)	0.048 (0.032)	-0.082*** (0.024)	-0.037 (0.031)	-0.026 (0.056)	0.222*** (0.041)	0.147** (0.060)	0.050 (0.071)	-0.131** (0.064)	-0.009 (0.051)	0.003 (0.081)	0.050* (0.028)
Missing	0.060 (0.042)		0.071 (0.116)	-0.217 (0.256)									-0.045 (0.055)	-0.051 (0.199)		Note 4
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.038*** (0.010)	-0.009 (0.028)	0.017 (0.033)	0.045 (0.054)	0.055 (0.036)	-0.048** (0.022)	0.036** (0.015)	0.062*** (0.014)	-0.004 (0.027)	0.086*** (0.018)	0.101** (0.042)	0.083** (0.038)	-0.006 (0.036)	0.020 (0.025)	0.093** (0.044)	0.021 (0.044)
High (ISCED 4-6)	0.054*** (0.012)	-0.090** (0.038)	0.086** (0.035)	0.077 (0.057)	0.055 (0.042)	-0.012 (0.023)	0.061*** (0.016)	0.094*** (0.019)	-0.049 (0.037)	0.106*** (0.033)	-0.006 (0.057)	0.111** (0.050)	0.086** (0.039)	0.033 (0.029)	0.051 (0.050)	0.057 (0.044)
<i>Inheritance</i>																
Dummy	0.200*** (0.010)	0.269*** (0.025)	0.104*** (0.025)	0.204*** (0.040)	0.249*** (0.021)	0.139*** (0.018)	Note 2	0.122*** (0.012)	0.439*** (0.028)	Note 3	0.180*** (0.036)	0.176*** (0.031)	0.102*** (0.065)	0.226*** (0.020)	0.292*** (0.040)	0.150*** (0.018)

(continued)

Table 18. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.068*** (0.016)	0.076 (0.046)	0.053 (0.044)	0.162** (0.078)	0.118** (0.032)	0.044 (0.034)	0.150*** (0.025)	0.077*** (0.021)	0.013 (0.034)	0.107*** (0.024)	0.174** (0.070)	0.034 (0.060)	-0.011 (0.064)	-0.051* (0.031)	0.031 (0.080)	-0.002 (0.026)
3rd Quintile	0.132*** (0.017)	0.097*** (0.048)	0.174*** (0.048)	0.131 (0.089)	0.161*** (0.050)	0.110*** (0.037)	0.250*** (0.024)	0.156*** (0.025)	0.051 (0.035)	0.189*** (0.026)	0.331*** (0.067)	0.049 (0.065)	0.017 (0.067)	0.030 (0.029)	0.024 (0.073)	0.020 (0.029)
4th Quintile	0.220*** (0.017)	0.102 (0.050)	0.264*** (0.046)	0.276*** (0.085)	0.264*** (0.048)	0.117*** (0.039)	0.349*** (0.030)	0.287*** (0.026)	0.070 (0.046)	0.297*** (0.026)	0.457*** (0.063)	0.081 (0.069)	0.131* (0.075)	0.050 (0.035)	0.090 (0.071)	0.032 (0.028)
5th Quintile	0.275*** (0.020)	0.194*** (0.056)	0.298*** (0.054)	0.305*** (0.083)	0.340*** (0.058)	0.198*** (0.035)	0.411*** (0.031)	0.328*** (0.028)	0.148*** (0.044)	0.332*** (0.028)	0.462*** (0.070)	0.105 (0.076)	0.138*** (0.069)	0.102*** (0.032)	0.114 (0.074)	-0.004 (0.047)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³Italy does not collect information on inheritance.

⁴In Slovakia there are missing observations in the labor market status, but due to perfect prediction the dummy is dropped.

Table 19. Average Marginal Effects of a Probit Model of Participation in Risky Financial Assets

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children	-0.050*** (0.010)	-0.029 (0.021)	-0.001 (0.032)	-0.070 (0.061)	-0.067*** (0.025)	-0.028 (0.021)	0.004 (0.017)	-0.080*** (0.013)	0.014 (0.017)	-0.085*** (0.021)	-0.069* (0.042)	0.029 (0.055)	0.002 (0.040)	-0.017 (0.023)	0.048 (0.059)	-0.011 (0.019)
>= 3 Adults	-0.099*** (0.012)	-0.062** (0.028)	-0.020 (0.051)	-0.011 (0.095)	-0.106*** (0.036)	-0.075*** (0.025)	-0.036 (0.030)	-0.147*** (0.022)	0.017 (0.021)	-0.165*** (0.023)	-0.087 (0.055)	0.055 (0.076)	-0.152** (0.076)	-0.051* (0.030)	0.014 (0.061)	-0.001 (0.023)
Single Parent	-0.039 (0.029)	-0.015 (0.053)	-0.094* (0.054)	0.085 (0.095)	0.028 (0.073)	-0.003 (0.051)	-0.033 (0.032)	-0.087*** (0.026)	-0.013 (0.015)	-0.083 (0.056)	-0.153 (0.102)	-0.093 (0.145)	-0.176 (0.145)	-0.029 (0.035)	-0.040 (0.070)	0.023 (0.044)
Couple with Children	-0.076*** (0.010)	-0.026 (0.026)	-0.015 (0.040)	-0.055 (0.060)	-0.084*** (0.026)	-0.052* (0.027)	-0.043** (0.019)	-0.089*** (0.016)	0.005 (0.016)	-0.134*** (0.024)	-0.079* (0.043)	0.141** (0.068)	-0.070 (0.044)	-0.022 (0.029)	0.058 (0.069)	-0.002 (0.016)
>= 3 Adults	-0.100*** (0.017)	-0.095*** (0.031)	-0.041 (0.066)	-0.040 (0.101)	-0.133*** (0.040)	-0.013 (0.043)	-0.067* (0.035)	-0.147*** (0.021)	0.012 (0.028)	-0.172*** (0.026)	-0.170*** (0.061)	0.080 (0.081)	-0.040 (0.089)	-0.048 (0.031)	-0.109 (0.083)	-0.010 (0.029)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	0.018** (0.008)	0.036** (0.017)	0.019 (0.027)	0.090* (0.047)	-0.004 (0.021)	0.018 (0.019)	0.020 (0.013)	0.028** (0.012)	0.001 (0.014)	0.020 (0.015)	0.031 (0.036)	-0.104** (0.050)	0.015 (0.036)	0.037** (0.016)	0.036 (0.036)	0.005 (0.013)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	0.025** (0.011)	0.009 (0.022)	0.076** (0.032)	0.226*** (0.047)	-0.044** (0.027)	0.072*** (0.021)	0.028** (0.014)	0.037*** (0.012)	0.021** (0.010)	0.121*** (0.013)	0.049 (0.037)	0.069 (0.055)	0.083** (0.040)	0.023 (0.019)	0.982*** (0.039)	0.015 (0.011)
65 Years and Over	0.040*** (0.015)	-0.025 (0.033)	0.136** (0.058)	0.135 (0.143)	0.005 (0.050)	0.133*** (0.043)	0.090*** (0.027)	0.029 (0.024)	0.054* (0.032)	0.093*** (0.023)	0.124 (0.080)	0.109 (0.079)	0.241*** (0.066)	0.028 (0.023)	0.076 (0.059)	0.031 (0.035)

(continued)

Table 19. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	PI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Labor Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	0.004 (0.011)	0.052* (0.030)	0.006 (0.060)	-0.046 (0.064)	-0.035 (0.030)	0.017 (0.027)	0.093*** (0.017)	0.018 (0.019)	0.002 (0.018)	0.029* (0.016)	0.038 (0.052)	0.069 (0.059)	0.046 (0.091)	0.019 (0.023)	-0.014 (0.076)	0.013 (0.022)
Unemployed	-0.048** (0.019)	0.030 (0.057)	-0.022 (0.060)	-0.039 (0.097)	-0.044 (0.061)	-0.042* (0.024)	-0.079*** (0.028)	-0.084*** (0.023)	-0.016 (0.019)	0.043 (0.054)	0.042 (0.070)	0.086 (0.134)	-0.077 (0.135)	-0.002 (0.033)	0.000 (0.063)	-0.027 (0.041)
Retired	0.031*** (0.011)	0.047 (0.029)	0.089* (0.052)	0.063 (0.140)	-0.011 (0.036)	0.034 (0.036)	0.062** (0.026)	-0.008 (0.018)	Note 3	0.127*** (0.018)	0.006 (0.062)	0.070 (0.068)	-0.116** (0.056)	0.019 (0.023)	0.005 (0.053)	-0.024 (0.021)
Other	0.043* (0.025)	0.039 (0.064)	-0.064 (0.077)	-0.150 (0.163)	0.052 (0.057)	-0.016 (0.043)	0.017 (0.025)	-0.044 (0.035)		0.157* (0.089)	0.065 (0.120)	-0.034 (0.093)	0.032 (0.071)	-0.033 (0.031)	-0.135*** (0.045)	0.012 (0.070)
Missing	-0.005 (0.039)		-0.059 (0.153)	0.287 (0.304)									0.024 (0.060)	Note 5		Note 6
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.056*** (0.007)	0.085*** (0.021)	0.110*** (0.028)	0.028 (0.055)	0.085*** (0.033)	0.096*** (0.019)	0.066*** (0.015)	0.036*** (0.012)	0.027** (0.012)	0.050*** (0.012)	0.126*** (0.027)	0.030 (0.043)	0.071 (0.044)	0.065*** (0.017)	0.110*** (0.034)	-0.001 (0.049)
High (ISCED 4-6)	0.135*** (0.011)	0.146*** (0.033)	0.200*** (0.034)	0.076 (0.060)	0.217*** (0.040)	0.176*** (0.020)	0.163*** (0.016)	0.083*** (0.015)	0.041*** (0.014)	0.051*** (0.020)	0.256*** (0.043)	0.084 (0.054)	0.106** (0.044)	0.130*** (0.020)	0.332*** (0.061)	0.056 (0.054)
<i>Inheritance</i>																
Dummy	0.076*** (0.009)	0.077*** (0.017)	0.112*** (0.022)	0.102** (0.041)	0.058*** (0.019)	0.077*** (0.017)	Note 2	0.095*** (0.009)	-0.007 (0.010)	Note 4	0.075** (0.034)	0.207*** (0.038)	0.173*** (0.051)	0.062*** (0.014)	0.021 (0.034)	-0.001 (0.013)

(continued)

Table 19. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.048*** (0.009)	0.030 (0.021)	0.117*** (0.030)	0.109 (0.068)	0.025 (0.025)	0.038** (0.024)	0.091*** (0.022)	0.058*** (0.011)	-0.004 (0.017)	0.074*** (0.009)	0.064 (0.041)	0.100* (0.056)	0.044 (0.056)	0.001 (0.017)	0.010 (0.059)	-0.002 (0.028)
3rd Quintile	0.119*** (0.012)	0.076*** (0.025)	0.208*** (0.038)	0.115 (0.079)	0.132*** (0.033)	0.040 (0.026)	0.181*** (0.023)	0.134*** (0.014)	0.005 (0.019)	0.173*** (0.014)	0.181*** (0.051)	0.110* (0.059)	0.055 (0.052)	0.032 (0.020)	0.106* (0.060)	0.006 (0.025)
4th Quintile	0.187*** (0.012)	0.150*** (0.034)	0.236*** (0.034)	0.207*** (0.079)	0.182*** (0.035)	0.084** (0.029)	0.261*** (0.026)	0.229*** (0.017)	0.025 (0.022)	0.300*** (0.020)	0.281*** (0.052)	0.206*** (0.065)	0.134** (0.063)	0.059*** (0.020)	-0.014 (0.057)	-0.024 (0.023)
5th Quintile	0.327*** (0.013)	0.198*** (0.035)	0.279*** (0.038)	0.375*** (0.088)	0.335*** (0.042)	0.220** (0.032)	0.427*** (0.030)	0.415*** (0.021)	0.062** (0.029)	0.472*** (0.022)	0.495*** (0.060)	0.249*** (0.081)	0.164*** (0.057)	0.201*** (0.029)	0.015 (0.068)	-0.014 (0.026)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³In Greece some indicators for the labor market status are dropped due to perfect prediction.

⁴Italy does not collect information on inheritance.

⁵Portugal has missing observations in the labor market status, but a coefficient cannot be estimated due to perfect prediction.

⁶In Slovakia there are missing observations in the labor market status, but due to perfect prediction the dummy is dropped.

Table 20. Average Marginal Effects of a Probit Model of Participation in Other Real Estate

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children	0.040*** (0.010)	0.007 (0.021)	0.008 (0.024)	0.116** (0.058)	0.007 (0.023)	0.072*** (0.024)	0.140*** (0.015)	0.037** (0.016)	0.063** (0.028)	0.069*** (0.017)	0.007 (0.060)	-0.007 (0.056)	0.038 (0.024)	0.038 (0.032)	0.086 (0.053)	-0.022 (0.090)
> 3 Adults w/o Children	0.040*** (0.015)	0.024 (0.045)	-0.016 (0.039)	0.242** (0.102)	-0.004 (0.034)	0.028 (0.033)	0.278*** (0.037)	0.033 (0.029)	0.133*** (0.036)	0.103*** (0.024)	0.055 (0.078)	0.018 (0.071)	0.026 (0.047)	0.037 (0.035)	0.139** (0.064)	0.062 (0.092)
Single Parent	-0.004 (0.020)	-0.001 (0.059)	0.032 (0.054)	-0.064 (0.085)	0.046 (0.067)	0.025 (0.056)	0.005 (0.030)	-0.025 (0.026)	0.083 (0.083)	-0.061* (0.034)	0.127 (0.095)	0.012 (0.101)	-0.011 (0.102)	-0.079* (0.044)	-0.111* (0.045)	0.017 (0.062)
Couple with Children	0.035*** (0.013)	-0.001 (0.026)	0.006 (0.035)	0.111* (0.061)	0.001 (0.027)	0.063** (0.029)	0.092*** (0.017)	0.040** (0.017)	0.072** (0.036)	0.083*** (0.025)	-0.030 (0.059)	0.107 (0.069)	0.047 (0.039)	0.015 (0.033)	0.055 (0.062)	0.028 (0.039)
>= 3 Adults with Children	0.036** (0.018)	0.003 (0.036)	0.023 (0.073)	0.026 (0.087)	-0.004 (0.042)	0.087** (0.043)	0.181*** (0.044)	0.022 (0.036)	0.098* (0.053)	0.087*** (0.031)	0.032 (0.085)	0.085 (0.083)	-0.041 (0.068)	0.017 (0.044)	0.160** (0.078)	0.002 (0.050)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	0.005 (0.009)	-0.003 (0.017)	0.043** (0.021)	0.049 (0.042)	-0.009 (0.021)	-0.017 (0.023)	0.049*** (0.010)	-0.001 (0.012)	0.037 (0.028)	0.007 (0.016)	0.069* (0.041)	-0.043 (0.049)	0.013 (0.020)	0.021 (0.016)	-0.060** (0.029)	-0.004 (0.025)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	0.103*** (0.008)	0.053*** (0.017)	0.086*** (0.025)	0.130** (0.056)	0.046** (0.024)	0.131*** (0.024)	0.206*** (0.012)	0.124*** (0.015)	0.089*** (0.026)	0.146*** (0.017)	0.094** (0.041)	0.112** (0.053)	0.076*** (0.022)	0.086*** (0.023)	0.169*** (0.026)	0.051* (0.026)
65 Years and Over	0.103*** (0.013)	0.057* (0.033)	0.070 (0.043)	-0.032 (0.116)	0.070 (0.044)	0.079** (0.036)	0.251*** (0.025)	0.007*** (0.029)	0.107** (0.044)	0.178*** (0.027)	0.184** (0.079)	0.138* (0.082)	0.039 (0.031)	0.135*** (0.033)	0.275*** (0.056)	0.023 (0.045)

(continued)

Table 20. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Labour Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	0.136*** (0.014)	0.089*** (0.033)	0.173*** (0.057)	0.168*** (0.062)	0.072** (0.031)	0.133*** (0.034)	0.192*** (0.018)	0.208*** (0.024)	0.129*** (0.032)	0.172*** (0.027)	0.157*** (0.060)	0.260*** (0.055)	0.082 (0.089)	0.162*** (0.028)	0.093 (0.066)	0.082** (0.041)
Unemployed	-0.047*** (0.015)	0.030 (0.070)	-0.040 (0.034)	0.031 (0.108)	-0.090*** (0.035)	-0.000 (0.037)	-0.051** (0.024)	-0.104*** (0.020)	-0.068 (0.095)	-0.038 (0.043)	Note 5	-0.054 (0.224)	0.104 (0.141)	-0.027 (0.040)	-0.059 (0.056)	0.030 (0.092)
Retired	0.061*** (0.013)	0.011 (0.024)	0.104*** (0.040)	0.017 (0.103)	0.038 (0.036)	0.151*** (0.031)	0.099*** (0.023)	0.064** (0.026)	0.091*** (0.032)	0.051*** (0.018)	0.047 (0.055)	0.112* (0.062)	0.025 (0.028)	0.046 (0.030)	-0.054 (0.045)	0.117*** (0.041)
Other	-0.002 (0.017)	Note 2	-0.040 (0.046)	-0.065 (0.103)	-0.003 (0.051)	0.094** (0.037)	0.011 (0.019)	-0.056** (0.027)	-0.020 (0.068)	0.031 (0.053)	-0.185** (0.075)	-0.072 (0.078)	-0.024 (0.021)	0.095 (0.060)	-0.092 (0.072)	0.092 (0.084)
Missing	0.015 (0.044)		0.017 (0.084)	0.193 (0.231)									0.002 (0.025)	0.194 (0.191)		Note 6
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.018*** (0.007)	-0.014 (0.024)	0.022 (0.029)	0.120** (0.047)	0.066*** (0.024)	0.022 (0.029)	0.025* (0.014)	0.026** (0.012)	-0.014 (0.029)	0.039*** (0.015)	-0.043 (0.042)	0.086*** (0.033)	-0.000 (0.022)	0.007 (0.022)	0.000 (0.039)	-0.130* (0.076)
High (ISCED 4-6)	0.075*** (0.012)	0.053 (0.033)	0.036 (0.025)	0.059 (0.053)	0.133*** (0.035)	0.041* (0.025)	0.050*** (0.015)	0.051*** (0.016)	0.026 (0.031)	0.130*** (0.025)	0.075 (0.055)	0.115** (0.058)	0.058** (0.026)	0.105*** (0.029)	0.048 (0.059)	0.023 (0.085)
<i>Inheritance</i>																
Dummy	0.165*** (0.008)	0.152*** (0.016)	0.082*** (0.017)	0.277*** (0.035)	0.105*** (0.015)	0.290*** (0.017)	Note 3	0.188*** (0.011)	0.066** (0.026)	Note 4	0.128*** (0.036)	0.163*** (0.037)	0.043 (0.031)	0.239*** (0.018)	0.099*** (0.030)	0.051** (0.020)

(continued)

Table 20. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.027*** (0.010)	0.045* (0.026)	-0.003 (0.030)	0.049 (0.073)	-0.015 (0.022)	0.122*** (0.027)	0.053*** (0.020)	0.043*** (0.016)	0.029 (0.031)	0.022 (0.021)	0.027 (0.066)	0.047 (0.059)	0.009 (0.047)	0.010 (0.028)	0.157*** (0.050)	0.034 (0.031)
3rd Quintile	0.070*** (0.013)	0.062*** (0.023)	0.006 (0.032)	0.048 (0.078)	0.054* (0.030)	0.162*** (0.024)	0.122*** (0.022)	0.072*** (0.023)	0.143*** (0.037)	0.052** (0.024)	0.097 (0.063)	0.087 (0.067)	-0.043 (0.046)	0.049 (0.034)	0.184*** (0.054)	0.121*** (0.046)
4th Quintile	0.130*** (0.014)	0.100*** (0.028)	0.083** (0.039)	0.116 (0.090)	0.144*** (0.035)	0.240*** (0.031)	0.169*** (0.024)	0.126*** (0.021)	0.121*** (0.038)	0.074*** (0.023)	0.160** (0.066)	0.106* (0.058)	-0.010 (0.043)	0.098*** (0.034)	0.109** (0.046)	0.164*** (0.056)
5th Quintile	0.221*** (0.017)	0.189*** (0.030)	0.151*** (0.042)	0.322*** (0.097)	0.210*** (0.049)	0.350*** (0.038)	0.229*** (0.025)	0.246*** (0.024)	0.246*** (0.040)	0.176*** (0.028)	0.264*** (0.077)	0.174** (0.073)	0.000 (0.043)	0.208*** (0.032)	0.275*** (0.065)	0.215*** (0.064)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²In Austria “other” labor status perfectly predicts failure and is dropped from the estimation.

³The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

⁴Italy does not collect information on inheritance.

⁵In Luxembourg “unemployed” labor status perfectly predicts failure and is dropped from the estimation.

⁶In Slovakia there are missing observations in the labor market status, but due to perfect prediction the dummy is dropped.

Table 21. Average Marginal Effects from a Probit Model of Participation in Business Ownership

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children >= 3 Adults	0.033*** (0.006)	0.036** (0.016)	0.031** (0.014)	0.004 (0.057)	0.039*** (0.015)	0.030** (0.015)	0.053*** (0.011)	0.042*** (0.008)	0.024*** (0.008)	0.029*** (0.008)	0.030 (0.034)	-0.015 (0.026)	0.023 (0.026)	0.027* (0.015)	Note 10	-0.033* (0.019)
Couple w/o Children Single Parent	0.067*** (0.008)	0.106*** (0.028)	0.030 (0.029)	0.046 (0.083)	0.042** (0.018)	0.058*** (0.021)	0.043* (0.023)	0.056*** (0.014)	0.061*** (0.020)	0.109*** (0.019)	0.011 (0.047)	-0.015 (0.029)	Note 7	0.044** (0.020)		0.016 (0.030)
Couple with Children >= 3 Adults	0.004 (0.008)	-0.002 (0.035)	0.021 (0.032)	0.002 (0.095)	0.015 (0.029)	-0.038** (0.018)	0.008 (0.024)	-0.008 (0.008)	-0.010 (0.007)	0.024 (0.023)	0.007 (0.026)	-0.030 (0.101)	-0.008 (0.067)	0.028 (0.040)		-0.014 (0.022)
Couple with Children >= 3 Adults with Children	0.039*** (0.006)	0.027 (0.020)	0.025 (0.017)	-0.006 (0.052)	0.035** (0.017)	0.046*** (0.017)	0.057*** (0.014)	0.057*** (0.009)	0.051*** (0.012)	0.049*** (0.012)	0.015 (0.018)	-0.040 (0.039)	-0.013 (0.019)	0.032* (0.016)		-0.025 (0.019)
	0.054*** (0.009)	0.077*** (0.031)	0.007 (0.032)	-0.021 (0.062)	0.062** (0.029)	0.044* (0.024)	-0.041** (0.018)	0.077*** (0.015)	0.058*** (0.022)	0.085*** (0.017)	0.061 (0.037)	-0.013 (0.051)	0.035 (0.068)	0.019 (0.020)		-0.021 (0.032)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	-0.016*** (0.004)	-0.019 (0.014)	-0.009 (0.016)	0.067** (0.030)	-0.016 (0.012)	-0.017 (0.012)	-0.009 (0.008)	-0.023*** (0.006)	-0.021** (0.009)	-0.012 (0.010)	-0.018 (0.021)	-0.032 (0.031)	0.008 (0.018)	-0.004 (0.013)	-0.051*** (0.019)	-0.016 (0.015)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	0.004 (0.005)	0.028* (0.015)	0.014 (0.013)	0.017 (0.039)	0.025* (0.015)	-0.018 (0.014)	0.085*** (0.008)	0.004 (0.007)	-0.016 (0.011)	-0.003 (0.012)	0.002 (0.021)	-0.014 (0.036)	-0.014 (0.026)	-0.004 (0.012)	-0.010 (0.018)	-0.009 (0.012)
65 Years and Over	-0.016** (0.006)	0.007 (0.023)	-0.015 (0.023)	-0.046 (0.145)	-0.015 (0.016)	-0.028 (0.025)	0.117*** (0.020)	-0.010 (0.011)	-0.020 (0.022)	-0.020 (0.015)	-0.017 (0.030)	-0.076 (0.052)	-0.047 (0.051)	0.017 (0.024)	-0.054* (0.029)	-0.001 (0.035)

(continued)

Table 21. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	PI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Labor Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	0.074*** (0.017)	0.452*** (0.046)	0.514*** (0.060)	0.481*** (0.070)	0.554*** (0.054)	0.791*** (0.030)	0.191*** (0.018)	0.735*** (0.021)	0.260*** (0.032)	Note 4	0.340*** (0.078)	0.564*** (0.080)	0.482*** (0.136)	0.377*** (0.037)	0.795*** (0.063)	0.703*** (0.065)
Unemployed	-0.022*** (0.005)	0.009 (0.068)	-0.006 (0.018)	-0.092** (0.039)	Note 2	-0.033*** (0.011)	-0.018 (0.020)	-0.018** (0.010)	0.011 (0.015)	0.030 (0.032)	Note 6	0.041 (0.147)	Note 8	-0.025** (0.013)	-0.003 (0.026)	Note 10
Retired	0.002 (0.006)	-0.016 (0.011)	0.000 (0.017)	-0.072 (0.124)	0.003 (0.015)	0.024 (0.027)	0.041** (0.019)	-0.009 (0.008)	0.020 (0.017)	0.012 (0.013)	0.018 (0.021)	0.048 (0.042)	-0.011 (0.027)	-0.021 (0.013)	0.026 (0.036)	0.024 (0.020)
Other	0.000 (0.010)	0.004 (0.071)	0.035 (0.042)	Note 10	-0.006 (0.022)	-0.010 (0.028)	-0.022 (0.014)	-0.022*** (0.008)	0.039 (0.031)	0.007 (0.029)		X10	0.039 (0.035)	Note 9	Note 10	0.051 (0.066)
Missing	0.074* (0.039)		-0.026*** (0.007)	-0.115* (0.065)									0.064* (0.039)	0.350 (0.225)		Note 10
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.010** (0.004)	-0.011 (0.019)	0.022 (0.015)	0.032 (0.046)	0.016 (0.016)	0.024* (0.013)	0.001 (0.011)	0.013** (0.006)	-0.010 (0.010)	0.003 (0.008)	0.015 (0.017)	0.010 (0.027)	0.023 (0.019)	0.022 (0.016)	0.033 (0.027)	-0.030 (0.027)
High (ISCED 4-6)	0.015*** (0.006)	-0.017 (0.026)	0.042*** (0.015)	-0.025 (0.045)	0.031* (0.018)	0.015 (0.012)	0.001 (0.011)	0.009 (0.009)	-0.027*** (0.010)	0.025 (0.015)	0.011 (0.021)	0.012 (0.031)	0.006** (0.028)	0.004 (0.013)	0.033 (0.031)	0.048 (0.039)
<i>Inheritance</i>																
Dummy	0.027*** (0.005)	0.047*** (0.010)	0.027*** (0.010)	0.011 (0.033)	0.031*** (0.011)	0.029*** (0.009)	Note 3	0.018*** (0.005)	-0.001 (0.006)	Note 5	0.021 (0.013)	0.035 (0.027)	0.064** (0.028)	0.037*** (0.011)	-0.021 (0.016)	-0.015 (0.012)

(continued)

Table 21. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.006 (0.007)	0.002 (0.010)	0.018 (0.017)	0.026 (0.037)	0.006 (0.023)	0.027** (0.013)	0.015 (0.013)	-0.003 (0.011)	0.003 (0.005)	0.006 (0.008)	0.007 (0.024)	0.046 (0.042)	-0.022 (0.048)	0.026* (0.014)	-0.011 (0.015)	0.012 (0.018)
3rd Quintile	0.021*** (0.007)	0.033 (0.026)	0.069*** (0.022)	0.106** (0.049)	0.012 (0.019)	0.049*** (0.014)	0.019 (0.013)	-0.012 (0.012)	0.016 (0.010)	0.030*** (0.010)	0.022 (0.025)	0.033 (0.042)	0.021 (0.043)	0.037** (0.017)	0.036** (0.017)	0.041* (0.024)
4th Quintile	0.029*** (0.006)	0.037 (0.024)	0.052*** (0.018)	0.107** (0.054)	0.024 (0.019)	0.080** (0.017)	0.046*** (0.015)	-0.013 (0.011)	0.028*** (0.011)	0.044*** (0.024)	0.032 (0.024)	0.066 (0.048)	-0.012 (0.036)	0.032* (0.018)	0.048* (0.028)	0.063* (0.032)
5th Quintile	0.062*** (0.008)	0.060*** (0.022)	0.061*** (0.022)	0.188*** (0.064)	0.069*** (0.026)	0.081** (0.017)	0.126*** (0.019)	0.003 (0.011)	0.057*** (0.013)	0.105*** (0.017)	0.061* (0.032)	0.134** (0.055)	0.003 (0.040)	0.072*** (0.017)	0.118*** (0.034)	0.101** (0.043)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²In Germany “unemployment” labor status perfectly predicts and is dropped from the estimation.

³The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

⁴In Italy “self-employment” labor status perfectly predicts success and is dropped from the estimation.

⁵Italy does not collect information on inheritance.

⁶In Luxembourg “unemployment” and “other” labor status perfectly predict and are dropped from the estimation.

⁷In the Netherlands “three or more adults without children” household type perfectly predicts and is dropped from the estimation.

⁸In the Netherlands “unemployment” labor status perfectly predicts and is dropped from the estimation.

⁹In Portugal “other” labor status perfectly predicts and is dropped from the estimation.

¹⁰Various indicators in several countries are perfect predictors and hence are dropped from the model.

Appendix 4. Tobit Models (Including Net Wealth Indicator)

Table 22. Tobit Model for the Portfolio Share of Other Real Estate

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children	-0.012 (0.029)	-0.063 (0.110)	0.042 (0.101)	0.185 (0.141)	-0.106 (0.098)	0.039 (0.043)	0.105*** (0.031)	-0.014 (0.045)	-0.038 (0.071)	0.048 (0.048)	-0.145 (0.137)	-0.057 (0.087)	-0.144 (0.225)	0.003 (0.057)	0.073 (0.092)	-0.072 (0.083)
>= 3 Adults w/o Children	-0.001 (0.035)	-0.080 (0.146)	0.029 (0.153)	0.213 (0.158)	-0.124 (0.111)	0.004 (0.050)	0.216*** (0.043)	0.012 (0.061)	0.001 (0.086)	0.123** (0.053)	-0.100 (0.156)	0.029 (0.107)	-0.184 (0.293)	0.032 (0.063)	0.06 (0.122)	0.052 (0.091)
Single Parent	-0.008 (0.039)	0.003 (0.215)	0.082 (0.142)	-0.078 (0.180)	0.015 (0.149)	0.011 (0.078)	-0.000 (0.050)	0.077 (0.065)	-0.007 (0.119)	-0.174* (0.094)	0.04 (0.181)	0.088 (0.244)	0.087 (0.654)	-0.137 (0.086)	-0.358*** (0.149)	-0.024 (0.113)
Couple with Children	-0.031 (0.034)	-0.096 (0.120)	0.054 (0.123)	0.155 (0.144)	-0.088 (0.114)	0.043 (0.054)	0.049 (0.031)	-0.064 (0.043)	-0.051 (0.081)	0.031 (0.053)	-0.207 (0.143)	0.036 (0.106)	-0.120 (0.279)	-0.027 (0.070)	-0.014 (0.120)	-0.008 (0.084)
>= 3 Adults with Children	0.003 (0.040)	-0.084 (0.140)	0.086 (0.195)	0.151 (0.164)	-0.212 (0.133)	0.095 (0.062)	0.092** (0.046)	0.038 (0.088)	0.035 (0.105)	0.107 (0.066)	-0.171 (0.176)	0.078 (0.094)	-0.881 (0.897)	0.01 (0.075)	0.088 (0.117)	-0.016 (0.105)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	-0.006 (0.018)	-0.018 (0.057)	0.117** (0.053)	0.056 (0.058)	-0.065 (0.055)	-0.043 (0.033)	0.041*** (0.015)	-0.004 (0.021)	-0.013 (0.038)	-0.003 (0.027)	0.048 (0.084)	-0.043 (0.060)	-0.088 (0.103)	0.015 (0.026)	-0.099* (0.054)	-0.003 (0.041)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	0.054** (0.024)	0.058 (0.068)	0.054 (0.102)	0.076 (0.067)	-0.015 (0.082)	0.049 (0.040)	0.043* (0.022)	0.011 (0.042)	0.012 (0.038)	0.141*** (0.045)	0.137 (0.105)	0.048 (0.062)	0.141 (0.157)	0.003 (0.045)	0.487*** (0.082)	-0.030 (0.048)
65 Years and Over	0.053* (0.030)	0.074 (0.106)	0.053 (0.120)	-0.083 (0.141)	0.014 (0.117)	0.056 (0.052)	0.051 (0.032)	-0.019 (0.058)	0.017 (0.066)	0.163*** (0.054)	0.213 (0.153)	0.171* (0.098)	-0.090 (0.231)	0.03 (0.057)	0.644*** (0.120)	-0.084 (0.087)

(continued)

Table 22. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Marital Status (Reference Person) (Base: Unmarried)</i>																
Married	0.032 (0.029)	0.008 (0.090)	-0.188** (0.092)	-0.118 (0.147)	0.12 (0.105)	-0.024 (0.046)	-0.045* (0.026)	0.048 (0.039)	0.000 (0.069)	0.027 (0.052)	0.249** (0.116)	0.007 (0.070)	0.168 (0.214)	-0.009 (0.049)	-0.361*** (0.097)	0.013 (0.099)
Divorced	0.034 (0.033)	0.063 (0.113)	0.031 (0.123)	-0.031 (0.132)	0.143 (0.098)	-0.019 (0.060)	0.001 (0.029)	-0.011 (0.046)	0.03 (0.092)	-0.005 (0.062)	0.148 (0.115)	0.132 (0.127)	-0.042 (0.283)	0.023 (0.060)	-0.592*** (0.128)	0.129 (0.087)
Widowed	-0.041 (0.030)	0.088 (0.121)	-0.062 (0.148)	-0.212* (0.126)	0.01 (0.107)	-0.164*** (0.055)	-0.090** (0.043)	0.023 (0.043)	-0.084 (0.087)	-0.067* (0.039)	0.109 (0.127)	-0.038 (0.110)	-0.311 (0.214)	0.029 (0.063)	-0.480*** (0.125)	-1.007 (0.094)
<i>Labour Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	0.074*** (0.022)	0.044 (0.067)	0.220** (0.095)	-0.016 (0.049)	0.042 (0.069)	0.031 (0.039)	0.097*** (0.018)	0.074*** (0.027)	-0.005 (0.043)	0.112*** (0.029)	0.152 (0.093)	0.021 (0.058)	0.308 (0.272)	0.073** (0.033)	-0.006 (0.089)	0.073 (0.060)
Unemployed	-0.049 (0.037)	0.098 (0.210)	-0.172 (0.177)	0.076 (0.127)	-0.253 (0.263)	0.025 (0.054)	-0.098** (0.040)	-0.124* (0.071)	-0.074 (0.174)	-0.091 (0.098)	23.54 (0.490)	-0.051 (0.490)	0.539 (0.490)	-0.052 (0.077)	-0.088 (0.126)	-0.003 (0.176)
Retired	-0.003 (0.022)	0.025 (0.076)	0.065 (0.070)	0.019 (0.120)	-0.007 (0.075)	0.065* (0.037)	0.007 (0.026)	-0.038 (0.039)	-0.030 (0.049)	-0.047* (0.028)	-0.054 (0.095)	0.014 (0.064)	0.095 (0.134)	0.061 (0.045)	-0.233*** (0.088)	0.185*** (0.063)
Other	-0.030 (0.040)	-20.29 (0.327)	-0.201 (0.201)	0.117 (0.160)	-0.016 (0.153)	0.114** (0.049)	-0.026 (0.033)	-0.107* (0.065)	-0.150 (0.114)	-0.138 (0.086)	-0.524 (0.437)	-0.146 (0.125)	-0.131 (0.197)	0.123 (0.080)	-0.371** (0.182)	0.171 (0.143)
Missing	0.015 (0.099)	-18.19 (0.657)	-0.074 (0.657)	0.295 (0.409)							0.014 (0.141)		0.014 (0.141)	0.186 (0.141)	-1.297 (0.141)	-1.720*** (0.169)
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	-0.042*** (0.014)	-0.080 (0.088)	-0.003 (0.084)	-0.010 (0.055)	0.192* (0.099)	-0.027 (0.043)	-0.001 (0.021)	-0.036 (0.024)	-0.086* (0.046)	-0.010 (0.022)	-0.122 (0.075)	0.049 (0.043)	0.031 (0.114)	-0.034 (0.044)	-0.120** (0.060)	-0.220** (0.104)
High (ISCED4-6)	0.023 (0.018)	0.111 (0.100)	-0.021 (0.079)	-0.038 (0.065)	0.322*** (0.111)	-0.061* (0.033)	-0.015 (0.019)	-0.030 (0.026)	-0.078 (0.050)	0.087*** (0.032)	0.029 (0.091)	0.072 (0.063)	0.187 (0.117)	0.005 (0.044)	-0.164* (0.085)	-0.011 (0.120)

(continued)

Table 22. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Inheritance</i>																
Dummy	0.183*** (0.017)	0.345*** (0.050)	0.099*** (0.047)	0.187*** (0.048)	0.125*** (0.041)	0.273*** (0.023)	Note 2	0.209*** (0.022)	-0.053* (0.032)	Note 3	0.066 (0.068)	0.087*** (0.041)	0.082 (0.135)	0.258*** (0.030)	0.150*** (0.048)	0.059* (0.032)
<i>Net Wealth Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.230*** (0.040)	0.005 (0.234)	0.378 (0.366)	0.209** (0.100)	-0.209 (0.132)	0.146* (0.075)	0.198*** (0.042)	0.410*** (0.082)	0.441*** (0.061)	0.532*** (0.092)	0.477* (0.261)	0.182** (0.091)	0.572 (0.1708)	0.246*** (0.060)	2012 (-1331)	0.188*** (0.076)
3rd Quintile	0.366*** (0.039)	0.330* (0.199)	0.238 (0.362)	0.382*** (0.104)	0.131 (0.125)	0.224*** (0.066)	0.492*** (0.041)	0.690*** (0.078)	0.451*** (0.070)	0.503*** (0.062)	0.162 (0.258)	0.312*** (0.097)	0.866 (0.1548)	0.308*** (0.068)	1867 (-1341)	0.339*** (0.073)
4th Quintile	0.509*** (0.043)	0.463** (0.202)	0.501 (0.356)	0.472*** (0.095)	0.347*** (0.123)	0.361*** (0.069)	0.743*** (0.040)	0.788*** (0.077)	0.632*** (0.075)	0.628*** (0.054)	0.289 (0.255)	0.467*** (0.087)	1084 (-1572)	0.441*** (0.063)	1974 (-1295)	0.319*** (0.077)
5th Quintile	0.797*** (0.042)	0.625*** (0.206)	0.897*** (0.348)	0.675*** (0.098)	0.643*** (0.122)	0.567*** (0.062)	0.908*** (0.039)	1.108*** (0.079)	0.948*** (0.074)	0.939*** (0.059)	0.774*** (0.250)	0.677*** (0.091)	1645 (-1517)	0.755*** (0.059)	2.387* (-1337)	0.545*** (0.075)
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	-0.002 (0.024)	0.165 (0.110)	-0.087 (0.102)	0.048 (0.085)	-0.095 (0.111)	0.118*** (0.038)	-0.047 (0.040)	0.023 (0.038)	0.009 (0.045)	-0.087*** (0.042)	0.079 (0.167)	-0.037 (0.066)	0.099 (0.204)	-0.001 (0.049)	0.413*** (0.098)	0.037 (0.078)
3rd Quintile	0.06 (0.029)	0.195 (0.308)	-0.137 (0.113)	-0.015 (0.094)	0.109 (0.119)	0.159** (0.036)	-0.011 (0.041)	0.018 (0.046)	0.095* (0.054)	-0.093** (0.049)	0.106 (0.160)	0.016 (0.078)	-0.183 (0.256)	0.004 (0.048)	0.435*** (0.128)	0.196** (0.099)
4th Quintile	0.074* (0.039)	0.265** (0.140)	0.032 (0.123)	-0.045 (0.093)	0.245** (0.128)	0.221** (0.053)	-0.032 (0.042)	-0.047 (0.044)	0.05 (0.063)	-0.131** (0.053)	0.093 (0.153)	-0.094 (0.072)	-0.122 (0.174)	0.044 (0.047)	0.278 (0.138)	0.218** (0.088)
5th Quintile	0.079* (0.043)	0.423** (0.193)	0.052 (0.123)	0.063 (0.131)	0.234** (0.131)	0.224** (0.054)	-0.062 (0.042)	0.003 (0.068)	0.022 (0.068)	-0.127*** (0.053)	0.157 (0.163)	-0.002 (0.089)	-0.147 (0.185)	0.075 (0.045)	0.322 (0.124)	0.284** (0.098)
Constant	-0.77*** (0.103)	-0.305*** (0.223)	-1.326*** (0.388)	-0.725*** (0.118)	-0.291*** (0.126)	-0.071*** (0.057)	-0.827*** (0.087)	-1.199*** (0.079)	-0.668*** (0.088)	-0.688*** (0.065)	-0.966*** (0.122)	-0.528*** (0.129)	-0.855*** (0.259)	-0.855*** (0.098)	-2.386* (-1530)	-0.840*** (0.141)
Sigma	0.501*** (0.008)	0.566*** (0.037)	0.576*** (0.028)	0.401*** (0.021)	0.540*** (0.023)	0.419*** (0.013)	0.447*** (0.007)	0.505*** (0.012)	0.484*** (0.014)	0.465*** (0.012)	0.549*** (0.025)	0.345*** (0.015)	0.417*** (0.004)	0.479*** (0.020)	0.431*** (0.032)	0.534*** (0.027)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³Italy does not collect information on inheritance.

Table 23. Tobit Model for the Portfolio Share of Business Assets

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children	0.095*** (0.029)	0.092 (0.099)	0.099 (0.068)	-0.103 (0.175)	0.120 (0.079)	0.020 (0.063)	0.025 (0.015)	0.161*** (0.032)	0.026 (0.027)	0.055 (0.049)	0.073 (0.120)	-0.150 (0.207)	-0.034 (0.246)	0.069 (0.108)	1.201*** (0.198)	-0.140*** (0.066)
>= 3 Adults	0.203*** (0.034)	0.292*** (0.110)	0.100 (0.144)	0.049 (0.226)	0.174** (0.087)	0.104 (0.071)	-0.000 (0.022)	0.213*** (0.059)	0.208* (0.125)	0.219*** (0.063)	0.02 (0.124)	-0.148 (0.285)	-3.491*** (0.774)	0.103 (0.103)	1.452*** (0.218)	-0.076 (0.072)
Single Parent	0.04 (0.051)	-0.091 (0.387)	0.217 (0.342)	-0.203 (0.385)	0.096 (0.155)	-0.112 (0.113)	0.023 (0.030)	-0.033 (0.070)	-0.313 (0.625)	0.064 (0.086)	0.032 (0.631)	0.078 (0.518)	0.127 (0.610)	0.115 (0.133)	0.019 (0.151)	-0.033 (0.075)
Couple with Children	0.132*** (0.051)	-0.013 (0.096)	0.074 (0.077)	-0.084 (0.190)	0.133* (0.081)	0.065 (0.071)	0.023 (0.017)	0.209*** (0.048)	0.159 (0.108)	0.147*** (0.058)	0.069 (0.119)	-0.221 (0.296)	-0.230 (0.245)	0.058 (0.098)	1.496*** (0.218)	-0.153*** (0.065)
>= 3 Adults	0.172*** (0.040)	0.167 (0.107)	0.003 (0.128)	-0.006 (0.205)	0.212* (0.125)	0.081 (0.076)	-0.092*** (0.026)	0.275*** (0.060)	0.162 (0.137)	0.173*** (0.059)	0.146 (0.136)	-0.243 (0.289)	-0.015 (0.582)	0.032 (0.110)	1.350*** (0.192)	-0.132 (0.081)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	-0.056*** (0.017)	-0.094 (0.064)	-0.075 (0.062)	0.136* (0.071)	-0.003 (0.055)	-0.052 (0.050)	-0.017** (0.007)	-0.115*** (0.027)	-0.173*** (0.059)	-0.065** (0.031)	-0.034 (0.072)	-0.116 (0.124)	0.118 (0.139)	-0.031 (0.050)	-0.107** (0.052)	-0.011 (0.044)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	-0.040* (0.021)	0.040 (0.077)	-0.026 (0.070)	-0.084 (0.072)	0.115* (0.062)	-0.093* (0.048)	0.053*** (0.013)	-0.105*** (0.032)	-0.176*** (0.063)	-0.044 (0.035)	-0.121 (0.090)	-0.152 (0.132)	-0.354 (0.243)	-0.118** (0.054)	-0.126 (0.090)	-0.033 (0.034)
65 Years and Over	-0.146*** (0.029)	-0.023 (0.116)	-0.114 (0.113)	-0.214 (0.317)	-0.128 (0.086)	-0.163** (0.080)	0.070*** (0.022)	-0.167*** (0.050)	-0.184 (0.135)	-0.097* (0.056)	-0.253* (0.131)	-0.316 (0.248)	-0.782 (0.858)	-0.048 (0.089)	-0.241 (0.158)	-0.072 (0.107)

(continued)

Table 23. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Marital Status (Reference Person) (Base: Unmarried)</i>																
Married	0.007 (0.030)	0.014 (0.082)	0.052 (0.090)	0.156 (0.188)	-0.007 (0.081)	0.003 (0.057)	0.014 (0.014)	0.009 (0.035)	0.093 (0.106)	0.029 (0.057)	-0.011 (0.110)	0.265 (0.324)	-0.258 (0.182)	0.103 (0.102)	0.373** (0.175)	0.010 (0.040)
Divorced	0.026 (0.032)	-0.100 (0.136)	0.076 (0.129)	0.434*** (0.144)	0.089 (0.080)	-0.076 (0.087)	-0.011 (0.017)	0.028 (0.043)	0.123 (0.139)	0.016 (0.075)	0.044 (0.127)	0.456 (0.303)	-0.135 (0.418)	0.153 (0.111)	0.374** (0.183)	-0.009 (0.062)
Widowed	-0.128*** (0.038)	-0.199 (0.250)	-0.197 (0.451)	0.421 (0.286)	-0.234* (0.137)	-0.043 (0.076)	0.034 (0.023)	-0.122** (0.062)	-0.348 (0.302)	-0.108 (0.076)	0.171 (0.167)	-2.444*** (0.390)	-0.226 (0.810)	-0.044 (0.139)	-1.067*** (0.168)	-0.241* (0.116)
<i>Labor Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	0.729*** (0.025)	0.660*** (0.078)	0.618*** (0.067)	0.423*** (0.092)	0.658*** (0.048)	0.059*** (0.050)	0.166*** (0.015)	0.806*** (0.050)	0.799*** (0.069)	0.735*** (0.040)	0.010*** (0.105)	0.630*** (0.100)	1.333*** (0.311)	0.544*** (0.052)	0.556*** (0.115)	0.564*** (0.063)
Unemployed	-0.164*** (0.041)	0.028 (0.359)	-0.089 (0.969)	-0.173 (0.171)	-1.658* (0.877)	-0.232 (0.187)	-0.014 (0.026)	-0.137* (0.082)	0.254 (0.124)	-0.152 (0.528)	-1.826*** (0.305)	0.151 (0.486)	-0.674 (0.106)	-0.078 (0.106)	-0.009 (0.203)	-1.075*** (0.168)
Retired	-0.017 (0.026)	-0.181** (0.080)	-0.091 (0.093)	-0.225 (0.320)	0.018 (0.070)	0.052 (0.063)	0.02 (0.016)	-0.098** (0.043)	0.174 (0.128)	0.01 (0.053)	0.032 (0.096)	0.093 (0.187)	-0.007 (0.524)	-0.167** (0.070)	-0.011 (0.168)	0.055 (0.068)
Other	-0.034 (0.061)	0.001 (0.371)	0.147 (0.385)	-2.465*** (0.340)	-0.202 (0.554)	-0.078 (0.101)	-0.027 (0.019)	-0.156* (0.089)	0.322 (0.564)	-0.043 (0.567)	-1.738*** (0.257)	-2.381*** (0.421)	0.486 (0.406)	-2.318*** (0.205)	-1.314*** (0.228)	0.172 (0.127)
Missing	0.16 (0.112)		-0.260 (0.773)	-0.360 (0.906)									0.511** (0.226)	0.446 (0.132)		-0.887*** (0.136)
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.010 (0.017)	-0.093 (0.082)	0.113 (0.083)	0.060 (0.086)	0.053 (0.074)	0.026 (0.035)	-0.006 (0.010)	0.042 (0.031)	-0.066 (0.062)	0.000 (0.025)	-0.005 (0.077)	-0.057 (0.129)	0.183 (0.253)	0.076 (0.059)	-0.186** (0.074)	-0.121 (0.093)
High (ISCED 4-6)	-0.003 (0.021)	-0.152 (0.116)	0.134 (0.088)	-0.008 (0.095)	0.053 (0.074)	0.02 (0.035)	-0.012 (0.011)	-0.005 (0.004)	-0.185*** (0.081)	-0.147*** (0.034)	0.011 (0.086)	-0.075 (0.113)	0.482* (0.277)	-0.054 (0.057)	-0.243** (0.108)	-0.008 (0.105)
<i>Inheritance</i>																
Dummy	0.029 (0.021)	-0.002 (0.055)	0.02 (0.045)	-0.144** (0.070)	0.029 (0.047)	0.042 (0.033)	Note 2 (0.026)	-0.002 (0.026)	-0.081** (0.040)	Note 3	-0.017 (0.062)	-0.107 (0.103)	0.257 (0.207)	0.026 (0.044)	-0.058 (0.057)	-0.070** (0.033)

(continued)

Table 23. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Net Wealth Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.128*** (0.042)	0.422 (0.339)	0.230 (0.357)	0.001 (0.159)	0.173 (0.122)	-0.025 (0.076)	0.015 (0.022)	0.225** (0.090)	0.176 (0.118)	0.108* (0.059)	0.130 (0.342)	2.018* (0.103)	-0.517 (0.107)	0.419 (0.610)	0.051 (0.096)	-0.004 (0.063)
3rd Quintile	0.195*** (0.037)	0.408 (0.339)	0.285 (0.352)	0.292* (0.145)	0.149 (0.116)	0.017 (0.074)	0.046** (0.019)	0.265** (0.086)	0.115 (0.105)	0.113** (0.057)	0.063 (0.436)	2.275* (0.109)	0.388 (0.328)	0.517 (0.606)	0.082 (0.221)	0.004 (0.053)
4th Quintile	0.165*** (0.040)	0.018 (0.334)	0.342 (0.354)	0.356** (0.153)	0.128 (0.117)	0.082 (0.074)	0.058** (0.019)	0.307*** (0.085)	0.16 (0.098)	0.032 (0.061)	0.285 (0.326)	2.337** (0.108)	0.708 (0.382)	0.531 (0.606)	0.221 (0.185)	0.011 (0.055)
5th Quintile	0.341*** (0.042)	1.065*** (0.382)	0.548 (0.356)	0.716*** (0.150)	0.307** (0.122)	0.233** (0.077)	0.096** (0.019)	0.520*** (0.086)	0.274*** (0.104)	0.101*** (0.065)	0.464 (0.349)	2.869* (0.125)	0.873 (0.538)	0.87 (0.604)	0.316*** (0.231)	0.186 (0.061)
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	-0.002 (0.038)	-0.103 (0.139)	0.037 (0.400)	0.132 (0.156)	-0.066 (0.157)	0.050 (0.093)	-0.020 (0.017)	-0.049 (0.045)	0.025 (0.066)	0.078 (0.057)	0.029 (0.139)	0.145 (0.306)	-0.052 (0.464)	0.039 (0.090)	-0.085 (0.106)	0.018 (0.097)
3rd Quintile	0.024 (0.041)	-0.053 (0.144)	0.236 (0.390)	0.295** (0.146)	-0.019 (0.127)	0.085 (0.085)	-0.021 (0.016)	-0.131*** (0.050)	0.112 (0.100)	0.093 (0.069)	0.081 (0.127)	0.033 (0.310)	0.257 (0.308)	0.034 (0.096)	0.13 (0.093)	0.156 (0.109)
4th Quintile	0.014 (0.036)	-0.057 (0.131)	0.128 (0.382)	0.221 (0.136)	-0.026 (0.121)	0.102 (0.090)	-0.001 (0.016)	-0.196*** (0.051)	0.188** (0.087)	0.144** (0.066)	0.095 (0.114)	0.199 (0.292)	-0.085 (0.333)	0.002 (0.099)	-0.016 (0.160)	0.145 (0.104)
5th Quintile	0.049 (0.035)	-0.081 (0.127)	0.132 (0.385)	0.221 (0.140)	0.119 (0.123)	0.057 (0.089)	0.067** (0.019)	-0.205*** (0.047)	0.269*** (0.091)	0.145** (0.071)	0.136 (0.124)	0.25 (0.290)	0.144 (0.356)	0.019 (0.093)	-0.054 (0.135)	0.202* (0.109)
Constant	-0.912*** (0.054)	-1.272*** (0.358)	-1.250*** (0.532)	-1.014 (0.250)	-1.102*** (0.137)	-0.651*** (0.120)	-0.376*** (0.027)	-0.862*** (0.102)	-1.129*** (0.160)	-0.844*** (0.080)	0.985*** (0.327)	0.25 (0.290)	-1.972*** (0.641)	-1.376*** (0.441)	-2.044*** (0.386)	-0.461*** (0.147)
Sigma	0.397*** (0.011)	0.446*** (0.050)	0.358*** (0.037)	0.405*** (0.045)	0.391*** (0.024)	0.323*** (0.022)	0.215** (0.013)	0.392** (0.018)	0.479*** (0.026)	0.350*** (0.015)	0.369*** (0.044)	0.466*** (0.044)	0.607*** (0.096)	0.431*** (0.027)	0.261*** (0.037)	0.237*** (0.027)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³Italy does not collect information on inheritance.

Table 24. Tobit Model for the Portfolio Share of Safe Financial Assets

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children	-0.059*** (0.012)	-0.012 (0.036)	-0.050* (0.029)	-0.040 (0.068)	-0.031 (0.034)	-0.064*** (0.021)	-0.042*** (0.014)	-0.034** (0.016)	-0.088*** (0.029)	-0.060*** (0.017)	-0.046 (0.036)	-0.004 (0.042)	0.025 (0.070)	-0.049 (0.035)	-0.095* (0.051)	-0.100*** (0.022)
>= 3 Adults w/o Children	-0.065*** (0.016)	-0.030 (0.043)	0.007 (0.046)	-0.095 (0.071)	-0.053 (0.047)	-0.061** (0.025)	-0.067*** (0.019)	-0.087*** (0.022)	-0.110*** (0.033)	-0.104*** (0.018)	-0.035 (0.049)	-0.022 (0.057)	0.081 (0.094)	-0.090** (0.040)	-0.084 (0.053)	-0.106*** (0.028)
Single Parent	-0.049** (0.022)	-0.019 (0.055)	-0.123** (0.049)	-0.120 (0.076)	0.033 (0.062)	-0.027 (0.032)	-0.044* (0.023)	-0.080*** (0.020)	0.069 (0.107**)	-0.027 (0.032)	-0.002 (0.077)	-0.095 (0.094)	-0.099 (0.106)	-0.002 (0.044)	-0.170** (0.081)	-0.036 (0.032)
Couple with Children	-0.092*** (0.013)	-0.026 (0.043)	-0.119*** (0.035)	-0.071 (0.063)	-0.056 (0.041)	-0.104*** (0.025)	-0.083*** (0.016)	-0.092*** (0.018)	-0.107*** (0.040)	-0.086*** (0.020)	-0.059 (0.039)	0.002 (0.051)	-0.062 (0.066)	-0.098** (0.042)	-0.100* (0.058)	-0.117*** (0.024)
>= 3 Adults with Children	-0.087*** (0.017)	-0.063 (0.057)	-0.119** (0.051)	-0.074 (0.790)	-0.065 (0.052)	-0.085*** (0.030)	-0.019 (0.026)	-0.082*** (0.027)	-0.123*** (0.047)	-0.121*** (0.024)	-0.039 (0.045)	-0.041 (0.055)	-0.079 (0.095)	-0.086* (0.045)	-0.044 (0.051)	-0.070** (0.032)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	-0.021*** (0.007)	-0.005 (0.022)	-0.005 (0.019)	0.009 (0.034)	-0.010 (0.022)	-0.018 (0.013)	-0.036*** (0.009)	-0.021** (0.010)	-0.013 (0.018)	0.002 (0.011)	-0.033 (0.026)	-0.015 (0.033)	-0.037 (0.038)	-0.016 (0.015)	-0.028 (0.021)	-0.035*** (0.011)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	-0.007 (0.009)	0.040 (0.025)	-0.075*** (0.027)	0.012 (0.026)	-0.008 (0.026)	0.022 (0.015)	0.041*** (0.014)	-0.001 (0.011)	-0.005 (0.018)	-0.001 (0.014)	0.042 (0.029)	0.046 (0.031)	0.076 (0.065)	0.023 (0.017)	-0.028 (0.026)	-0.013 (0.015)
65 Years and Over	0.003 (0.013)	0.043 (0.040)	-0.114*** (0.038)	-0.018 (0.087)	0.007 (0.045)	0.001 (0.025)	0.005 (0.021)	0.045* (0.024)	0.015 (0.027)	0.01 (0.015)	-0.03 (0.038)	0.013 (0.040)	0.081 (0.092)	0.047** (0.023)	-0.048 (0.041)	-0.050* (0.028)

(continued)

Table 24. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Marital Status (Reference Person) (Base: Unmarried)</i>																
Married	-0.045*** (0.012)	-0.021 (0.029)	-0.004 (0.030)	0.029 (0.065)	-0.088** (0.037)	0.002 (0.023)	0.007 (0.013)	-0.036*** (0.012)	-0.039 (0.031)	-0.010 (0.020)	-0.054 (0.036)	-0.072 (0.044)	-0.095* (0.052)	-0.031 (0.024)	-0.004 (0.039)	0.019 (0.021)
Divorced	-0.046*** (0.016)	-0.033 (0.037)	0.006 (0.043)	0.065 (0.058)	-0.078* (0.043)	-0.047 (0.031)	-0.001 (0.015)	-0.043*** (0.016)	-0.117*** (0.041)	-0.001 (0.017)	-0.090* (0.048)	-0.101* (0.060)	-0.002 (0.067)	-0.096** (0.029)	-0.084 (0.052)	-0.036 (0.024)
Widowed	-0.066*** (0.013)	0.110*** (0.041)	0.014 (0.042)	0.036 (0.072)	-0.065 (0.044)	-0.036 (0.026)	-0.055*** (0.019)	-0.020 (0.019)	-0.088*** (0.032)	-0.030* (0.016)	-0.091* (0.048)	0.056 (0.060)	-0.107 (0.069)	-0.049 (0.031)	0.009 (0.055)	-0.093*** (0.028)
<i>Labor Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	-0.014 (0.009)	0.008 (0.029)	-0.079*** (0.024)	0.009 (0.028)	-0.040 (0.029)	-0.003 (0.014)	-0.025* (0.014)	-0.028*** (0.012)	0.015 (0.014)	-0.014 (0.011)	0.026 (0.034)	0.055** (0.024)	0.002 (0.012)	-0.017 (0.017)	-0.011 (0.028)	-0.035** (0.017)
Unemployed	-0.018 (0.019)	-0.001 (0.057)	-0.000 (0.048)	-0.053 (0.053)	-0.027 (0.072)	-0.010 (0.028)	0.043* (0.022)	-0.022 (0.021)	-0.011 (0.071)	-0.097** (0.042)	0.049 (0.107)	-0.031 (0.068)	-0.006 (0.095)	0.048 (0.036)	-0.113*** (0.039)	0.009 (0.053)
Retired	0.037*** (0.009)	0.018 (0.033)	0.028 (0.034)	0.07 (0.080)	0.052 (0.037)	0.030* (0.018)	0.042** (0.019)	0.030* (0.018)	0.064** (0.020)	0.025** (0.011)	0.025 (0.031)	0.067* (0.036)	0.016 (0.062)	0.038** (0.017)	-0.040 (0.038)	-0.035* (0.020)
Other	0.060*** (0.020)	0.113 (0.101)	0.01 (0.046)	-0.013 (0.129)	0.027 (0.059)	-0.013 (0.020)	0.075*** (0.023)	0.067*** (0.021)	0.246*** (0.057)	0.001 (0.037)	0.039 (0.067)	-0.038 (0.063)	0.009 (0.067)	0.004 (0.039)	-0.071 (0.055)	-0.066*** (0.024)
Missing	-0.024 (0.057)		0.021 (0.078)	-0.278 (0.233)									0.024 (0.060)	0.02 (0.277)		-0.359* (0.188)
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.021** (0.009)	0.004 (0.029)	0.009 (0.028)	0.033 (0.035)	-0.025 (0.042)	0.040** (0.017)	-0.037*** (0.012)	0.012 (0.011)	0.055*** (0.017)	0.014* (0.009)	0.039 (0.029)	-0.006 (0.023)	0.005 (0.039)	0.007 (0.017)	-0.043 (0.037)	0.068*** (0.034)
High (ISCED 4-6)	0.025** (0.011)	0.079** (0.039)	0.026 (0.026)	0.043 (0.033)	-0.001 (0.042)	0.048*** (0.011)	-0.021 (0.013)	0.032*** (0.012)	0.074*** (0.018)	0.017 (0.013)	0.045 (0.033)	0.033 (0.024)	-0.032 (0.037)	0.007 (0.019)	0.003 (0.031)	0.077** (0.036)
<i>Inheritance</i>																
Dummy	-0.046*** (0.007)	-0.044*** (0.016)	0.002 (0.016)	-0.019 (0.023)	-0.058*** (0.020)	-0.014* (0.008)	Note 2	0.010 (0.008)	-0.049*** (0.011)	Note 3	0.016 (0.020)	0.001 (0.017)	-0.036 (0.055)	-0.048*** (0.012)	-0.028 (0.019)	-0.028*** (0.011)

(continued)

Table 24. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
Net Wealth Distribution (Base: 1st Quintile)																
2nd Quintile	-0.121*** (0.013)	-0.148*** (0.040)	-0.339*** (0.043)	-0.178*** (0.051)	-0.134*** (0.045)	-0.284*** (0.023)	-0.288*** (0.021)	0.019 (0.017)	-0.302*** (0.031)	-0.144*** (0.020)	-0.229*** (0.053)	-0.379*** (0.046)	0.002 (0.070)	-0.371*** (0.029)	-0.237*** (0.039)	-0.202*** (0.025)
3rd Quintile	-0.283*** (0.013)	-0.387*** (0.042)	-0.508*** (0.035)	-0.231*** (0.045)	-0.292*** (0.046)	-0.294*** (0.023)	-0.568*** (0.019)	-0.322*** (0.015)	-0.316*** (0.031)	-0.276*** (0.018)	-0.390*** (0.043)	-0.471*** (0.036)	-0.028 (0.065)	-0.446*** (0.026)	-0.231*** (0.043)	-0.215*** (0.023)
4th Quintile	-0.359*** (0.012)	-0.570*** (0.041)	-0.454*** (0.037)	-0.230*** (0.045)	-0.478*** (0.044)	-0.271*** (0.023)	-0.546*** (0.017)	-0.382*** (0.014)	-0.301*** (0.031)	-0.298*** (0.019)	-0.398*** (0.046)	-0.471*** (0.040)	-0.249*** (0.052)	-0.457*** (0.025)	-0.251*** (0.041)	-0.226*** (0.025)
5th Quintile	-0.372*** (0.014)	-0.592*** (0.035)	-0.453*** (0.037)	-0.259*** (0.047)	-0.534*** (0.048)	-0.279*** (0.024)	-0.534*** (0.018)	-0.385*** (0.016)	-0.291*** (0.029)	-0.313*** (0.019)	-0.418*** (0.046)	-0.537*** (0.036)	-0.245*** (0.051)	-0.450*** (0.024)	-0.239*** (0.046)	-0.206*** (0.027)
Income Distribution (Base: 1st Quintile)																
2nd Quintile	0.020 (0.013)	-0.000 (0.037)	-0.058* (0.033)	-0.019 (0.049)	-0.056 (0.052)	0.015 (0.017)	-0.084*** (0.019)	0.048*** (0.014)	0.011 (0.027)	0.058*** (0.016)	-0.048 (0.052)	-0.020 (0.034)	0.046 (0.069)	0.028 (0.024)	0.150*** (0.057)	0.037 (0.024)
3rd Quintile	0.015 (0.013)	-0.011 (0.035)	-0.017 (0.038)	0.002 (0.048)	-0.089* (0.047)	-0.010 (0.019)	-0.108*** (0.019)	0.073*** (0.015)	0.034 (0.024)	0.101*** (0.019)	-0.046 (0.041)	0.018 (0.035)	0.003 (0.063)	0.021 (0.022)	0.175*** (0.051)	0.021 (0.022)
4th Quintile	0.031*** (0.014)	0.045 (0.035)	-0.009 (0.037)	0.068 (0.048)	-0.053 (0.051)	-0.007 (0.021)	-0.141*** (0.019)	0.091*** (0.016)	0.062*** (0.028)	0.126*** (0.019)	-0.008 (0.045)	0.035 (0.037)	-0.035 (0.064)	0.028 (0.024)	0.140*** (0.045)	0.045** (0.022)
5th Quintile	0.069*** (0.014)	0.066 (0.043)	0.018 (0.036)	0.057 (0.047)	-0.021 (0.051)	0.021 (0.020)	-0.119*** (0.022)	0.156*** (0.016)	0.081*** (0.029)	0.174*** (0.019)	-0.000 (0.045)	0.061 (0.043)	-0.031 (0.059)	0.066** (0.028)	0.175*** (0.048)	0.088*** (0.031)
Constant	0.661*** (0.021)	0.688*** (0.053)	0.744*** (0.050)	0.749*** (0.077)	0.883*** (0.061)	0.386*** (0.026)	0.793*** (0.029)	0.458*** (0.020)	0.365*** (0.043)	0.283*** (0.023)	0.539*** (0.067)	0.590*** (0.061)	0.496*** (0.103)	0.612*** (0.038)	0.908*** (0.079)	0.316*** (0.040)
Sigma	0.292*** (0.002)	0.326*** (0.009)	0.275*** (0.007)	0.224*** (0.014)	0.340*** (0.007)	0.211*** (0.007)	0.297*** (0.004)	0.261*** (0.003)	0.250*** (0.007)	0.214*** (0.004)	0.243*** (0.010)	0.223*** (0.009)	0.339*** (0.010)	0.280*** (0.008)	0.177*** (0.013)	0.204*** (0.007)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³Italy does not collect information on inheritance.

Appendix 5. Tobit Models (Excluding Net Wealth Indicator)

Table 25. Tobit Model for the Portfolio Share of the Households' Main Residence

Variables	EA ¹	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>															
Couple w/o Children	0.141*** (0.019)	0.157*** (0.044)	-0.111 (0.068)	0.197*** (0.050)	0.037 (0.029)	-0.015 (0.022)	0.105*** (0.033)	0.134*** (0.034)	0.034 (0.025)	0.040 (0.065)	0.201*** (0.060)	0.203*** (0.073)	0.084*** (0.032)	0.172*** (0.080)	0.098*** (0.029)
>= 3 Adults w/o Children	0.102*** (0.024)	0.134* (0.075)	-0.080 (0.080)	0.247*** (0.066)	-0.016 (0.037)	-0.069** (0.031)	0.188*** (0.048)	0.104** (0.049)	0.016 (0.037)	-0.038 (0.097)	0.139* (0.083)	0.196 (0.175)	0.096** (0.040)	0.271*** (0.089)	0.105*** (0.044)
Single Parent	-0.009 (0.039)	0.094 (0.116)	0.078 (0.088)	-0.050 (0.143)	0.040 (0.069)	-0.051 (0.045)	-0.102* (0.053)	0.078 (0.111)	0.063 (0.070)	-0.030 (0.127)	0.023 (0.161)	-0.019 (0.172)	-0.011 (0.066)	0.253* (0.143)	0.073 (0.047)
Couple with Children	0.242*** (0.020)	0.232*** (0.057)	0.045 (0.061)	0.280*** (0.065)	0.126*** (0.033)	0.156*** (0.024)	0.276*** (0.036)	0.199*** (0.040)	0.092*** (0.031)	0.130* (0.070)	0.316*** (0.066)	0.494*** (0.074)	0.170*** (0.043)	0.283*** (0.098)	0.150*** (0.038)
>= 3 Adults with Children	0.155*** (0.029)	0.246*** (0.078)	-0.047 (0.100)	0.445*** (0.086)	-0.051 (0.048)	0.047 (0.044)	0.100 (0.063)	0.135** (0.055)	0.050 (0.050)	0.170 (0.107)	0.269*** (0.085)	0.457*** (0.135)	0.120*** (0.054)	0.272*** (0.104)	0.085 (0.052)
<i>Gender (Reference Person) (Base: Female)</i>															
Male	-0.019 (0.014)	-0.085** (0.035)	-0.070 (0.047)	-0.025 (0.047)	0.004 (0.024)	-0.006 (0.015)	0.002 (0.021)	-0.049* (0.026)	-0.034* (0.019)	-0.174*** (0.051)	-0.007 (0.048)	0.009 (0.065)	0.006 (0.025)	-0.052 (0.048)	-0.013 (0.020)
<i>Age (Reference Person) (Base: Below 40 Years)</i>															
40-64 Years	0.250*** (0.014)	0.185*** (0.044)	-0.041 (0.056)	0.376*** (0.047)	0.090*** (0.028)	0.226*** (0.019)	0.369*** (0.027)	0.262*** (0.028)	0.193*** (0.032)	0.107* (0.056)	0.019 (0.044)	0.002 (0.072)	0.221*** (0.042)	0.120* (0.071)	0.165*** (0.026)
65 Years and Over	0.346*** (0.021)	0.164*** (0.065)	0.112 (0.167)	0.440*** (0.079)	0.147*** (0.039)	0.286*** (0.029)	0.397*** (0.041)	0.347*** (0.054)	0.295*** (0.043)	0.306*** (0.096)	0.047 (0.070)	0.189 (0.118)	0.262*** (0.054)	0.175 (0.093)	0.251*** (0.038)

(continued)

Table 25. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Labor Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	-0.106*** (0.018)	0.036 (0.072)	-0.060 (0.057)	-0.103 (0.063)	-0.001 (0.061)	-0.249*** (0.029)	0.033 (0.026)	-0.033 (0.031)	-0.059* (0.034)	-0.122*** (0.025)	-0.235*** (0.083)	-0.161*** (0.044)	-0.235* (0.127)	-0.107*** (0.030)	-0.137 (0.150)	-0.076** (0.032)
Unemployed	-0.150*** (0.031)	-0.332*** (0.143)	-0.246*** (0.079)	-0.033 (0.111)	-0.246* (0.143)	-0.109** (0.047)	-0.154*** (0.041)	-0.277*** (0.052)	0.051 (0.114)	0.039 (0.079)	-0.435 (0.694)	-0.001 (0.114)	-0.151 (0.206)	-0.169*** (0.049)	0.075 (0.097)	-0.249 (0.172)
Retired	0.088*** (0.018)	0.099* (0.059)	0.123** (0.048)	-0.007 (0.160)	0.137* (0.070)	-0.012 (0.030)	0.096*** (0.027)	0.149*** (0.040)	0.118*** (0.041)	0.189*** (0.030)	0.03 (0.072)	-0.112* (0.065)	-0.147 (0.103)	-0.044 (0.038)	0.321*** (0.066)	0.070** (0.030)
Other	-0.070** (0.028)	-0.185 (0.203)	-0.195*** (0.096)	-0.158 (0.177)	-0.194 (0.125)	0.007 (0.034)	-0.218*** (0.034)	-0.166*** (0.058)	-0.112 (0.092)	0.322*** (0.069)	0.243** (0.117)	0.119 (0.099)	-0.200* (0.106)	0.031 (0.075)	-0.085 (0.162)	0.027 (0.429)
Missing	0.049 (0.065)		0.108 (0.147)	-0.239 (0.483)									-0.092 (0.075)	-0.253 (0.839)		0.429* (0.251)
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.02 (0.015)	-0.058 (0.048)	-0.039 (0.042)	-0.014 (0.063)	0.075 (0.072)	-0.088*** (0.029)	0.005 (0.019)	0.058*** (0.022)	-0.021 (0.038)	0.077*** (0.022)	0.077 (0.059)	0.059 (0.038)	-0.024 (0.039)	-0.011 (0.032)	0.063 (0.058)	-0.038 (0.053)
High (ISCED 4-6)	0.030* (0.017)	-0.181*** (0.069)	0.011 (0.044)	0.019 (0.068)	0.05 (0.076)	-0.053** (0.024)	0.008 (0.021)	0.111*** (0.028)	-0.083* (0.044)	0.061* (0.035)	-0.055 (0.073)	0.058 (0.044)	0.096* (0.037)	-0.029 (0.034)	-0.051 (0.069)	-0.112** (0.057)
<i>Inheritance</i>																
Dummy	0.189*** (0.014)	0.407*** (0.039)	0.057** (0.029)	0.063 (0.039)	0.346*** (0.037)	-0.020 (0.019)	Note 2	0.103*** (0.019)	0.311*** (0.021)	Note 3	0.125*** (0.043)	0.080** (0.032)	0.094 (0.074)	0.137*** (0.025)	0.172*** (0.040)	0.089*** (0.015)

(continued)

Table 25. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.072*** (0.024)	0.142 (0.091)	0.064 (0.058)	0.091 (0.083)	0.259** (0.110)	-0.002* (0.033)	0.165*** (0.033)	0.118*** (0.035)	-0.070 (0.044)	0.085*** (0.030)	0.225** (0.110)	0.016 (0.077)	-0.017 (0.109)	-0.116*** (0.041)	0.051 (0.090)	-0.068** (0.034)
3rd Quintile	0.137*** (0.024)	0.158* (0.087)	0.145** (0.059)	0.073 (0.090)	0.286*** (0.102)	-0.015 (0.037)	0.246*** (0.032)	0.213*** (0.037)	-0.112*** (0.043)	0.160*** (0.030)	0.391*** (0.106)	-0.001 (0.081)	0.073 (0.107)	-0.050 (0.041)	-0.073 (0.086)	-0.073* (0.041)
4th Quintile	0.228*** (0.024)	0.139 (0.087)	0.207*** (0.054)	0.135 (0.090)	0.404*** (0.092)	-0.043 (0.041)	0.372*** (0.036)	0.378*** (0.036)	-0.078 (0.054)	0.273*** (0.033)	0.508*** (0.097)	0.001 (0.081)	0.216** (0.110)	-0.045 (0.046)	0.101 (0.093)	-0.094* (0.043)
5th Quintile	0.225*** (0.027)	0.217*** (0.095)	0.184*** (0.067)	0.069 (0.095)	0.442*** (0.102)	-0.072* (0.039)	0.353*** (0.039)	0.314*** (0.039)	-0.050 (0.056)	0.246*** (0.036)	0.465*** (0.109)	-0.081 (0.084)	0.184* (0.102)	-0.087*** (0.041)	0.043 (0.100)	-0.166*** (0.048)
Constant	-0.411*** (0.033)	-0.395*** (0.086)	0.069 (0.067)	0.392*** (0.113)	-0.934*** (0.104)	0.572*** (0.043)	-0.065 (0.039)	-0.321*** (0.036)	0.443*** (0.034)	0.027 (0.045)	-0.038 (0.094)	0.275*** (0.094)	-0.051 (0.108)	0.230*** (0.050)	0.162 (0.127)	0.603*** (0.060)
Sigma	0.548*** (0.003)	0.653*** (0.013)	0.481*** (0.010)	0.439*** (0.016)	0.611*** (0.011)	0.408*** (0.009)	0.483*** (0.005)	0.588*** (0.006)	0.465*** (0.006)	0.521*** (0.007)	0.512*** (0.015)	0.412*** (0.012)	0.585*** (0.012)	0.510*** (0.011)	0.391*** (0.019)	0.321*** (0.005)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³Italy does not collect information on inheritance.

Table 26. Tobit Model for the Portfolio Share of the Risky Financial Assets

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children	-0.067*** (0.010)	-0.078** (0.036)	-0.028 (0.032)	0.002 (0.021)	-0.105*** (0.027)	-0.036** (0.016)	-0.028** (0.012)	-0.064*** (0.010)	0.028 (0.049)	-0.087*** (0.018)	-0.074** (0.035)	0.010 (0.038)	-0.024 (0.032)	-0.038 (0.028)	-0.005 (0.035)	-0.010 (0.032)
>= 3 Adults	-0.123*** (0.013)	-0.131** (0.055)	-0.046 (0.032)	-0.009 (0.020)	-0.177*** (0.042)	-0.070*** (0.021)	-0.054** (0.016)	-0.120** (0.019)	0.023 (0.065)	-0.169*** (0.021)	-0.160** (0.040)	0.024 (0.060)	-0.160** (0.080)	-0.087** (0.043)	-0.028 (0.038)	-0.011 (0.036)
w/o Children	-0.016 (0.037)	-0.031 (0.079)	-0.125** (0.063)	0.021 (0.027)	0.071 (0.031)	-0.035 (0.029)	-0.059*** (0.019)	-0.069*** (0.019)	-0.065 (0.392)	-0.066 (0.048)	-0.134 (0.113)	-0.102 (0.113)	-0.074 (0.197)	-0.065 (0.126)	-0.096** (0.046)	0.021 (0.052)
Single Parent	-0.037*** (0.007)	-0.085** (0.048)	-0.039 (0.035)	-0.017 (0.016)	-0.153*** (0.033)	-0.062** (0.022)	-0.075 (0.018)	-0.084*** (0.014)	-0.008 (0.043)	-0.135*** (0.020)	0.085*** (0.033)	0.04 (0.043)	-0.075** (0.037)	-0.036 (0.043)	-0.035 (0.041)	-0.065 (0.028)
Couple with Children	-0.104*** (0.010)	-0.149*** (0.049)	-0.053 (0.039)	-0.019 (0.023)	-0.218*** (0.056)	-0.035 (0.026)	-0.085*** (0.019)	-0.148*** (0.022)	-0.045 (0.082)	-0.160*** (0.026)	-0.139*** (0.032)	0.014 (0.032)	-0.045 (0.074)	-0.069** (0.043)	-0.006 (0.041)	-0.025 (0.034)
>= 3 Adults with Children	-0.121*** (0.019)	-0.175*** (0.075)	-0.075 (0.058)	-0.023 (0.022)												
<i>Gender (Reference Person) (Base: Female)</i>																
Male	0.020*** (0.008)	0.054* (0.029)	0.028 (0.026)	0.030* (0.017)	0.002 (0.025)	0.013 (0.013)	0.008 (0.009)	0.024*** (0.009)	0.015 (0.034)	0.011 (0.014)	0.030 (0.026)	-0.039 (0.030)	0.004 (0.034)	0.056** (0.026)	0.029 (0.020)	0.016 (0.023)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	0.011 (0.012)	0.003 (0.031)	0.071** (0.032)	0.053*** (0.017)	-0.063** (0.031)	0.064*** (0.019)	-0.019 (0.009)	-0.014 (0.011)	0.070** (0.038)	0.107*** (0.018)	0.022 (0.027)	0.040 (0.031)	0.058 (0.040)	-0.001 (0.033)	-0.008 (0.026)	0.030 (0.023)
65 Years and Over	0.031* (0.018)	-0.029 (0.050)	0.141*** (0.048)	0.088 (0.057)	0.006 (0.058)	0.100*** (0.028)	0.010 (0.015)	-0.014 (0.018)	0.109 (0.066)	0.101*** (0.026)	0.075* (0.045)	0.083* (0.049)	0.149** (0.060)	0.014 (0.035)	-0.011 (0.034)	0.057 (0.032)

(continued)

Table 26. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Labour Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	0.003 (0.011)	0.062 (0.040)	0.026 (0.053)	-0.012 (0.019)	-0.026 (0.041)	0.002 (0.017)	0.031*** (0.010)	-0.005 (0.012)	0.002 (0.038)	0.018 (0.015)	0.001 (0.027)	0.012 (0.027)	0.038 (0.064)	0.021 (0.034)	-0.019 (0.040)	0.012 (0.027)
Unemployed	-0.051** (0.025)	0.083 (0.091)	0.041 (0.067)	-0.017 (0.024)	-0.069 (0.092)	-0.025 (0.022)	-0.044** (0.022)	-0.078*** (0.023)	-1.070*** (0.189)	0.016 (0.046)	0.010 (0.512)	0.115 (0.097)	-0.066 (0.097)	0.007 (0.056)	0.055 (0.047)	-0.047 (0.106)
Retired	0.040*** (0.013)	0.073* (0.039)	0.078* (0.043)	-0.038 (0.046)	0.009 (0.050)	0.02 (0.021)	0.038** (0.014)	-0.008 (0.013)	-0.025 (0.052)	0.098*** (0.016)	0.018 (0.033)	0.018 (0.041)	-0.020 (0.048)	0.024 (0.033)	-0.025 (0.027)	-0.053 (0.042)
Other	0.063** (0.031)	0.051 (0.088)	-0.050 (0.090)	-0.020 (0.118)	0.106 (0.077)	-0.034 (0.032)	0.042** (0.019)	-0.037 (0.027)	0.024 (0.559)	0.087 (0.062)	0.023 (0.090)	0.011 (0.066)	0.059 (0.061)	-0.047 (0.435)	-0.165*** (0.059)	0.006 (0.086)
Missing	-0.008 (0.060)		-0.040 (0.318)	0.253 (0.253)									0.017 (0.066)	-0.934 (0.644)		-0.675*** (0.114)
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.052*** (0.009)	0.164*** (0.061)	0.090*** (0.034)	-0.002 (0.015)	0.105 (0.070)	0.081*** (0.017)	0.041*** (0.010)	0.028*** (0.009)	0.085** (0.040)	0.033*** (0.010)	0.092*** (0.026)	0.013 (0.023)	0.017 (0.043)	0.100*** (0.025)	0.078** (0.031)	0.008 (0.111)
High (ISCED 4-6)	0.122*** (0.011)	0.235*** (0.074)	0.145*** (0.033)	0.015 (0.017)	0.237*** (0.071)	0.125*** (0.019)	0.088*** (0.010)	0.057*** (0.011)	0.111*** (0.041)	0.047*** (0.016)	0.155*** (0.037)	0.035 (0.024)	0.049 (0.046)	0.191*** (0.043)	0.174*** (0.040)	0.085 (0.116)
<i>Inheritance</i>																
Dummy	0.061*** (0.009)	0.095*** (0.033)	0.085*** (0.024)	0.014 (0.010)	0.051*** (0.022)	0.049*** (0.012)	Note 2	0.001*** (0.009)	-0.024 (0.027)	Note 3	0.031 (0.021)	0.087*** (0.020)	0.124*** (0.036)	0.076*** (0.020)	-0.002 (0.018)	-0.013 (0.021)

(continued)

Table 26. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.058*** (0.019)	0.093 (0.076)	0.097** (0.040)	-0.006 (0.022)	0.010 (0.066)	0.037* (0.021)	0.053*** (0.019)	0.081*** (0.019)	0.020 (0.113)	0.166*** (0.021)	0.091 (0.062)	0.064 (0.040)	0.009 (0.082)	0.015 (0.049)	-0.036 (0.036)	0.003 (0.044)
3rd Quintile	0.138*** (0.021)	0.176*** (0.086)	0.200*** (0.049)	0.005 (0.025)	0.169*** (0.063)	0.025 (0.025)	0.096*** (0.020)	0.142*** (0.020)	0.041 (0.114)	0.266*** (0.027)	0.146*** (0.055)	0.065 (0.043)	0.000 (0.057)	0.075 (0.048)	0.003 (0.032)	0.004 (0.036)
4th Quintile	0.190*** (0.017)	0.280*** (0.098)	0.197*** (0.042)	0.019 (0.023)	0.215*** (0.057)	0.051** (0.023)	0.128*** (0.022)	0.193*** (0.021)	0.098 (0.112)	0.347*** (0.031)	0.201*** (0.055)	0.115** (0.045)	0.070 (0.058)	0.115** (0.046)	-0.042 (0.036)	-0.042 (0.039)
5th Quintile	0.277*** (0.019)	0.318*** (0.104)	0.229*** (0.044)	0.038 (0.024)	0.333** (0.060)	0.113*** (0.024)	0.202*** (0.024)	0.271*** (0.027)	0.156 (0.114)	0.435*** (0.032)	0.274*** (0.060)	0.130** (0.054)	0.097* (0.057)	0.267*** (0.063)	-0.026 (0.037)	-0.025 (0.042)
Constant	-0.493*** (0.027)	-0.733*** (0.181)	-0.546*** (0.055)	-0.129*** (0.035)	-0.481*** (0.085)	-0.349*** (0.033)	-0.230*** (0.018)	-0.341*** (0.021)	-0.603*** (0.143)	-0.546*** (0.035)	-0.387*** (0.063)	-0.242*** (0.051)	-0.327*** (0.081)	-0.605*** (0.092)	-0.181*** (0.052)	-0.311*** (0.141)
Sigma	0.256*** (0.010)	0.299*** (0.055)	0.287*** (0.022)	0.097*** (0.019)	0.311*** (0.021)	0.169*** (0.013)	0.229*** (0.008)	0.186*** (0.011)	0.218*** (0.038)	0.223*** (0.012)	0.175*** (0.020)	0.209*** (0.019)	0.269*** (0.051)	0.245*** (0.034)	0.135*** (0.016)	0.162*** (0.027)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³Italy does not collect information on inheritance.

Table 27. Tobit Model for the Portfolio Share of Other Real Estate

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children	0.056*** (0.021)	-0.025 (0.068)	-0.027 (0.071)	0.179** (0.076)	-0.006 (0.063)	0.081** (0.033)	0.197*** (0.025)	0.058* (0.033)	0.057 (0.048)	0.115*** (0.037)	-0.019 (0.126)	-0.032 (0.067)	0.198 (0.138)	0.018 (0.048)	0.181* (0.100)	-0.056 (0.074)
>= 3 Adults	0.056*** (0.027)	-0.019 (0.114)	-0.064 (0.131)	0.247*** (0.102)	-0.021 (0.091)	0.037 (0.043)	0.305*** (0.037)	0.065 (0.057)	0.113** (0.054)	0.157*** (0.036)	0.055 (0.141)	0.021 (0.089)	0.131 (0.241)	0.013 (0.053)	0.261*** (0.112)	0.082 (0.085)
Single Parent	-0.015 (0.040)	0.006 (0.204)	0.074 (0.144)	-0.071 (0.145)	0.057 (0.150)	0.022 (0.076)	0.008 (0.058)	0.006 (0.063)	0.075 (0.094)	-0.165*** (0.083)	0.251 (0.187)	0.020 (0.260)	-0.082 (0.759)	-0.178** (0.093)	-0.278** (0.142)	0.027 (0.107)
Couple with Children	0.034 (0.026)	-0.043 (0.081)	-0.031 (0.102)	0.130 (0.079)	-0.009 (0.079)	0.058 (0.041)	0.123*** (0.028)	0.016 (0.033)	0.071 (0.056)	0.118*** (0.043)	-0.062 (0.129)	0.071 (0.078)	0.248 (0.184)	-0.022 (0.057)	0.166 (0.121)	0.034 (0.066)
>= 3 Adults	0.045 (0.032)	-0.061 (0.108)	0.016 (0.183)	0.087 (0.100)	-0.063 (0.111)	0.089 (0.056)	0.201*** (0.049)	0.053 (0.081)	0.114 (0.078)	0.140*** (0.050)	0.047 (0.163)	0.096 (0.089)	-0.348 (0.981)	-0.006 (0.061)	0.291*** (0.119)	0.004 (0.091)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	0.003 (0.018)	-0.017 (0.056)	0.137*** (0.057)	0.088 (0.054)	-0.046 (0.098)	-0.019 (0.030)	0.074*** (0.016)	-0.008 (0.022)	0.028 (0.040)	0.004 (0.027)	0.131 (0.086)	-0.059 (0.058)	0.042 (0.104)	0.028 (0.025)	-0.065 (0.054)	-0.007 (0.042)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	0.186*** (0.022)	0.160*** (0.059)	0.224** (0.091)	0.118* (0.067)	0.114 (0.073)	0.142*** (0.038)	0.325*** (0.023)	0.201*** (0.034)	0.127*** (0.040)	0.268*** (0.041)	0.218** (0.094)	0.140** (0.065)	0.432*** (0.149)	0.122*** (0.044)	0.432*** (0.080)	0.073 (0.048)
65 Years and Over	0.200*** (0.029)	0.170 (0.107)	0.192 (0.128)	-0.048 (0.154)	0.187 (0.118)	0.117** (0.049)	0.386*** (0.037)	0.193*** (0.055)	0.145** (0.062)	0.318*** (0.051)	0.329** (0.151)	0.202** (0.103)	0.250 (0.214)	0.171*** (0.053)	0.537*** (0.112)	0.064 (0.081)

(continued)

Table 27. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Labor Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	0.203*** (0.021)	0.160** (0.070)	0.368*** (0.100)	0.065 (0.054)	0.144** (0.071)	0.149*** (0.037)	0.238*** (0.023)	0.299*** (0.029)	0.118*** (0.042)	0.221*** (0.033)	0.262*** (0.089)	0.230*** (0.047)	0.412 (0.309)	0.211*** (0.037)	0.072 (0.088)	0.116* (0.060)
Unemployed	-0.090** (0.036)	0.104 (0.215)	-0.164 (0.160)	0.044 (0.125)	-0.387* (0.218)	0.092 (0.054)	-0.110** (0.044)	-0.189*** (0.059)	-0.070 (0.188)	-0.058 (0.101)	-24.40 (-2363)	-0.016 (0.348)	0.501 (0.452)	-0.045 (0.081)	-0.122 (0.125)	0.052 (0.174)
Retired	0.082*** (0.022)	0.027 (0.075)	0.210** (0.090)	-0.007 (0.133)	0.057 (0.079)	0.153*** (0.038)	0.123*** (0.030)	0.075* (0.041)	0.083* (0.046)	0.055* (0.030)	0.090 (0.068)	0.099 (0.068)	0.140 (0.137)	0.100** (0.048)	-0.100 (0.088)	0.164** (0.064)
Other	0.006 (0.041)	-1973 (-1827)	-0.233 (0.303)	0.056 (0.171)	0.003 (0.166)	0.145*** (0.051)	0.002 (0.033)	-0.089 (0.063)	-0.044 (0.119)	0.038 (0.083)	-0.531 (0.451)	-0.135 (0.121)	-0.160 (0.175)	0.202** (0.093)	-0.115 (0.176)	0.192 (0.135)
Missing	0.045 (0.100)		0.019 (0.683)	0.214 (0.452)									0.043 (0.152)	0.365 (-1507)		-2.031*** (0.157)
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.019 (0.014)	-0.071 (0.083)	0.053 (0.083)	0.053 (0.059)	0.219** (0.094)	0.019 (0.042)	0.022 (0.023)	0.015 (0.034)	-0.006 (0.045)	0.071*** (0.024)	-0.104 (0.082)	0.103*** (0.038)	-0.010 (0.127)	0.033 (0.048)	-0.008 (0.071)	-0.181* (0.102)
High (ISCED 4-6)	0.125*** (0.020)	0.110 (0.095)	0.096 (0.075)	0.037 (0.069)	0.398*** (0.113)	0.032 (0.033)	0.054** (0.023)	0.053* (0.029)	0.035 (0.045)	0.208*** (0.036)	0.121 (0.095)	0.152** (0.066)	0.244* (0.125)	0.149*** (0.045)	0.076 (0.096)	0.087 (0.118)
<i>Inheritance</i>																
Dummy	0.300*** (0.018)	0.474*** (0.052)	0.203*** (0.045)	0.303*** (0.049)	0.276*** (0.044)	0.347*** (0.024)	Note 2	0.339*** (0.024)	0.062* (0.037)	Note 3	0.187*** (0.070)	0.194*** (0.042)	0.244 (0.151)	0.355*** (0.031)	0.187*** (0.052)	0.092*** (0.034)

(continued)

Table 27. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.062** (0.026)	0.207* (0.114)	-0.018 (0.103)	0.079 (0.096)	-0.072 (0.114)	0.194*** (0.041)	0.078* (0.041)	0.105*** (0.037)	0.049 (0.045)	0.002 (0.045)	0.076 (0.174)	0.027 (0.073)	0.042 (0.214)	0.039 (0.050)	0.392*** (0.121)	0.087 (0.079)
3rd Quintile	0.161*** (0.031)	0.287*** (0.106)	0.001 (0.113)	0.012 (0.101)	0.199* (0.120)	0.266*** (0.037)	0.194*** (0.042)	0.171*** (0.045)	0.206*** (0.058)	0.069 (0.048)	0.203 (0.160)	0.077 (0.087)	-0.262 (0.238)	0.107** (0.052)	0.428*** (0.122)	0.264*** (0.099)
4th Quintile	0.260*** (0.032)	0.388*** (0.111)	0.212* (0.120)	0.083 (0.103)	0.431*** (0.117)	0.368*** (0.048)	0.247*** (0.045)	0.198*** (0.044)	0.183*** (0.064)	0.099** (0.048)	0.254 (0.155)	0.072 (0.076)	-0.046 (0.206)	0.174*** (0.049)	0.260* (0.135)	0.313*** (0.099)
5th Quintile	0.366*** (0.033)	0.559*** (0.104)	0.308** (0.120)	0.232* (0.108)	0.494*** (0.129)	0.452*** (0.051)	0.300*** (0.045)	0.369*** (0.042)	0.290*** (0.061)	0.224*** (0.048)	0.402 (0.169)	0.163* (0.089)	-0.021 (0.196)	0.334*** (0.045)	0.503*** (0.128)	0.367*** (0.107)
Constant	-1.185*** (0.042)	-1.310*** (0.141)	-1.190*** (0.130)	-0.440*** (0.110)	-1.275*** (0.141)	-0.751*** (0.055)	-0.921*** (0.035)	-0.952*** (0.047)	-0.557*** (0.070)	-0.871*** (0.048)	-0.907*** (0.147)	-0.536*** (0.106)	-1.684*** (0.248)	-0.787*** (0.069)	-1.241*** (0.154)	-0.744*** (0.137)
Sigma	0.534*** (0.007)	0.578*** (0.039)	0.621*** (0.029)	0.435*** (0.021)	0.578*** (0.025)	0.444*** (0.011)	0.515*** (0.007)	0.547*** (0.012)	0.535*** (0.014)	0.499*** (0.013)	0.623*** (0.027)	0.409*** (0.018)	0.716*** (0.006)	0.516*** (0.020)	0.484*** (0.037)	0.455*** (0.029)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³Italy does not collect information on inheritance.

Table 28. Tobit Model for the Portfolio Share of the Business Assets

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple	0.137*** (0.025)	0.256** (0.102)	0.164*** (0.062)	-0.011 (0.137)	0.141** (0.068)	0.051 (0.060)	0.038*** (0.011)	0.217*** (0.044)	0.163* (0.097)	0.101*** (0.043)	0.091 (0.043)	-0.057 (0.131)	0.020 (0.218)	0.141* (0.076)	1.458*** (0.324)	-0.083 (0.003)
>= 3 Adults	0.249*** (0.030)	0.516*** (0.124)	0.161 (0.135)	0.081 (0.168)	0.206*** (0.078)	0.141** (0.068)	0.013 (0.019)	0.256*** (0.053)	0.356*** (0.118)	0.262*** (0.053)	0.043 (0.130)	-0.053 (0.197)	-4.225*** (0.707)	0.176** (0.081)	1.845*** (0.355)	-0.005 (0.071)
Single Parent	0.047 (0.048)	-0.155 (0.405)	0.223 (0.343)	0.032 (0.384)	0.114 (0.155)	-0.135 (0.111)	0.013 (0.030)	-0.045 (0.065)	-0.147 (0.628)	0.068 (0.065)	0.129 (0.612)	-0.236 (0.446)	-0.055 (0.682)	0.096 (0.131)	-0.114 (0.072)	-0.082 (0.074)
Couple with Children	0.170*** (0.025)	0.212** (0.108)	0.148* (0.078)	-0.037 (0.121)	0.136* (0.073)	0.086 (0.062)	0.037*** (0.013)	0.261*** (0.041)	0.317*** (0.100)	0.198*** (0.041)	0.045 (0.092)	-0.159 (0.170)	-0.238 (0.208)	0.142** (0.070)	1.558*** (0.331)	-0.084 (0.057)
>= 3 Adults with Children	0.209*** (0.036)	0.385*** (0.123)	0.069 (0.141)	-0.026 (0.173)	0.240** (0.115)	0.099 (0.069)	-0.073*** (0.024)	0.318*** (0.053)	0.304** (0.127)	0.220*** (0.059)	0.129 (0.112)	-0.111 (0.176)	0.004 (0.601)	0.123 (0.094)	1.797*** (0.334)	-0.082 (0.089)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	-0.046*** (0.016)	-0.092 (0.069)	-0.050 (0.061)	0.165*** (0.074)	-0.004 (0.053)	-0.038 (0.048)	-0.016** (0.008)	-0.110*** (0.027)	-0.125** (0.008)	-0.062*** (0.030)	-0.025 (0.086)	-0.118 (0.135)	0.133 (0.142)	-0.008 (0.052)	-0.130* (0.069)	0.002 (0.040)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	0.008 (0.018)	0.177** (0.077)	0.067 (0.059)	0.072 (0.082)	0.145*** (0.055)	-0.051 (0.041)	0.078*** (0.012)	-0.026 (0.027)	-0.145** (0.061)	-0.026 (0.034)	-0.045 (0.085)	-0.039 (0.125)	-0.210 (0.188)	-0.013 (0.056)	-0.060 (0.078)	-0.014 (0.034)
65 Years and Over	-0.095*** (0.027)	0.039 (0.125)	-0.053 (0.116)	0.020 (0.355)	-0.090 (0.077)	-0.119 (0.074)	0.107*** (0.021)	-0.106** (0.051)	-0.151 (0.131)	-0.070 (0.050)	-0.149 (0.138)	-0.344 (0.237)	-0.612 (0.899)	0.055 (0.090)	-0.132 (0.142)	-0.014 (0.099)

(continued)

Table 28. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Labour Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	0.786*** (0.023)	0.869*** (0.143)	0.708*** (0.079)	0.486*** (0.094)	0.686*** (0.048)	0.718*** (0.054)	0.178*** (0.014)	0.907*** (0.042)	0.826*** (0.070)	0.753*** (0.037)	0.647*** (0.105)	1.024*** (0.118)	1.434*** (0.258)	0.667*** (0.053)	0.705*** (0.195)	0.598*** (0.072)
Unemployed	-0.183*** (0.039)	0.084 (0.376)	-0.105 (0.943)	-0.276 (0.095)	-1.663* (0.087)	-0.244 (0.181)	-0.017 (0.026)	-0.165** (0.077)	0.240 (0.124)	-0.159 (0.522)	-1.768*** (0.263)	0.155 (0.533)	-0.599 (0.181)	-0.137 (0.099)	-0.172 (0.171)	-1.093*** (0.161)
Retired	0.002 (0.026)	-0.099 (0.079)	-0.015 (0.097)	-0.280 (0.359)	0.006 (0.067)	0.091 (0.063)	0.035** (0.016)	-0.058 (0.043)	0.186 (0.130)	0.007 (0.051)	0.110 (0.094)	0.231 (0.182)	-0.023 (0.558)	-0.129* (0.076)	-0.002 (0.154)	0.029 (0.069)
Other	-0.027 (0.060)	0.040 (0.407)	0.110 (0.418)	-2.517*** (0.305)	-0.188 (0.551)	-0.046 (0.107)	-0.024 (0.019)	-0.176** (0.087)	0.324 (0.569)	-0.035 (0.559)	-1.625*** (0.243)	-2.753*** (0.308)	0.453 (0.442)	-2.232*** (0.185)	-1.797*** (0.294)	0.194 (0.143)
Missing	0.180 (0.113)		-0.268 (0.834)	-0.356 (0.1157)									0.501** (0.212)	0.551 (0.185)	-0.874*** (0.294)	-0.874*** (0.138)
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.036** (0.018)	-0.080 (0.092)	0.142* (0.084)	0.102 (0.095)	0.080 (0.080)	0.047 (0.036)	-0.007 (0.010)	0.008** (0.029)	-0.046 (0.061)	0.012 (0.024)	0.033 (0.076)	0.030 (0.115)	0.207 (0.251)	0.123* (0.068)	-0.046 (0.056)	-0.084 (0.111)
High (ISCED 4-6)	0.039* (0.021)	-0.149 (0.121)	0.206** (0.092)	-0.049 (0.105)	0.102 (0.080)	0.057 (0.038)	-0.008 (0.010)	0.043 (0.042)	-0.152** (0.076)	-0.127*** (0.033)	0.040 (0.089)	0.055 (0.137)	0.504* (0.270)	0.039 (0.062)	0.007 (0.076)	0.064 (0.126)
<i>Inheritance</i>																
Dummy	0.079*** (0.020)	0.188*** (0.046)	0.081* (0.044)	-0.021 (0.077)	0.074* (0.045)	0.078** (0.031)	Note 2	0.008*** (0.023)	-0.050 (0.041)	Note 3	0.057 (0.058)	0.087 (0.104)	0.399** (0.192)	0.121*** (0.044)	-0.037 (0.061)	-0.054 (0.034)

(continued)

Table 28. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	0.019 (0.037)	0.000 (0.132)	0.078 (0.428)	0.122 (0.155)	-0.045 (0.152)	0.084 (0.096)	-0.009 (0.016)	-0.022 (0.046)	0.002 (0.067)	0.086 (0.054)	0.015 (0.138)	0.239 (0.303)	-0.065 (0.509)	0.112 (0.094)	-0.002 (0.139)	0.040 (0.104)
3rd Quintile	0.063 [*] (0.038)	0.134 (0.180)	0.306 (0.419)	0.322 ^{**} (0.141)	0.012 (0.122)	0.148 (0.093)	-0.002 (0.016)	-0.083 (0.052)	0.156 (0.098)	0.112 [*] (0.064)	0.103 (0.119)	0.166 (0.304)	0.239 (0.309)	0.164 (0.107)	0.224 [*] (0.121)	0.189 (0.121)
4th Quintile	0.076 ^{**} (0.034)	0.169 (0.173)	0.227 (0.408)	0.337 ^{**} (0.150)	0.023 (0.112)	0.187 [*] (0.098)	0.027 [*] (0.015)	-0.118 ^{**} (0.054)	0.233 ^{***} (0.086)	0.176 ^{***} (0.058)	0.164 (0.113)	0.348 (0.306)	-0.062 (0.341)	0.156 (0.108)	0.061 (0.219)	0.198 [*] (0.116)
5th Quintile	0.154 ^{***} (0.034)	0.238 [*] (0.134)	0.255 (0.411)	0.447 ^{***} (0.146)	0.199 [*] (0.113)	0.179 [*] (0.090)	0.107 ^{***} (0.017)	-0.068 (0.050)	0.356 ^{***} (0.085)	0.195 ^{***} (0.063)	0.254 ^{**} (0.120)	0.494 [*] (0.297)	0.154 (0.329)	0.280 ^{***} (0.104)	0.160 (0.141)	0.280 ^{**} (0.119)
Constant	-0.904 ^{***} (0.048)	-1.257 ^{***} (0.258)	-1.209 ^{***} (0.463)	-0.887 ^{***} (0.222)	-1.072 ^{***} (0.134)	-0.763 ^{***} (0.101)	-0.376 ^{***} (0.025)	-0.787 ^{***} (0.060)	-1.178 ^{***} (0.133)	-0.833 ^{***} (0.076)	-0.936 ^{***} (0.146)	-1.093 ^{***} (0.344)	-1.852 ^{***} (0.436)	-1.146 ^{***} (0.121)	-2.192 ^{***} (0.457)	-0.604 ^{***} (0.186)
Sigma	0.404 ^{***} (0.011)	0.509 ^{***} (0.074)	0.384 ^{***} (0.044)	0.479 ^{***} (0.055)	0.401 ^{***} (0.025)	0.332 ^{***} (0.023)	0.214 ^{***} (0.013)	0.402 ^{***} (0.016)	0.485 ^{***} (0.027)	0.353 ^{***} (0.016)	0.386 ^{***} (0.046)	0.578 ^{***} (0.060)	0.688 ^{***} (0.109)	0.470 ^{***} (0.030)	0.331 ^{***} (0.067)	0.255 ^{***} (0.031)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³Italy does not collect information on inheritance.

Table 29. Tobit Model for the Portfolio Share of Safe Financial Assets

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Household Type (Base: Single)</i>																
Couple w/o Children	-0.083*** (0.010)	-0.109*** (0.026)	-0.093*** (0.025)	-0.043 (0.042)	-0.087*** (0.025)	-0.059*** (0.019)	-0.045*** (0.014)	-0.062*** (0.015)	-0.104*** (0.021)	-0.072*** (0.014)	-0.047 (0.031)	-0.120** (0.049)	-0.064 (0.054)	-0.076*** (0.026)	-0.135*** (0.051)	-0.073*** (0.018)
>= 3 Adults	-0.088*** (0.013)	-0.148*** (0.039)	-0.048 (0.049)	-0.116*** (0.044)	-0.114*** (0.039)	-0.048*** (0.023)	-0.058*** (0.017)	-0.115*** (0.023)	-0.120*** (0.025)	-0.110*** (0.012)	-0.031 (0.051)	-0.121* (0.066)	-0.029 (0.097)	-0.104*** (0.031)	-0.145*** (0.052)	-0.084*** (0.026)
Single Parent	-0.043* (0.023)	-0.057 (0.058)	-0.096* (0.051)	-0.089 (0.062)	0.038 (0.069)	-0.059 (0.037)	-0.014 (0.030)	-0.072*** (0.021)	-0.004 (0.082)	-0.028 (0.037)	-0.062 (0.087)	-0.131 (0.104)	-0.070 (0.114)	0.029 (0.051)	-0.205** (0.085)	-0.057* (0.030)
Couple with Children	-0.136*** (0.012)	-0.113*** (0.034)	-0.163*** (0.029)	-0.074** (0.034)	-0.119*** (0.034)	-0.119*** (0.019)	-0.113*** (0.015)	-0.138*** (0.017)	-0.148*** (0.029)	-0.112*** (0.015)	-0.090*** (0.033)	-0.176*** (0.058)	-0.196*** (0.046)	-0.128*** (0.030)	-0.173*** (0.064)	-0.101*** (0.021)
>= 3 Adults with Children	-0.114*** (0.016)	-0.125*** (0.054)	-0.179*** (0.044)	-0.070 (0.043)	-0.167*** (0.044)	-0.055* (0.032)	-0.050* (0.030)	-0.080** (0.032)	-0.140*** (0.041)	-0.127*** (0.021)	-0.145*** (0.040)	-0.179*** (0.064)	-0.187*** (0.079)	-0.094** (0.038)	-0.118** (0.053)	-0.050 (0.032)
<i>Gender (Reference Person) (Base: Female)</i>																
Male	-0.016** (0.008)	-0.029 (0.026)	0.015 (0.021)	-0.001 (0.032)	-0.007 (0.022)	-0.008 (0.014)	-0.047*** (0.012)	-0.021** (0.010)	0.004 (0.019)	0.010 (0.011)	-0.016 (0.031)	-0.004 (0.040)	-0.064 (0.041)	-0.024 (0.015)	-0.019 (0.022)	-0.019 (0.013)
<i>Age (Reference Person) (Base: Below 40 Years)</i>																
40-64 Years	-0.086*** (0.009)	-0.052* (0.027)	-0.160*** (0.026)	-0.003 (0.026)	-0.088*** (0.027)	-0.027* (0.015)	-0.111*** (0.012)	-0.110*** (0.011)	-0.081*** (0.018)	-0.060*** (0.015)	-0.034 (0.028)	-0.010 (0.031)	-0.006 (0.061)	-0.006*** (0.018)	-0.084*** (0.030)	-0.072*** (0.015)
65 Years and Over	-0.104*** (0.013)	-0.043 (0.047)	-0.191*** (0.043)	-0.028 (0.088)	-0.111** (0.047)	-0.056** (0.025)	-0.197*** (0.023)	-0.072*** (0.021)	-0.086*** (0.030)	-0.067*** (0.016)	-0.115*** (0.041)	-0.035 (0.047)	-0.060 (0.088)	-0.054** (0.026)	-0.091* (0.051)	-0.142*** (0.028)

(continued)

Table 29. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Labor Market Status (Reference Person) (Base: Employee)</i>																
Self-employed	-0.063*** (0.008)	-0.082** (0.033)	-0.125*** (0.029)	-0.010 (0.030)	-0.089*** (0.029)	-0.021 (0.014)	-0.063*** (0.016)	-0.119*** (0.012)	-0.015 (0.012)	-0.051*** (0.011)	0.011 (0.033)	-0.043* (0.025)	-0.029 (0.009)	-0.057*** (0.015)	-0.040 (0.035)	-0.036* (0.020)
Unemployed	0.025 (0.021)	0.031 (0.060)	0.074 (0.053)	-0.041 (0.052)	0.065 (0.076)	0.021 (0.032)	0.086*** (0.028)	0.002 (0.020)	-0.029 (0.075)	-0.098*** (0.044)	0.166 (0.109)	-0.089 (0.084)	-0.047 (0.093)	0.099*** (0.037)	-0.089*** (0.037)	0.041 (0.057)
Retired	-0.008 (0.010)	-0.009 (0.034)	-0.038 (0.035)	0.068 (0.077)	-0.006 (0.038)	0.006 (0.020)	-0.023 (0.023)	-0.036* (0.020)	0.027 (0.021)	-0.029*** (0.011)	-0.032 (0.033)	0.048 (0.037)	0.005 (0.008)	0.026 (0.020)	-0.086* (0.049)	-0.046*** (0.019)
Other	0.052** (0.022)	0.147 (0.116)	0.085 (0.054)	-0.001 (0.136)	0.042 (0.068)	-0.009 (0.024)	0.097*** (0.028)	0.070*** (0.021)	0.283*** (0.073)	-0.087*** (0.038)	-0.012 (0.085)	-0.034 (0.073)	0.089 (0.070)	-0.034 (0.016)	-0.063 (0.063)	-0.070*** (0.023)
Missing	-0.035 (0.055)		-0.047 (0.097)	-0.242 (0.244)									-0.010 (0.099)	0.016 (0.356)		-0.222 (0.198)
<i>Education (Reference Person) (Base: Low (ISCED 1 and 2))</i>																
Middle (ISCED 3)	0.002 (0.010)	-0.026 (0.031)	-0.005 (0.030)	0.009 (0.037)	-0.063 (0.050)	0.050*** (0.019)	-0.043*** (0.015)	-0.010 (0.011)	0.056*** (0.019)	-0.013 (0.009)	0.007 (0.034)	-0.051** (0.023)	0.012 (0.040)	-0.025 (0.017)	-0.075* (0.039)	0.043 (0.037)
High (ISCED 4-6)	-0.010 (0.012)	0.040 (0.045)	-0.016 (0.030)	0.010 (0.035)	-0.071 (0.054)	0.040*** (0.011)	-0.039*** (0.016)	-0.002 (0.013)	0.086*** (0.021)	-0.013 (0.016)	0.024 (0.038)	-0.046 (0.030)	-0.038 (0.040)	-0.033* (0.018)	-0.023 (0.037)	0.038 (0.039)
<i>Inheritance</i>																
Dummy	-0.109*** (0.007)	-0.191*** (0.018)	-0.040** (0.018)	-0.064*** (0.025)	-0.169*** (0.017)	-0.046*** (0.008)	Note 2	-0.056*** (0.009)	-0.105*** (0.013)	Note 3	-0.046* (0.024)	-0.076*** (0.020)	-0.077 (0.053)	-0.116*** (0.014)	-0.065*** (0.024)	-0.044*** (0.011)

(continued)

Table 29. (Continued)

Variables	EA ¹	AT	BE	CY	DE	ES	FI	FR	GR	IT	LU	MT	NL	PT	SI	SK
<i>Income Distribution (Base: 1st Quintile)</i>																
2nd Quintile	-0.018 (0.014)	-0.080* (0.045)	-0.105*** (0.040)	-0.046 (0.053)	-0.107* (0.056)	-0.003 (0.018)	-0.148*** (0.024)	0.009 (0.016)	0.010 (0.030)	0.022 (0.017)	-0.106* (0.060)	-0.032 (0.044)	0.060 (0.072)	0.038 (0.029)	0.119* (0.068)	0.039* (0.023)
3rd Quintile	-0.057*** (0.014)	-0.121*** (0.042)	-0.119*** (0.045)	-0.029 (0.050)	-0.193*** (0.049)	-0.031** (0.022)	-0.216*** (0.021)	-0.005 (0.014)	0.018 (0.026)	0.031* (0.019)	-0.172*** (0.051)	-0.028 (0.048)	0.015 (0.064)	-0.014 (0.026)	0.137*** (0.057)	0.004 (0.021)
4th Quintile	-0.079*** (0.015)	-0.103*** (0.046)	-0.144*** (0.045)	0.009 (0.053)	-0.226*** (0.050)	-0.045* (0.024)	-0.289*** (0.024)	-0.041** (0.017)	0.032 (0.029)	0.020 (0.019)	-0.177*** (0.053)	-0.037 (0.047)	-0.070 (0.065)	-0.027 (0.025)	0.116* (0.053)	0.023 (0.022)
5th Quintile	-0.075*** (0.015)	-0.137*** (0.054)	-0.122*** (0.047)	-0.011 (0.050)	-0.243*** (0.051)	-0.038* (0.023)	-0.292*** (0.026)	-0.021 (0.017)	0.032 (0.031)	0.043* (0.020)	-0.201*** (0.051)	-0.033 (0.052)	-0.064 (0.060)	-0.014 (0.026)	0.139*** (0.052)	0.066*** (0.033)
Constant	0.606*** (0.022)	0.682*** (0.050)	0.602*** (0.044)	0.192*** (0.069)	0.839*** (0.062)	0.230*** (0.024)	0.657*** (0.030)	0.475*** (0.019)	0.193*** (0.033)	0.231*** (0.021)	0.437*** (0.055)	0.420*** (0.069)	0.528*** (0.084)	0.389*** (0.031)	0.258*** (0.083)	0.213*** (0.041)
Sigma	0.318*** (0.002)	0.377*** (0.009)	0.314*** (0.007)	0.245*** (0.016)	0.373*** (0.007)	0.238*** (0.009)	0.350*** (0.004)	0.301*** (0.003)	0.277*** (0.010)	0.242*** (0.005)	0.275*** (0.011)	0.284*** (0.009)	0.368*** (0.011)	0.321*** (0.007)	0.198*** (0.016)	0.221*** (0.008)

Source: HFCS 2013.

Notes: Standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

¹The model for the euro area includes country fixed effects for which the estimates are not reported.

²The dummy for inheritance for Finland is dropped from the model due to no recorded inheritances.

³Italy does not collect information on inheritance.

Appendix 6. Definitions

Definition of Explanatory Variables

- *Household Type*: single (base), couples with children, three or more adults without children, single parent, couple with dependent children, three or more adults with dependent children
- *Gender of the Reference Person*: dummy equal to 1 for male reference person
- *Age of Reference Person*: below forty years (base), forty to sixty-four years, sixty-five years and older
- *Marital Status of the Reference Person*: single (base), married (including consensual union on a legal basis), divorced, widowed
- *Employment Status of the Reference Person*: employee (base), self-employed, unemployed, retired, other, missing
- *Education of the Reference Person*: low (ISCED 1 and 2) (base), middle (ISCED 3), high (ISCED 4–6)
- *Inheritance*: dummy equal to 1 if a household has inherited in the past
- *Net Wealth Distribution*: quintiles (base: first quintile)
- *Income Distribution*: quintiles (base: first quintile)

Definition of Reference Person

- The reference person is defined in accordance with the Canberra definition, i.e., applying the following rule in the order that is given until one person is found: “one of the partners in a registered or de facto marriage, with dependent children; one of the partners in a registered or de facto marriage, without dependent children; a lone parent with dependent children; the person with the highest income; the eldest person” (see also United Nations 2011, pp. 65–66).

Definitions of the Institutional Indicators

Table 30. Institutional Indicators—Investigating Differences in the Effect of Explanatory Variables for Housing Assets

Indicators	Definition	Source
Mortgage Market	Share of mortgages used for purposes other than financing a new home	ECB (2009)
Housing Price-to-Rent Ratio	Price of the house on annual rent; long-term average = 100; 2009	OECD Stat
Inheritance Tax on HMR	Yes/No—Inheritance tax on own principal home	ECB (2009)
Pension-Replacement Rate	Gross pension-replacement rates: average earners	OECD (2011)

Table 31. Institutional Indicators—Investigating Differences in the Effect of Explanatory Variables for Risky Assets

Indicators	Definition	Source
Stock Capitalization	Stock market total value traded to GDP (%)	World Bank
Literacy	Senior business leader’s evaluation of the statement “Economic literacy among the population is generally high—scale from 0 to 10”	“World Competitiveness Yearbook” as seen in figure 1 (Jappelli 2010)
Trust	Country index of interpersonal trust (last available data 1999 for AT, BE, GR, LUX, MT, PT, SK; 2005 for DE, FI, IT, SI; 2006 for CY, FR, NL; 2007 for ES)	Values Surveys EVS/WVS
Internet Access	Percentage of households with access to the Internet (2009)	OECD-EU Community
Pension-Replacement Rate	Gross pension-replacement rates: average earners	OECD (2011)

References

- Campbell, J. 2006. "Household Finance." *Journal of Finance* 61 (4): 1553–1604.
- Carroll, C. D. 2002. "Portfolios of the Rich." In *Household Portfolios*, ed. L. Guiso, M. Haliassos, and T. Jappelli, 389–429 (chapter 10). Cambridge, MA: MIT Press.
- Chiuri, M. C., and T. Jappelli. 2003. "Financial Market Imperfections and Home Ownership: A Comparative Study." *European Economic Review* 47 (5): 857–75.
- Christelis, D., D. Georgarakos, and M. Haliassos. 2013. "Differences in Portfolios across Countries: Economic Environment versus Household Characteristics." *Review of Economics and Statistics* 95 (1): 220–36.
- Cox, C., and O. Stark. 2005. "Bequests, Inheritances and Family Traditions." Working Paper No. 2005-09, Center for Retirement Research.
- Davies, J. B., and A. F. Shorrocks. 1999. "The Distribution of Wealth." In *Handbook of Income Distribution*, Vol. 1, ed. A. B. Atkinson and F. Bourguignon, 605–75 (chapter 11). Elsevier.
- European Central Bank. 2009. "Housing Finance in the Euro Area." ECB Occasional Paper No. 101.
- European Commission. 2011. "Study on the Costs and Benefits of the Different Policy Options for Mortgage Credit." Final Report.
- Guiso, L., M. Haliassos, and T. Jappelli. 2002. *Household Portfolios*. Cambridge, MA: MIT Press.
- . 2003. "Household Stockholding in Europe: Where Do We Stand and Where Do We Go?" *Economic Policy* 18 (36): 123–70.
- Guiso, L., T. Jappelli, and D. Terlizzese. 1996. "Income Risk, Borrowing Constraints, and Portfolio Choice." *American Economic Review* 86 (1): 158–72.
- Guiso, L., P. Sapienza, and L. Zingales. 2008. "Trusting the Stock Market." *Journal of Finance* 63 (6): 2557–2600.
- Heaton, J., and D. Lucas. 2000. "Portfolio Choice in the Presence of Background Risk." *Economic Journal* 110 (460): 1–26.
- Household Finance and Consumption Network (HFCN). 2013a. "The Eurosystem Household Finance and Consumption Survey: Methodological Report for the First Wave." ECB Statistical Paper No. 1.

- . 2013b. “The Eurosystem Household Finance and Consumption Survey: Results from the First Wave.” ECB Statistical Paper No. 2.
- Jappelli, T. 2010. “Financial Literacy: An International Comparison.” *Economic Journal* 120 (548): F429–F451.
- Mathä, T. Y., A. Porgiglia, and M. Ziegelmeyer. 2014. “Household Wealth in the Euro Area: The Importance of Intergenerational Transfers, Homeownership and House Price Dynamics.” ECB Working Paper No. 1690.
- Organisation for Economic Co-operation and Development (OECD). 2011. *Pensions at a Glance 2011: Retirement-income Systems in OECD and G20 Countries*. OECD Press.
- Sierminska, E., and K. Doorley. 2012. “Decomposing Wealth Portfolios across Countries: An Age-Old Question?” LISER Working Paper No. 2012-32.
- United Nations. 2011. *Canberra Group Handbook on Household Income Statistics*, 2nd Edition. Geneva: United Nations.
- Van Rooij, M., A. Lusardi, and R. Alessie. 2011. “Financial Literacy and Stock Market Participation.” *Journal of Financial Economics* 101 (2): 449–72.

Supranational Supervision: How Much and for Whom?*

Thorsten Beck^a and Wolf Wagner^b

^aCass Business School, City University London, and CEPR

^bRotterdam School of Management and CEPR

We argue that the extent to which supervision of banks takes place on the supranational level should be guided by two factors: cross-border externalities from bank failure and heterogeneity in bank failure costs. Based on a simple model, we show that supranational supervision is more likely to be welfare enhancing when externalities are high and country heterogeneity is low. This suggests that different sets of countries (or regions) should differ in the extent to which their regulators cooperate across borders. We apply the insights of our model to discuss optimal supervisory arrangements for different regions of the world and contrast them with existing arrangements and current policy initiatives. We also offer a political economy discussion on the likelihood with which countries delegate supervisory authority to supranational authorities.

JEL Codes: G21, G28.

1. Introduction

The question of how to regulate and supervise large international banks has taken center stage in the debate on the reform of the banking sector. The failure of internationally active financial institutions, such as Lehman Brothers, and cross-border banks, such as Fortis, Dexia, or the Icelandic banks, played a prominent role during the Global Financial Crisis. As a consequence, there is a growing

*We are grateful for comments and suggestions from two anonymous referees as well as participants at seminars at the World Bank and the Banque de France, the conference on Deposit Guarantees and Bank Crises in Reykjavik, and the workshop on Banking Supervision and Central Banks at the ECB. Thorsten Beck acknowledges support from the European Commission under Marie Curie Grant, IRG 239469. Author e-mails: TBeck@city.ac.uk and wagner@rsm.nl.

recognition that memoranda of understanding and supervisory colleges are not sufficient to deal with large and systemically important cross-border financial institutions. In the euro zone, a banking union with a single supervisory mechanism at the European Central Bank and a single resolution board is being implemented, both as a crisis-resolution tool and as a necessary condition for making the euro zone a sustainable currency union (Beck 2012).

The discussion on the optimal international financial architecture is a complex one and often gets mired in details. In this paper, we argue that this discussion should be guided by a basic trade-off. This trade-off can serve as a general framework for gauging the need and feasibility of different forms of cross-border integration of bank supervision. In particular, based on a simple model, we derive circumstances under which a supranational supervisor is preferable to a national supervisor. Our model also permits us to analyze intermediate forms of cooperation, such as minimum standards across countries. We then apply the insights from the model to the discussion on the optimality of different forms of cross-border cooperation that are currently being considered in the global regulatory reform debate, as well as a political economy discussion on what circumstances make it more likely that countries will delegate part or all of their supervisory authority to supranational authorities.

In the wake of the Global Financial Crisis, several initiatives have aimed at closer international cooperation to regulate banks (for example, principles and standards, peer reviews, and progress reports by the Financial Stability Board). One key insight from the crisis, however, has been that such cooperation is most important at the stage of intervention and resolution of failing banks, i.e., at the point where supervisors have to decide if and how to intervene in a failing bank. There have been efforts to force bail-ins of creditors to reduce the costs of bank failure to taxpayers. In this context, there are also reforms under discussion to lessen the impact of bank failures on the rest of the financial system and the economy at large. Recovery and resolution plans, also known as living wills, for the largest financial institutions, are an important part of these reforms.

The different initiatives to intensify cooperation among supervisors have seen different degrees of success. Initial cooperation in the context of the living wills for G-SIFIS (global systemically important financial institutions) has been replaced by increased

suspicion, especially between U.S. and European supervisors.¹ On the other hand, in several smaller regions, there has been progress. In the Nordic-Baltic region, a memorandum of understanding has been signed that includes ex ante burden-sharing agreements. Moreover, a college of resolution authorities has been formed that includes ministries of finance. Supervisors in Africa have taken first steps towards closer cooperation with the establishment of the Community of African Banking Supervisors. Cooperation in certain subregions, as for example in the East African Community, has advanced even further. In the euro zone there have been attempts to move toward a fully fledged banking union, with a supranational supervisor and resolution authority. In spring 2014, political negotiations resulted in a partial banking union, with a single supervisory mechanism, a coordinated resolution mechanism based on national schemes, but no single deposit insurance fund.

The variety of experiences and approaches that are taken raises the question of what kind of cooperation is optimal for which set of countries. Our paper aims to inform the debate by focusing on the supervisory decision to intervene and resolve failing banks. Specifically, we propose that there are two dimensions that should determine the degree of supervisory integration—cross-border externalities from financial instability and heterogeneity of countries in the costs of failing banks. We model the supervisory decision to intervene in a failing bank under national and supranational supervision regimes and derive conditions under which either of the two results in higher welfare. The analysis shows that higher externalities and lower heterogeneity between countries in failure costs result in a higher likelihood that supranational supervision is welfare improving over national supervision. We also show that there is an intermediate form of cooperation between national supervisors that can reduce (but not eliminate) externalities from national supervision of cross-border banks while at the same time avoiding most of the inefficiencies related to heterogeneity in failure costs. Based on the analysis, we propose solutions for cross-border regulatory coordination or integration for different countries and regions in the world, and contrast them with current arrangements and policy initiatives.

¹See, for instance, *Financial Times* (2013a).

However, we also analyze under which circumstances countries are likely to agree to different forms of regulatory coordination or supervisory integration, thus providing a political economy analysis of the different degrees of progress made in cross-border regulatory cooperation around the globe. We show that incentive compatibility can seriously limit the implementation of a supranational solution. We also show that small countries—even if their preferences only have little effect on supranational decision making—can benefit more from delegation than large countries. Finally, we show that biases arising from national supervision of cross-border banks can also result in too lenient licensing of banks.

Our paper is linked to a small—but growing—literature on cross-border bank regulation. Loranth and Morrison (2007) discuss the implications of capital requirements and deposit insurance for cross-border banks and show that capital requirements set at a level to offset the safety-net subsidy of deposit insurance result in too little risk taking in the case of multi-national banks. Dell’Arricia and Marquez (2006) show that competition between national regulators can lead to lower capital adequacy standards, since national regulators do not take into account the external benefits of higher capital adequacy standards in terms of higher stability in other countries. Acharya (2003) argues that coordinating capital adequacy ratios across countries without coordinating other dimensions of the regulatory framework, such as resolution policies, can have detrimental effects. Freixas (2003) and Goodhart and Schoenmaker (2009) show that ex post negotiations on recapitalization of failing cross-border banks can lead to underprovision of the necessary resources and identify an advantage of ex ante burden-sharing agreements in helping overcome coordination problems between regulators. Holthausen and Ronde (2002) consider cooperation between home- and host-country supervisor on the intervention decision for a multi-national bank. Given that national regulators represent national interests, a misalignment of interests leads to sub-optimal exchange of information and distorted intervention decisions. Niepmann and Schmidt-Eisenlohr (2013) show that decisions of national governments on recapitalization of failing banks are inefficient if national banking systems are linked through the interbank markets.

More closely related to our paper, Calzolari and Loranth (2011) analyze how the organizational structure of multi-national banks can

influence regulatory behavior. Specifically, organization of foreign presence through branches leads to higher incentives to intervene, as the home-country regulator can draw on all assets. At the same time, it can reduce intervention incentives if the regulator is responsible for repaying all deposits, including in foreign branches. However, there is no heterogeneity that induces costs for supranational regulation and hence no tension between the optimality of domestic and supranational regulation, which is the focus of our analysis. Beck, Todorov, and Wagner (2013) show that different dimensions of cross-border banking (deposit collection, investment and ownership) distort regulatory interventions in different directions. Similar to Calzolari and Loranth (2011), the analysis focuses on distortions arising from national solutions and there is no trade-off with supranational regulation. The paper also provides evidence on intervened banks from the recent crisis, supporting the theoretical analysis in that intervention decisions in foreign banks are distorted. Unlike the previous literature, our paper focuses on the intervention decision into failing banks and compares different national and supranational regulatory arrangements. Unlike previous papers, we also focus on incentive compatibility and political economy considerations.

There is also a more institutionally oriented literature on legal differences across countries in the treatment of domestic and foreign creditors (e.g., Krimminger 2007). Osterloo and Schoenmaker (2005) and Schoenmaker (2010) discuss the importance of regulation of cross-border banks within Europe. Allen et al. (2011) discuss policy options for the regulation of cross-border banks in the European Union. Schoenmaker and Siegmann (2013) compare the efficiency of different burden-sharing agreements to a supranational supervisor, using data on the largest thirty European banks.

The externality-heterogeneity trade-off discussed in this paper mirrors a similar discussion in the literature on fiscal decentralization (see, for example, Oates 1972). This literature argues that the comparative advantage of centralization increases with the size of interjurisdictional externalities but decreases with preference heterogeneity. The trade-off is also related to the literature on optimal currency areas and trade blocs. Following Mundell (1961), the cost of having a common currency is that countries are subject to different shocks (Mundell 1961), hence their “optimal” exchange rate differs (Maloney and Macmillen 1999, and Mundell 1961). A currency

area imposes a common exchange rate and thus creates costs similar to the one from imposing a common intervention threshold in our paper. The externalities in that literature are different, though; common currencies can be motivated without resorting to externalities between the members of the union (e.g., elimination of frictions from currency exchange is a key motive), but externalities arise vis-à-vis countries that are not in the union. Heterogeneity and externalities also play a role in the trade literature. In standard models of international trade, heterogeneity is not a cost to trade agreements (as the optimal tariff is zero and hence independent of country characteristics) but can threaten incentive compatibility, as it will lead to an asymmetric distribution of gains (see, e.g., Bond and Park 2002 for an analysis of asymmetries in country size). Externalities in this literature arise from trade connections among countries, similar to cross-border banking in the present paper.

The remainder of the paper is structured as follows. The next section discusses the key trade-off faced by supranational supervision, based on externalities and country heterogeneity. Section 3 offers a formal model and derives the levels of externalities and heterogeneity for which supranational supervision is preferable to national supervision. Section 4 applies the insights of the theoretical model and derives political economy implications of our analysis. Section 5 extends our theoretical model along several dimensions and provides a broader discussion on the optimality of different forms of cross-border cooperation in bank regulation and supervision. Section 6 uses the theoretical analysis to discuss the current status of cross-border cooperation between supervisors, while section 7 concludes.

2. The Trade-Off Arising from Cross-Border Bank Supervision

Since the onset of the Global Financial Crisis, there has been an increasing realization that the regulatory perimeter of banks has to match their geographic footprint. Many analysts and observers, however, also agree that a one-size-fits-all approach to supranational regulation is neither desirable nor realistic, as benefits and costs from moving from national to supranational regulatory frameworks differ greatly across different regions.

We argue that there are two factors that determine whether the regulatory architecture should become supranational.

2.1 Cross-Border Externalities

The *raison d'être* for financial regulation is externalities from bank failure. After all, in the absence of such externalities, bank governance can be left in the hands of shareholders and other stakeholders—as is the case for non-financial corporations. Externalities from bank failures partly materialize at the domestic level, for example, by causing a credit crunch in the domestic economy. Such externalities do not create a rationale for international regulation, since a domestic supervisor will be best equipped to deal with them. However, the failure of banks in a country also causes substantial externalities for other countries—and increasingly so, due to the fact that the financial systems of countries have become more interconnected in recent decades, along several dimensions.

First, externalities arise from cross-border activities of specific financial institutions. For example, the failure of a bank that has foreign assets will incur costs abroad—among others, by leading to lower credit availability to foreign firms. Such costs will not be taken into account by a domestic supervisor, leading to inefficient decisions. A point in case is Iceland (which from the perspective of the Icelandic supervisor had substantial foreign assets and deposits), where it can be argued that supervisors had insufficient incentives to control bank risk. Beck, Todorov, and Wagner (2013) show that banks' cross-border activities distorted supervisory incentives during the crisis of 2007–9. The implications for international regulation are straightforward: in order to avoid these distortions, the perimeter of the supervisor should match that of banks. Or, put differently, the benefits from moving to supranational supervision are higher for regions with significant cross-border banking activities.

This first source of externalities is a problem for developing and developed countries alike. As documented by Claessens and van Horen (2014), there are close ownership links in banking across the world, which have been increasing over the past two decades. These links have led countries to sign (legally non-binding) memoranda of understanding between supervisory authorities and have led to

the establishment of supervisory colleges. The resolution experience with several multi-national banks over recent years has made clear that such arrangements might not be enough.

Second, in a financially integrated world, there are plenty of other channels through which a shock arising from failure of one bank can spill over to other countries. This includes fire-sale externalities and common asset exposures, informational contagion among investors, direct interbank exposures, or counterparty risk. For such externalities and contagion effects to materialize, no direct cross-border links have to exist between two banking systems. It is more likely to find such externalities and sources of contagion in more developed financial systems where banks focus increasingly on non-interest sources of income and market-based funding and investment strategies (Demirgüç-Kunt and Huizinga 2010).

Third, specific externalities arise within a monetary union because a country cannot simply devalue its currency to regain competitiveness following a shock and hence may need to tap—in some form or other—the resources of other countries. The costs from asymmetric shocks are thus much higher in monetary unions. Further, relying on a common lender of last resort might result in a tragedy-of-the-commons problem, as it is in the interest of every member government with fragile banks to “share the burden” with the other members. It is important to note that this externality applies on the systemic level rather than just for individual institutions. The Spanish *cajas* did not have any specific cross-border exposures, but their failure is at the core of the Spanish crisis, with repercussions for the whole euro zone. Similarly, Cypriot banks have not had particularly close links with the rest of the euro zone (though links with other European countries, especially Russia, have been close), but their failure has imposed stress on the euro zone as a whole.

Fourth, externalities also arise from regulatory arbitrage. Banks have incentives to move to jurisdictions with lighter regulation—such jurisdictions benefit from an “inflow” of banking business—but this will cause negative externalities for other countries if and when lighter regulation leads to bank failure. Related to this, a cross-border financial institution operating in different jurisdictions might be subject to a “regulatory run,” leading to an inefficient resolution process. Again the externalities are higher among financially

more integrated countries since the hurdles to moving business across borders are lower.

Not all cross-border externalities are of equal importance. A crucial distinction arises between externalities related to specific financial institutions and systemic externalities. It is mainly the systemic externalities that deserve regulation and supervision. For example, the failure of international banks in a country may not affect other countries much if the banks in these countries are in good financial health at the same time. This suggests that the extent to which cross-border externalities are systemic is much higher in financially and economically integrated areas because in those areas the likelihood that banks will face stress simultaneously is greater.

2.2 Heterogeneity in Resolution Costs across Countries

If all countries were identical *ex ante*, it would be easy to agree on the right structure for international regulation, and implementation would be straightforward. However, countries differ in practice along various dimensions, which increases the cost of closer cooperation and convergence.

First, countries differ in their legal and regulatory systems. This makes it hard to specify a common set of rules and standards, forcing adaptation of general principles to local circumstances. For example, while some countries are moving towards a universality approach where international insolvency is treated as a single case, many countries adopt a territorial approach where each country looks out for its own creditors before contributing assets to pay creditors in other countries. These differences not only lead to higher costs of bank failure in the case of internationally exposed banks but also lead to a higher difference in such costs.²

A second source of heterogeneity arises from preferences. Countries may differ, for example, in how they view the role of the government in the economy (one consequence being differences in state ownership), in how they focus on fiscal independence, or with respect to their risk tolerance. For example, a basic trade-off in banking

²See Claessens, Herring, and Schoenmaker (2010) for a more detailed discussion.

(and finance more generally) is between risk and return; e.g., lightly regulated institutions may perform better under normal conditions but may be more prone to fragility, while heavy-handed regulation reduces the risk but may also depress banks' profitability and their contribution to economic growth. Differences in risk tolerance can also lead to differences in the costs of bank failure.

Third, heterogeneity can result from informational asymmetries. Such asymmetries arise with respect to the health of another country's banking system but also regarding the most suitable approach to resolving problems under local conditions. Informational asymmetries tend to be compounded in the presence of cultural differences or a lack of geographical proximity. A somewhat different case is that of asymmetric interests and resources between home- and host-country supervisors, such as in the case of market-dominating subsidiaries that form only a small part of the overall banking group. While the subsidiary is considered systemically important for the host country, it is not for the overall banking group and for the home-country supervisor.

There are thus multiple sources of heterogeneity that decrease both the optimality and the desirability of supranational supervision. The next section models heterogeneity as arising from differences in the costs that bank failure imposes on countries.

3. A Model of Optimal Allocation of Supervisory Power

In this section we introduce a simple model to analyze the circumstances under which supervision should be delegated to the supranational level and when it should remain national. The trade-off will be determined by two factors: cross-border externalities arising from cross-border exposure of domestic banks and country heterogeneity arising from differences in the cost of bank failures. In our analysis we will focus on the supervisory task of intervening and closing a troubled bank.

There are two countries, A and B, each inhabited by a representative bank. Both countries are of the same size—an assumption which we will relax later. There are three periods—0, 1, and 2—and there is no discounting. In period 0, each bank raises one unit of funds from depositors and invests it into a project. The deposit

interest rate is to be taken as zero.³ The return on the project is random. More specifically, the project succeeds with probability λ and yields a return of $R > 1$ at date 2, while with probability $1 - \lambda$, the project fails and yields a zero return in period 2. The ex ante probability of success is uniformly distributed on $[0, 1]$.

Both banks have a cross-border exposure of β ($0 \leq \beta \leq 1$), meaning that a share β of each project is carried out in the other country. Note that while cross-border externalities arise here from cross-border investments, they could alternatively also arise in the presence of indirect foreign depositors or foreign bank ownership (Beck, Todorov, and Wagner 2013). Besides direct cross-border exposures, β can also be thought of as resulting from other, indirect, cross-border externalities, such as those due to common asset exposures and contagion effects. While we assume here cross-border activities that are symmetric (the source of heterogeneity in our analysis comes from differences in bank failure costs), this need not be the case. We will return to the issue of asymmetric externalities in section 5.2.

At date 1, each bank's project probability of success, λ_i ($i \in \{A, B\}$), becomes known. Based on this information, a supervisor can decide whether to intervene in a bank or to allow it to continue. If the supervisor decides to intervene in a bank, she can recover the initial investment of one. This intervention can be interpreted in different ways: it could be a liquidation or a purchase and assumption operation involving another bank. If the supervisor decides not to intervene and allows a bank to continue to period 2, with probability λ_i , the project will be successful and the bank will be able to repay its debt and pay out the surplus to equity. With probability $1 - \lambda_i$, the bank will fail. Bank failure causes external costs c_i . These costs include losses for borrowers losing access to their financing, cost of disruption for savers and creditors of the banks, and costs external to the bank's stakeholders, such as contagion and spillover effects for the rest of the financial system and the real economy.

These costs of bank failure may vary across banks or countries, and without loss of generality we assume $c_A \leq c_B$. Heterogeneous failure costs may, for example, arise because the cost of bank failure

³This may be the consequence of deposit insurance with a risk-insensitive premium.

is expected to be significantly higher in more bank-based economies where there is greater reliance by enterprises, households, and governments on bank financing. Countries may also differ in their marginal cost of public funds (needed to stabilize the economy after bank failure)—more indebted countries may find it difficult to cope with bank failures (Demirgüç-Kunt and Huizinga 2013).⁴ There might also be differences in terms of risk-return trade-offs where country A is more willing to accept the costs of bank failure. Failure costs may also depend on bank types, with smaller, more regional banks imposing fewer costs on the national economy than large, too-big-to-fail banks.

3.1 *Efficient Supervision*

We first consider the benchmark of efficient intervention decisions. Efficiency requires the supervisor to maximize world (utilitarian) welfare, consisting of the returns to domestic debt, and equity minus external costs in both countries. For bank i , the efficient intervention threshold is given by λ_i , at which the expected returns from continuation equal the return from immediate liquidation.

The return for the world economy if the project of bank i succeeds is R (occurring with probability λ_i), while the return in the case the bank fails is $-c_i$ (occurring with probability $1 - \lambda_i$). The return in the case of date 1 liquidation is 1. We hence obtain for the threshold λ_i that creates indifference to liquidation:

$$\lambda_i R - (1 - \lambda_i) c_i = 1. \quad (1)$$

Solving for λ gives

$$\lambda_i^* = \frac{1 + c_i}{R + c_i}. \quad (2)$$

Efficiency thus dictates intervention when $\lambda < \lambda_i^*$ and continuation when $\lambda \geq \lambda_i^*$. Note that λ_i^* , given the assumption of uniformly

⁴For a discussion on the external costs that bank failure can impose on the financial system and the real economy, see Beck (2011). In principle, intervention at date 1 may also incur some costs; however, we would think that such costs are of lower order than those arising from bank failure at date 2.

distributed shocks, is also the likelihood of intervention (from (2) we also have that $\lambda_i^* \in (0, 1)$). Equation (2) thus shows that (efficient) intervention becomes more likely when the failure costs, c_i , increase (since $\lambda_i^{*'}(c_i) > 0$). The implication is that supervisors should be stricter in countries with higher failure costs. Note also that cross-border activities do not affect the efficient intervention point, as they are internalized in the efficient solution.

3.2 *Decentralized Supervision*

We now consider outcomes when each bank is supervised domestically. National supervisors will only care about domestic payoffs. This may modify the intervention threshold and drive a wedge between the socially efficient and the domestic intervention point.

The intervention point for bank i can be derived as follows. If the domestic supervisor intervenes at the intermediate date, the bank will be liquidated, in which case domestic payoffs are 1 and identical to world payoffs. Where there is no intervention, the bank succeeds with probability λ . In this case the payoff is R , which again is the same as before. With probability $1 - \lambda$, the bank fails. In this case there is no return for the bank, and the country in addition suffers the domestic share of the bank failure cost, $(1 - \beta)c_i$. Total expected domestic payoff is hence $\lambda R - (1 - \lambda)(1 - \beta)c_i$. It follows that the domestic supervisor is indifferent to intervention when

$$\lambda_i^D R - (1 - \lambda)(1 - \beta)c_i = 1. \quad (3)$$

Rearranging for λ_i^D , we obtain the intervention threshold

$$\lambda_i^D = \frac{1 + (1 - \beta)c_i}{R + (1 - \beta)c_i}. \quad (4)$$

For $\beta > 0$ the intervention threshold differs from that derived in the previous section and is hence inefficient from the perspective of world welfare. The reason is that a domestic supervisor does not internalize the cost of bank failure accruing abroad. In fact, we can see from equation (4) that the domestic supervisor is more

lenient compared with the efficient solution (for $\beta > 0$ we have that $\lambda_i^D < \lambda_i^*$).⁵

PROPOSITION 1. *Domestic and efficient interventions do not coincide ($\lambda_i^D \neq \lambda_i^*$) whenever there are cross-border activities ($\beta > 0$). In particular, there exists a range of λ 's for which the domestic supervisor lets the bank continue, even though this is inefficient (that is, the domestic supervisor is too lenient).*

Proof. The proof follows directly from comparing equations (2) and (4), observing that $\lambda_i^D = \lambda_i^*$ for $\beta = 0$ and $\lambda_i^{D'}(\beta) < 0$ and $\lambda_i^{*'}(\beta) = 0$.

3.3 Supranational Supervision

We next consider the case of a supranational supervisor. Compared with a domestic supervisor, the supranational supervisor has the potential to improve welfare because he takes into account the cost of bank failure in both countries. The disadvantage of supranational supervision is that the supranational supervisor is assumed to follow a uniform policy across countries, that is, he cannot set a different intervention threshold in country A than in country B. Thus, his intervention decision cannot reflect country-specific bank failure costs.

The supervisor sets his policy λ^S at $t = 0$, maximizing expected welfare in the world economy. This welfare consists of the expected world payoffs from the activities of both banks:

$$\begin{aligned} W(\lambda^S) = & \int_0^{\lambda^S} d\lambda + \int_{\lambda^S}^1 (\lambda R - (1 - \lambda)c_A)d\lambda \\ & + \int_0^{\lambda^S} d\lambda + \int_{\lambda^S}^1 (\lambda R - (1 - \lambda)c_B)d\lambda. \end{aligned} \quad (5)$$

⁵The counterpart to lenient interventions in domestic banks with foreign operations is excessive intervention in foreign-owned banks (in which case the regulator will not internalize the benefit of continuation accruing to foreign shareholders). More generally, overall intervention distortions in international banks will depend on foreign assets, deposits, and equity shares. In particular, Beck, Todorov, and Wagner (2013) show that the presence of foreign deposits makes a national regulator more lenient, while foreign ownership of the bank makes the domestic regulator stricter. In our model, we abstract from foreign deposits and foreign ownership.

In equation (5), the first expression is expected welfare arising when the λ of bank A is below the intervention threshold λ^S (and the supervisor intervenes) and the second expression is expected welfare when the health of bank A is above the threshold, in which case the supervisor does not intervene. The third and fourth expressions are the respective terms arising for bank B.

The first-order condition for the supranational supervisor is given by

$$2 - (\lambda^S R - (1 - \lambda^S)c_A) - (\lambda^S R - (1 - \lambda^S)c_B) = 0. \quad (6)$$

We hence obtain the following for the intervention threshold of the supranational supervisor:

$$\lambda^S = \frac{1 + \frac{c_A + c_B}{2}}{R + \frac{c_A + c_B}{2}}. \quad (7)$$

Two points are worthy of note. First, and as expected, the supranational supervisor's decision does not depend on cross-border exposures. Second, it depends on the average failure costs in both countries, $\frac{c_A + c_B}{2}$, rather than the cost specific to the bank in question. This introduces an inefficiency ex post (equation (2) tells us that optimal intervention should depend on the country-specific costs).

PROPOSITION 2. *Supranational and efficient interventions do not coincide ($\lambda^S \neq \lambda_i^*$) whenever there is country heterogeneity ($c_A < c_B$). In particular, there exists a range of λ 's for which the supranational supervisor inefficiently intervenes in the country with the low failure costs but inefficiently allows continuation in the country with high failure costs.*

Proof. The proof follows directly from comparing equations (2) and (7).

Note that without our assumption of the supervisor being constrained to a uniform policy across countries, supranational regulation would obviously be always welfare enhancing, as it would then coincide with the efficient solution. There are various reasons why this assumption is sensible. The first one is practical. Fairness in international regulation dictates that countries cannot be treated

differently. For example, suppose that a pan-European supervisor closes down banks in Southern Europe (because he perceives a high c there) but lets banks of the same health in Northern Europe continue. This would cause obvious political problems. Second, country-specific failure costs are not contractible in reality. To see the impact of this, consider a slight modification in the model. Suppose that instead of ex ante heterogeneity in failure costs (that is, we already know at $t = 0$ which country has high and low failure costs at $t = 1$), failure costs materialize at $t = 1$ (only at date 1 the identity of the country that has high failure costs is learned, and each country has the same probability of being the high-cost country). So, at date $t = 0$ only the aggregate realization of failure costs is known but not which country has the high cost). This modification does not change anything in the efficiency properties of the analysis (since there is still one high- and one low-cost country). And since at $t = 0$ (when the supranational agency is formed and countries have to decide on the threshold) the identity of the high- and low-cost country is not known yet, countries will have to implement a supranational solution that does not vary across countries. A third justification for uniform policies is information asymmetry: while the domestic supervisor may be able to observe the failure cost of its bank at date 1, a supranational supervisor may not. The best the supranational supervisor can hence do is to base his intervention decisions on the ex ante distribution of failure costs, which may be symmetric. Finally, actual regulation is almost always symmetric. For example, Basel Accords impose identical capital requirement rules across countries, even though failure costs of banks in different countries are very likely to differ.

Domestic intervention decisions are inefficient in our model because a domestic supervisor does not internalize the cost of failure of the domestic bank for foreign stakeholders in the bank. A similar externality arises when intervention decisions in the domestic bank affect risk taking at the foreign bank. In particular, Shapiro and Skeie (2013) analyze a setting where banks are intervened sequentially. Intervention (or lack thereof) in the first bank can provide a signal to the second bank about the likelihood of supervisory intervention and affect the risk taking of this bank. Efficiency may then require shutting down the first bank for certain realizations of the failure probability in which it would otherwise remain open. This is

in order to contain risk taking at the second bank. Such a channel would provide an alternative rationale for supranational regulation: domestic supervisors would ignore the beneficial signaling effect of bank closure on foreigners and create an externality similar to the one arising from cross-border bank activities.

3.4 When Is Supranational Supervision Efficient?

We are now in a position to analyze whether supervision should take place at the domestic or the supranational level. For this we examine whether supranational supervision leads to higher world welfare. Expected world welfare under domestic regulation is

$$\begin{aligned} W(\lambda_A^D, \lambda_B^D) &= \int_0^{\lambda_A^D} d\lambda + \int_{\lambda_A^D}^1 (\lambda R - (1 - \lambda)c_A) d\lambda \\ &\quad + \int_0^{\lambda_B^D} d\lambda + \int_{\lambda_B^D}^1 (\lambda R - (1 - \lambda)c_B) d\lambda. \end{aligned} \quad (8)$$

The welfare impact of supranational supervision can be written as

$$\begin{aligned} \Delta W &= W(\lambda^S) - W(\lambda_A^D, \lambda_B^D) \\ &= \int_{\lambda_A^D}^{\lambda^S} (1 - \lambda R + (1 - \lambda)c_A) d\lambda \\ &\quad - \int_{\lambda^S}^{\lambda_B^D} (1 - \lambda R + (1 - \lambda)c_B) d\lambda. \end{aligned} \quad (9)$$

We denote with $\Delta c := c_B - c_A$ the difference in costs across countries.

PROPOSITION 3. *The benefits from supranational supervision, ΔW ,*

- (i) *increase in cross-border externalities β ;*
- (ii) *decrease in country heterogeneity $\Delta c (= c_B - c_A)$.*

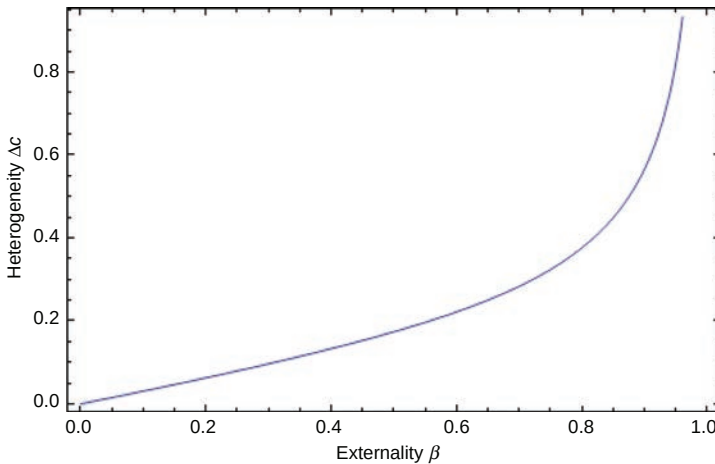
In addition, there exists a function $\widehat{\Delta c}(\beta)$ with $\frac{d\widehat{\Delta c}}{d\beta} > 0$ such that for $\Delta c < \widehat{\Delta c}(\beta)$ supranational supervision is efficient, while for $\Delta c > \widehat{\Delta c}(\beta)$ domestic supervision is efficient.

Proof. Using (4) and (7) to substitute λ_A^D , λ_B^D , and λ^S in (9), we obtain ΔW as a function of β and Δc : $\Delta W = \Delta W(\beta, \Delta c)$. From this we can derive that $\frac{\partial \Delta W}{\partial \beta} > 0$ and $\frac{\partial \Delta W}{\partial \Delta c} < 0$. Thus, β increases the benefits from supranational supervision, while Δc decreases it. Since in addition we have that $\Delta W(0, 0) = 0$, there exists hence a function $\widehat{\Delta c}(\beta)$ (with $\frac{d\widehat{\Delta c}}{d\beta} > 0$) for which $\Delta W(\beta, \widehat{\Delta c}(\beta)) = 0$. For this function we then have that $\Delta W(\beta, \Delta c) < 0$ if $\Delta c > \widehat{\Delta c}(\beta)$ and $\Delta W(\beta, \Delta c) > 0$ if $\Delta c < \widehat{\Delta c}(\beta)$.

How can we interpret this finding in the context of the discussion in section 2? High externalities in the form of large global banks being active across several countries or in the form of banks across countries being exposed to the same capital markets increase the likelihood that supranational supervision is welfare improving. Similarly, high externalities stemming from being part of a currency union increases the optimality of supranational supervision. On the other hand, a high difference in failure costs reduces this likelihood, as it increases the range of λ where the supranational supervisor makes an inefficient decision from the viewpoint of either country. As discussed above, such differences can arise from different financial structures or fiscal policy stances but also political preferences.

Figure 1 illustrates the trade-off between externalities and heterogeneity. This figure depicts $\widehat{\Delta c}(\beta)$ for a (gross) return in the case of success of $R = 1.1$ and failure costs of $c = 0.3$ (note that this restricts Δc to be less than or equal to 0.6). The area above $\widehat{\Delta c}(\beta)$ gives the region where domestic supervision is optimal, while the area below this critical line indicates efficiency of supranational supervision. We can see that the critical line passes the origin of the coordinate system—which is to be expected since for $\beta = 0$ and $\Delta c = 0$ there are neither benefits nor cost to supranational supervision. We can also see that the critical line is upward sloping, that is, higher externalities have to be offset by higher heterogeneity in order to preserve the neutrality of both types of supervision. In addition, the figure shows that when the externalities are only modest ($\beta < 0.5$), the relationship between β and Δc is fairly linear. However, when the externalities are high (in particular, for $\beta > 0.7$), the costs needed to offset them become very high. This suggests that for sets of countries that display a high degree of externalities,

**Figure 1. Externalities vs. Heterogeneity:
The Case of Supranational Supervision**



supranational supervision is desirable no matter how heterogenous the countries are.

In our two-country world, the natural bound for β is 0.5. However, our model can also be interpreted as pertaining to a world of $2n$ ($n \geq 1$) countries, where half of the countries are identical to country A in the baseline model and the other half are identical to country B. In this world, a complete diversification allocation implies $\beta = \frac{n-1}{n}$, which is only bounded by one. We also note that banks that have more than half of their activities outside their country of domicile are not uncommon, as for example the case of Swiss banks shows; hence the analysis of the trade-off for $\beta > 0.5$ has relevance.

It should be pointed out that the decision to delegate supervision to the supranational level is in principle orthogonal to whether supervision is carried out in a rule-based or discretionary way.⁶ Both supranational and national supervision can be carried out in the form of a rule (set at date 0) or as discretionary (at date 1). For national supervision there is absolutely no difference between setting the intervention threshold at date 0 and date 1. For supranational regulation, consider the following modification of the model. Instead

⁶Since risk is exogenous in our model, there is no time-inconsistency problem here.

of each country being inhabited by one bank, let there be a continuum of banks operating whose realizations of λ are drawn independently. At date 1, a supervisor will thus face the whole specter of ranges of λ (by the law of large numbers, there will be realizations of λ in each non-empty interval on $[0, 1]$ in each country). The supervisor then has to decide on a marginal bank to intervene, which by the symmetry assumption has to be the same across countries. He thus faces exactly the same problem as from an *ex ante* perspective.

4. The Political Economy of Supranational Supervision

So far, we have considered the optimality of supranational supervision from the viewpoint of global welfare. But is agreeing to supranational supervision also incentive compatible from the individual country's viewpoint? This section discusses the political economy of delegating supervisory authority to a supranational institution. We first discuss the general case of incentive compatibility before gauging the role of relative country size.

4.1 Incentive Compatibility

As countries are asymmetric in their failure costs, their incentives to join a supranational solution are not identical. This creates situations where even though a supranational solution is optimal for overall welfare, one of the two countries would suffer under supranational regulation. In this case, delegation to the supranational level may not be politically feasible.

The following proposition analyzes this problem.

PROPOSITION 4. *Whenever $c_A < c_B$, efficient supranational supervision may not be incentive compatible. In particular, one can define a $\hat{\beta}_0$ such that*

- (i) *for $\beta < \hat{\beta}_0$, there are parameter values for which the welfare of country A is lower under supranational supervision ($W_A(\lambda^S) < W_A(\lambda_A^D, \lambda_B^D)$) even if such supervision is efficient ($W_A(\lambda^S) + W_B(\lambda^S) > W_A(\lambda_A^D, \lambda_B^D) + W_B(\lambda_A^D, \lambda_B^D)$);*
- (ii) *for $\beta > \hat{\beta}_0$, there are parameter values for which the welfare of country B is lower under supranational supervision*

($W_B(\lambda^S) < W_B(\lambda_A^D, \lambda_B^D)$) even if such supervision is efficient from the perspective of world welfare ($W_A(\lambda^S) + W_B(\lambda^S) > W_A(\lambda_A^*) + W_B(\lambda_B^*)$).

Proof. The welfare impact of moving from domestic to supranational regulation is for country A and country B, respectively,

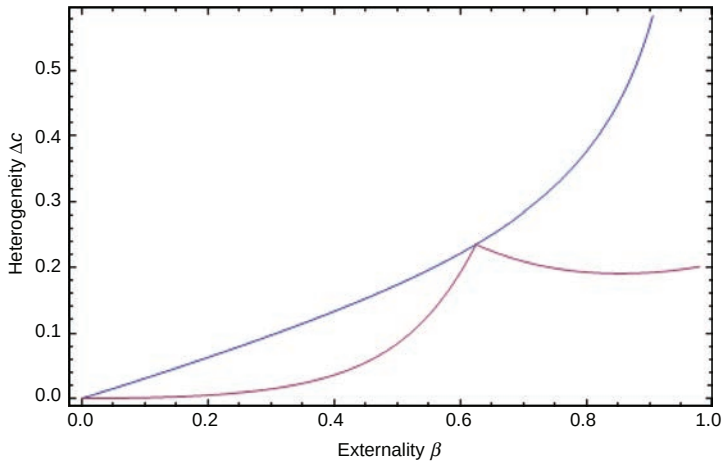
$$\begin{aligned}\Delta W_A &= W_A(\lambda^S) - W_A(\lambda_A^D, \lambda_B^D) \\ &= \int_{\lambda_A^D}^{\lambda^S} (1 - \lambda R + (1 - \beta)(1 - \lambda)c_A) d\lambda \\ &\quad - \int_{\lambda^S}^{\lambda_B^D} \beta(1 - \lambda)c_B d\lambda, \end{aligned} \quad (10)$$

$$\begin{aligned}\Delta W_B &= W_B(\lambda^S) - W_B(\lambda_A^D, \lambda_B^D) \\ &= \int_{\lambda_A^D}^{\lambda^S} \beta(1 - \lambda)c_A d\lambda \\ &\quad - \int_{\lambda^S}^{\lambda_B^D} (1 - \lambda R + (1 - \beta)(1 - \lambda)c_B) d\lambda. \end{aligned} \quad (11)$$

Analogous to the proof of proposition 3, one can define $\widehat{\Delta c}_A(\beta)$ and $\widehat{\Delta c}_B(\beta)$ (with $\frac{d\widehat{\Delta c}_A}{d\beta}, \frac{d\widehat{\Delta c}_B}{d\beta} > 0$) for which $\Delta W_A(\beta, \widehat{\Delta c}(\beta)) = 0$ and $\Delta W_B(\beta, \widehat{\Delta c}(\beta)) = 0$. These functions give combinations of Δc and β for which a country is indifferent to supranational regulation. Next it can be shown that $\widehat{\Delta c}_A(\beta) - \widehat{\Delta c}_B(\beta)$ is increasing in β (that is, country A's incentives to join relative to country B are increasing in β). In addition, we have that $\widehat{\Delta c}_A(\beta) - \widehat{\Delta c}_B(\beta) < 0$ for $\beta = 0$ and $\widehat{\Delta c}_A(\beta) - \widehat{\Delta c}_B(\beta) > 0$ for sufficiently large β . Since $\widehat{\Delta c}_A(\beta) - \widehat{\Delta c}_B(\beta)$ is continuous and increasing in β , it follows by the intermediate value theorem that there exists a $\widehat{\beta}_0$ such that $\widehat{\Delta c}_A(\beta) - \widehat{\Delta c}_B(\beta) < 0$ for $\beta < \widehat{\beta}_0$ and $\widehat{\Delta c}_A(\beta) - \widehat{\Delta c}_B(\beta) > 0$ for $\beta > \widehat{\beta}_0$.

The intuition behind this result is the following. Since supranational regulation is based on average costs, interventions will become

Figure 2. Incentive Compatibility of the Supranational Solution



relatively tighter in the low-cost country under the supranational outcome: from (4) and (7) we have that $\lambda^S - \lambda_A^D > \lambda^S - \lambda_B^D$ (for the high-cost country, interventions may even become less stringent). Because of this, country A will prefer supranational regulation less than country B. There is, however, also a second effect. Since costs are higher in country B, the externality from bank failures in this country are also higher. Thus, correcting this externality (by moving to supranational regulation) is relatively more beneficial for country A. The importance of the second effect depends on β , the measure of externality. For small β the first effect will thus dominate, while for large β the second will be larger.

Figure 2 illustrates this point. The upper line replicates the externality-heterogeneity trade-off of figure 1 (supranational supervision is hence efficient below this line). The lower line defines the incentive compatibility of the supranational solution: all points below the lower line refer to parameters constellations where both countries benefit from supranational regulation, while above the lower line supranational is not desirable for at least one country. In the area between the upper and the lower line are hence the outcomes where supranational regulation is desirable but not incentive compatible. To the left of the peak in the lower line this is because

the incentive constraint of country A is binding, while to the right it is the constraint of country B that binds. We can see that incentive compatibility is a serious problem, as it significantly reduces the area where efficient supranational regulation can be implemented without violating the interest of individual countries. We can also see that incentive compatibility is most “problematic” (as judged by the vertical distance between the upper and the lower line) when externalities are either very low or very high. For modestly high externalities (β around 0.65), there are few incentive problems. The variation of incentive problems across different degrees of externalities underlines the need for context-specific analysis of cross-border regulatory cooperation.

4.2 *Asymmetric Country Size*

Another source of incentive constraints can arise when the sizes of countries differ. Supranational regulation may then to a larger extent reflect the characteristics of the larger country, which may negatively effect the incentives of the smaller country to join.

To analyze the impact of country size, consider the following extension to the model. While in the baseline the size of each bank (size of the initial investment) was 1, let us assume that the size of the bank in country A and B is w_A and w_B , respectively. The bank in country i now needs w_i funds at date 0, returns w_i if liquidated at date 1, returns $w_i R$ at date 2 in case of success, and causes costs of $w_i c_i$ in case of failure (equivalently to modifying bank size, one may also change the number of banks operating in each country). This simple scaling of operations will neither affect the efficient nor the decentralized intervention points (equations (2) and (4) still apply). However, it will affect the supranational solution, as the latter applies to both countries at the same time. Welfare is now given by the weighted average of the payoffs from each bank:

$$W(\lambda^S) = w_A \left(\int_0^{\lambda^S} d\lambda + \int_{\lambda^S}^1 (\lambda R - (1 - \lambda)c_A) d\lambda \right) + w_B \left(\int_0^{\lambda^S} d\lambda + \int_{\lambda^S}^1 (\lambda R - (1 - \lambda)c_B) d\lambda \right). \quad (12)$$

Note that for $w_A = w_B$, this collapses to welfare in the baseline model, equation (5). The first-order condition for λ^S is

$$w_A + w_B - w_A(\lambda^S R - (1 - \lambda^S)c_A) - w_B(\lambda^S R - (1 - \lambda^S)c_B) = 0. \quad (13)$$

Solving for λ^S leads to the new intervention threshold of the supranational supervisor:

$$\lambda^S = \frac{1 + \frac{w_A c_A + w_B c_B}{w_A + w_B}}{R + \frac{w_A c_A + w_B c_B}{w_A + w_B}}. \quad (14)$$

The supranational outcome is hence determined by the *weighted* average of the failure costs in the two countries, $\frac{w_A c_A + w_B c_B}{w_A + w_B}$. The failure costs of the smaller country are hence taken into account less for supranational decision making.

PROPOSITION 5. *A country's gain from moving from domestic to supranational supervision may increase or decrease as the size of the other country changes (that is, $\frac{\partial(W_i(\lambda^S) - W_i(\lambda_A^D, \lambda_B^D))}{\partial w_j}$ may be either positive or negative for $i \neq j$).*

Proof. See the appendix.

The intuition for why the impact of higher size of the other country can go either way is that there are three effects on the country's benefit from joining a supranational approach. First, when the other country is larger, externalities from bank failures in the other country are higher. This will either increase or decrease the benefits from supranational regulation, depending on whether under the supranational solution supervision in the other country become tighter or not. Second, a larger size of the other country will mean that the supranational solution depends less on the characteristics of the domestic bank, in accordance with equation (14). This lowers the country's utility from operation of its own bank, as interventions are then less tailored to the characteristics of the domestic bank. Third, the change in the supranational regulation arising from a larger foreign bank will affect domestic utility by changing the likelihood of failure of the other bank. This leads to an improvement in domestic

utility if the other country is the high-cost country since then supranational regulation will become tighter and the foreign bank will fail less (if the foreign bank is the low-cost bank, this effect is reversed).

The result of proposition 5 is interesting, as it goes against the often-voiced argument that smaller countries tend to lose under supranational solutions if under such solutions their characteristics are less taken into account. The reason is that a small country can be subject to significant externalities from the failure of foreign banks (simply, because there are many foreign banks from the perspective of a small country). It hence has a high interest in international regulation that addresses the cross-border externalities from bank failures.

While in this section we considered asymmetries in country size as the source of incentive constraints, incentive problems also arise when the externalities are asymmetric (that is, β differs across countries). For instance, suppose that country B is a financial center. Most of the costs of bank failure will then fall outside its borders, while the country itself may be relatively little affected by bank failures in other countries. For such a country there are limited gains from supranational supervision (arising because it allows internalizing of externalities). It may hence object to supranational supervision even if it is of benefit to countries overall. We will discuss this in more detail below.

5. Extensions

This section discusses several extensions of our model. First, we will analyze an intermediate solution between decentralized and supranational supervision. Second, we will discuss the case of asymmetric externalities. Finally, we discuss how cross-border externalities of bank failure results in biased decisions to allow banks to operate in the first place.

5.1 *An Intermediate Solution*

Domestic and supranational supervision are two extreme solutions on a continuum of possible forms of cooperation on cross-border banking. In the following, we will discuss an intermediate solution where countries commit to a *minimum threshold* for intervention.

Such solutions are commonly observed in international agreements, which define minimum standards but leave it up to countries to implement higher standards. They also retain the requirement of symmetry in that the same threshold applies to each country.

Suppose that countries agree on a threshold $\lambda_{\min}^*$, such that a country has to intervene whenever $\lambda \leq \lambda_{\min}^*$ but is free to decide about intervention when $\lambda > \lambda_{\min}^*$. Such a minimum threshold helps to internalize externalities that tend to make countries more lenient in their intervention policies. At the same time, by giving countries discretion about interventions, it allows them to cater intervention policies to their own failure costs.

The next proposition shows that such an approach has appeal relative to the two solutions considered previously.

PROPOSITION 6. *When $\beta > 0$ and $c_A < c_B$, an optimally chosen minimum threshold $\lambda_{\min}^*$*

- (i) *results in strictly higher welfare than under the decentralized solution ($W(\lambda_{\min}^*) > W^A(\lambda_A^D, \lambda_B^D) + W^B(\lambda_A^D, \lambda_B^D)$ for $\lambda_{\min}^* = \arg \max W(\lambda_{\min})$);*
- (ii) *results in (weakly) higher welfare than under the supranational solution ($W(\lambda_{\min}^*) \geq W^A(\lambda^S) + W^B(\lambda^S)$ for $\lambda_{\min}^* = \arg \max W(\lambda_{\min})$).*

Proof. See the appendix.

The reason why an (optimally) set minimum intervention point dominates the domestic solution is that it allows to implement efficient supervision in country A (by setting $\lambda_{\min} = \lambda_A^*$) without imposing any inefficiencies in the high-cost country B, as this country is still free to deviate to a higher level of stringency. It also dominates supranational regulation whenever $\lambda^S < \lambda_B^D$. In this case, when setting $\lambda_{\min} = \lambda^S$, country B again has the possibility to deviate by setting a higher stringency, which would benefit welfare. However, when $\lambda^S \geq \lambda_B^D$, no country deviates from a minimum threshold λ^S . In this case, a welfare improvement may not be attainable under the intermediate solution.

Since an optimally set intermediate solution is never dominated by the two other solutions, it is not instructive to analyze how the heterogeneity-externality trade-off affects the desirability of the

intermediate solution. In the following we will thus focus on a “naive” intermediate approach where the minimum threshold is set equal to the efficient level of country A: $\lambda_{\min} = \lambda_A^*$. This can be thought of as the natural outcome in a world where supranational regulators are reluctant to enforce regulation that is stricter than the one required for the low-cost country (i.e., it avoids that regulation is ever excessive for a country).

Since $\lambda_{\min} = \lambda_A^*$, intervention decisions will then be efficient whenever they are done in country A:

$$\lambda_A^I = \lambda_{\min}. \quad (15)$$

Country B may decide to be even stricter and hence to intervene sometimes when $\lambda > \lambda_{\min}$. This is desirable (and also optimal for the country itself) since the country has higher failure costs and hence also a higher optimal intervention threshold. However, whenever $\beta > 0$, the country will not be strict enough from a world perspective and supervision may still be subject to some inefficiency. Formally, intervention by country B will be the maximum of the domestically optimal intervention for the country, λ_B^D , and the minimum threshold:

$$\lambda_B^I = \max[\lambda_B^D, \lambda_{\min}]. \quad (16)$$

How does the intermediate solution compare with the domestic and the supranational approach? Compared with the domestic solution, we have that intervention will always be more efficient in country A under the intermediate approach (as λ_A^I is fully efficient). For interventions in country B, two situations arise. The first case is when the minimum threshold is not binding. In this case country B will set the same threshold as in the domestic solution. Where the threshold is binding, the country will set a higher threshold than under the domestic solution. Interventions will then be more efficient, as the threshold partially forces the country to internalize the externalities. Overall, we thus have that intervention is always more efficient in country A under the intermediate solution, while it is at least as efficient in country B. The minimum threshold λ_A^* thus still dominates decentralized supervision.

However, the intermediate solution does not necessarily dominate the supranational approach. Interventions are more efficient in

country A, but they may be more or less efficient in country B. In fact, a similar trade-off as in section 3.4 arises. On the one hand, the intermediate solution allows country B to carry out interventions depending on the country's own cost. On the other hand, the country will not fully internalize the externality, as the country will determine its own intervention level whenever the threshold is not binding.

PROPOSITION 7. *The benefits from supranational supervision relative to the intermediate solution*

- (i) *increase in cross-border externalities β ;*
- (ii) *decrease in country heterogeneity $\Delta c := c_B - c_A$.*

In addition, there is a function $\widehat{\Delta c}(\beta)$ with $\frac{\widehat{\Delta c}^I}{d\beta} > 0$ such that for $\Delta c < \widehat{\Delta c}^I$ supranational supervision is optimal, while for $\Delta c > \widehat{\Delta c}^I(\beta)$ the intermediate solution is optimal.

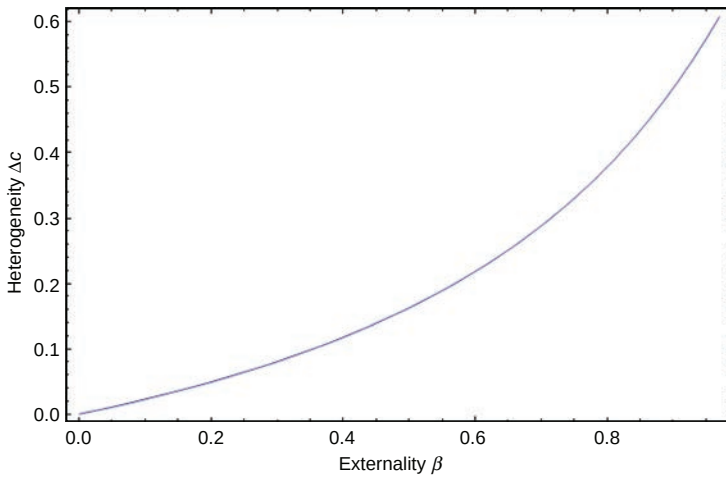
Proof. Welfare under the intermediate solution is given by

$$\begin{aligned} W(\lambda_A^D, \lambda_B^D) = & \int_0^{\lambda_{\min}} d\lambda + \int_{\lambda_{\min}}^1 (\lambda R - (1 - \lambda)c_A) d\lambda \\ & + \int_0^{\min[\lambda_B^D, \lambda_{\min}]} d\lambda + \int_{\min[\lambda_B^D, \lambda_{\min}]}^1 (\lambda R - (1 - \lambda)c_B) d\lambda. \end{aligned} \quad (17)$$

The remaining part of the proof is analogous to proposition 3.

Figure 3 depicts the trade-off for the same parameters as in figure 1 ($R = 1.1$ and $c = 0.3$). The region where supranational supervision remains optimal is below the critical threshold $\widehat{\Delta c}^I$. We can see that $\widehat{\Delta c}^I(\beta)$ still goes to the origin of the coordinate system—which is, of course, because whenever there is neither an externality nor a cost difference, intermediate solution and supranational supervision coincide. It can also be seen that the figure shows a positive relationship between β and $\widehat{\Delta c}^I$. However, compared with figure 1,

**Figure 3. Externalities vs. Heterogeneity:
The Case of the Intermediate Solution**



the relationship is now less sensitive to β in regions where externalities are high. It should be pointed out that $\widehat{\Delta c}^I$ is always below $\widehat{\Delta c}$ in figure 1, indicating that there are now fewer situations where supranational supervision is desirable. This is because the alternative (intermediate solution) is now more attractive than in section 3 (where we considered the domestic solution).

5.2 *Asymmetries in Externalities*

For the baseline model we have assumed that the sole source of heterogeneity is country differences in the failure costs c . Two questions arise. First, does heterogeneity in β create a similar trade-off with externalities as cost heterogeneity does? Second, is the heterogeneity-externality trade-off robust to introducing asymmetries in β ?

Consider first the question of whether β -heterogeneity creates its own trade-off. For this we modify the baseline model such that we now have $\beta_A \geq \beta_B$ (beta heterogeneity) but $c_A = c_B = c$ (no cost heterogeneity). The intervention thresholds for the efficient, the decentralized, and the supranational solution are then (similar to equations (2), (4), and (7))

$$\lambda^* = \frac{1 + c}{R + c}, \quad (18)$$

$$\lambda_i^D = \frac{1 + (1 - \beta_i)c}{R + (1 - \beta_i)c}, \quad (19)$$

$$\lambda^S = \frac{1 + c}{R + c}. \quad (20)$$

We can see that as long as $\beta_i > 0$, domestic interventions are still inefficient ($\lambda_i^D < \lambda^*$), as they ignore the cross-border externalities. However, the supranational solution is now identical to the efficient one ($\lambda^S = \lambda^*$). Intuitively, this is because an asymmetric distribution of the failure costs among countries (differences in β 's) does not affect the efficient intervention point (λ^* is now the same across countries). There is thus no longer a cost to supranational regulation, which previously arose because it imposed a symmetric threshold across countries that actually required different interventions. The lesson is thus that a trade-off is created by heterogeneity in the efficient intervention points but not by heterogeneity in the decentralized solutions. A corollary of this is that the supranational solution is always optimal among countries with the same failure costs, even if externalities from cross-border banking vary across the countries.

The next question is, what happens to the trade-off of the baseline model if we allow β to vary across countries? We now permit $\beta_A \neq \beta_B$ and $c_A \neq c_B$. As before, introducing β -heterogeneity affects neither the efficient intervention points λ_i^* nor the supranational intervention point, λ^S , which are still given by equation (2) and (7), respectively. Replacing β with β_i in equation (4), we obtain for the new decentralized intervention point of country i

$$\lambda_i^D = \frac{1 + (1 - \beta_i)c_i}{R + (1 - \beta_i)c_i}. \quad (21)$$

The welfare impact of moving from domestic to supranational regulation is still given by equation (9), but now with λ_i^D as given above. We denote with $\bar{\beta} := \frac{\beta_A + \beta_B}{2}$ the average cross-border externality in the economy and with $\Delta\beta = \beta_B - \beta_A$ the beta heterogeneity.

PROPOSITION 8. *When there is asymmetry in externalities ($\beta_A \neq \beta_B$), the benefits from supranational regulation ΔW*

- (i) increase in average cross-border externalities β ;
- (i) can decrease or increase in country heterogeneity Δc .

Proof. See the appendix.

The reason why cost heterogeneity may now also increase the benefits from supranational regulation is the following. When β_A is smaller than β_B , an increase in cost asymmetry may also increase externalities. The total cross-border externality that would arise from the failure of both banks is $\beta_A c_A + \beta_B c_B = \beta_A(c - \Delta c) + \beta_B(c + \Delta c)$, which is increasing in Δc whenever $\beta_B > \beta_A$. Cost asymmetries and externalities cannot be separated in this case and hence the trade-off cannot be analyzed.

5.3 Biases in the Decision to Let Banks Operate

Our analysis has focused on intervention decisions at $t = 1$. However, the fact that a bank operates across borders also has implications for the incentives for letting banks operate at $t = 0$. To see this, let us modify the model and assume that liquidation of the bank at date 1 only returns $l \leq 1$. Hence, it is no longer clear that letting the bank operate is optimal.

We first analyze the decision to allow the bank to invest at $t = 0$ for an (exogenously) given intervention decision, denoted $\hat{\lambda}$. This decision can be interpreted in a strict sense as whether to grant a license to a bank, but also more generally as an action by regulators or supervisors that affects the incentives of a bank to invest in a project. For instance, tighter capital regulation may make certain investments uneconomical.

World welfare (net of cost of investment at $t = 0$) from letting a bank operate is $l - 1$ when the bank is liquidated (occurring when $\lambda \leq \hat{\lambda}$) and $\lambda R - (1 - \lambda)c_A - 1$ otherwise (same as in the baseline model). In expected terms we thus have

$$W_i^n(\hat{\lambda}) = \int_0^{\hat{\lambda}} l d\lambda + \int_{\hat{\lambda}}^1 (\lambda R - (1 - \lambda)c_A) d\lambda - 1. \quad (22)$$

By contrast, the domestic supervisor only perceives costs of $(1 - \beta)c_A$ when a bank fails. Domestic welfare is thus

$$W_i^{n,D}(\hat{\lambda}) = \int_0^{\hat{\lambda}} l d\lambda + \int_{\hat{\lambda}}^1 (\lambda R - (1 - \beta)(1 - \lambda)c_A) d\lambda - 1. \quad (23)$$

For $\beta > 0$ we have that $W_i^{n,D}(\lambda) > W_i^n(\lambda)$, that is, the domestic benefits from operating the bank are higher than the benefits for world welfare. From this we can conclude the following proposition.

PROPOSITION 9. *For given intervention threshold $\hat{\lambda}$ ($0 < \hat{\lambda} < 1$), the domestic decision to let a bank operate may be inefficient. In particular, whenever $\beta > 0$ there are parameter values for which it is not efficient to let the bank operate, but a domestic supervisor nevertheless would let it operate.*

Proof. We have that $W_i^n(\hat{\lambda}) < 0$ for $R = 0$ and $W_i^n(\hat{\lambda}) > 0$ for sufficiently large R . Since W_i^n is monotonically and continuously increasing in R , there exists an $\hat{R}$ at which $W_i^n(\hat{\lambda}) = 0$ (intermediate value theorem). Consider a very small ε ($\varepsilon > 0$). For $\hat{R} - \varepsilon$ we then have $W_i^n(\hat{\lambda}) < 0$ but $W_i^{n,D}(\hat{\lambda}) > 0$ (since $W_i^{n,D}(\hat{\lambda}) > W_i^n(\hat{\lambda})$). There exist thus parameter values for which it is not optimal to let the bank operate, but a domestic supervisor would nevertheless choose to let it operate.

The intuition for this result is straightforward. The domestic supervisor does not internalize the foreign costs of bank failures. She hence perceives higher benefits from operating the bank than warranted from the perspective of world welfare.

Another question is whether there is any bias in letting banks operate at $t = 0$ when intervention thresholds are endogenous. That is, we can compare the decision of the domestic supervisor to let the bank operate at $t = 0$ given that she will also set $\lambda = \lambda_i^D$, with the decision whether the bank should be operated in a first-best world (that is, is it efficient to run the bank at $t = 0$ given that liquidations are set efficiently at λ_i^*).

The domestic benefit from letting the bank operate is now given by (replacing $\hat{\lambda}$ with λ_i^D in equation (23))

$$W_i^{n,D}(\lambda_i^D) = \int_0^{\lambda_i^D} l d\lambda + \int_{\lambda_i^D}^1 (\lambda R - (1 - \lambda)(1 - \beta)c_A) d\lambda - 1. \quad (24)$$

We have $W_i^{n,D}(\lambda_i^D) \geq W_i^{n,D}(\lambda_i^*)$ (that is, domestic benefits are at least as high under the decentralized solution than under any other intervention threshold). Otherwise λ_i^D would not maximize

the benefits of the domestic supervisor. From this it follows that $W_i^{n,D}(\lambda_i^D) > W_i^n(\lambda^*)$ since we have $W_i^{n,D}(\hat{\lambda}) > W_i^n(\hat{\lambda})$ for arbitrary $\bar{\lambda}$ as shown above. Thus, the domestic benefits from operating the bank are still higher. This leads to the following proposition.

PROPOSITION 10. *Whenever $\beta > 0$, the domestic supervisor's decision to let a bank operate at $t = 0$ with an intervention threshold of $\lambda = \lambda_i^D$ is biased relative to the first best with an intervention threshold λ_i^* . In particular, there are parameter values for which it is not efficient to let the bank operate, but the domestic supervisor nevertheless lets it operate.*

Proof. Since $\lambda_i^D = \arg \max_{\lambda} W_i^{n,D}(\lambda)$, we have that $W_i^{n,D}(\lambda_i^D) \geq W_i^{n,D}(\hat{\lambda})$ for arbitrary $\hat{\lambda}$. The rest of the proof is analogous to proposition 9.

There are now two reasons for this bias. First, as in proposition 9, there is the bias arising from the fact that for a given intervention threshold, the domestic costs of letting the bank operate are lower than the social costs (due to the externality). Second, the domestic supervisor will choose an intervention threshold that is more lenient than the efficient one. This further increases the domestic benefits from operating the bank.⁷

A corollary of the last point is that the ex ante decision whether to let a bank operate will be less subject to inefficiencies if the ex post intervention decision is on the supranational level. In the context of the European Banking Union, this would mean that the decision to delegate intervention powers for large banks to the European Central Bank has alleviated the need for having also supranational control over the operation of banks.

Propositions 9 and 10 suggest that in a world where banks are domestically licensed and supervised, we have too many banks operating. This argument is independent of the normal reasoning relying on subsidies for banks arising from bailouts and deposit insurance, and is solely due to cross-border activities of banks. Our model thus

⁷Note that there is no straightforward way to analyze the bias for a supranational regulator to let a bank operate, because her intervention decision depends on the characteristics of the other bank as well.

suggests that cross-border banking without appropriate cross-border regulatory cooperation can result in “overbanking.”

It should be noted that the decision of whether to delegate the $t = 0$ decision to the supranational level is subject to the same trade-off as the one for the decision at $t = 1$. In particular, when a supranational decision maker determines whether to let both banks operate or not, there will be costs in the presence of heterogeneity (when $c_A < c_B$, it might be optimal to let bank A operate but not bank B). On the upside, a supranational regulator can eliminate the bias that domestic decisions are subject to, as analyzed above. The last section of the appendix shows this formally.

6. Implications for the Debate on Supranational Supervision

In this section we will apply the insights from the theoretical analysis to the policy discussion on cross-border bank regulation and supervision. The baseline model has discriminated between two possible solutions (national and supranational supervision). In reality, there is a continuum of solutions, reflecting different degrees of cooperation (such as through minimum intervention thresholds). We can use the insights of our model to discuss these different forms of cooperation. The key challenge for an appropriate approach is to overcome externalities while at the same time being adequate for different degrees of heterogeneity.

Regions and countries differ markedly regarding the extent to which their banks pose externalities to other banks but also how heterogeneous their economies and banking systems are. This leads to the straightforward but important conclusion that the optimal degree of cross-border regulatory convergence also differs across regions. In particular, applying our trade-off, homogenous regions with strong externalities should implement a large degree of common supervision. On the other end of the spectrum, the gains from supranational supervision are the lowest for heterogeneous regions in which cross-border externalities are limited.

6.1 *Solutions in the Case of Low Externalities*

Low externalities do not call for heavy institutional solutions. Nevertheless, the exact arrangements should depend on the heterogeneity

of the countries involved. In the case of high heterogeneity, simple solutions, such as supervisory colleges and memoranda of understanding (MoUs) for information exchange and cooperation between home- and host-country supervisors suffice. In addition, countries can carry out joint crisis-simulation exercises or even develop joint crisis-management plans. This is the case for countries that have very low shares of cross-border banks and have limited integration with international financial markets, such as, e.g., India, a country with limited foreign bank participation and still some capital account restrictions. In the context of our model, such cooperation will imply domestic solutions but with potentially lower external costs c .

Countries that are more homogenous in their legal and regulatory structure (or because they pursue the joint goal of financial integration), and whose bank failure costs are therefore more similar, can go a step further and establish colleges of bank resolution authorities, which include not only supervisors but also other stakeholders involved in the resolution of banks, including deposit insurers and, critically, ministry of finance officials representing taxpayers. Such countries can also try to achieve convergence in cross-border regulatory frameworks. An example of a relatively homogenous but not yet financially well-integrated region is the East African community.⁸ Such a solution might be similar to the intermediate solution we discussed above, with a common intervention threshold.

6.2 *Solutions in the Case of High Externalities*

High externalities call for institutional and regulatory solutions that go beyond those described above. In most cases, this also means surpassing the arrangements that were in place before the 2007 crisis. We argue that one can broadly distinguish between four different cases, which reflect different degrees of heterogeneity across the countries involved.

A first case arises between financially well-integrated regions that are nevertheless relatively heterogeneous, such as the United States

⁸While most of the East African countries (Burundi, Kenya, Rwanda, Tanzania, and Uganda) have had historically a high share of non-African banks, there has been a recent trend for Kenyan banks to expand across the other four countries, with several banks from these countries also planning to expand across East Africa.

and Europe or continental Europe and the United Kingdom. In such a situation, moving supervision completely to the supranational level is too costly and politically infeasible. Our model suggests this would not be welfare improving, not only on the aggregate level but also most likely not for individual countries. This suggests that efforts should therefore rather focus on removing the largest externalities and distortions in the regulatory process and achieving a certain degree of convergence. Given the political constraints and legal differences, such arrangements have to be partly on an institution-specific basis (e.g., SIFIs) or joint support structures for specific financial markets, such as standing foreign exchange swap facilities (Allen et al. 2011). The current trend towards resolution and recovery plans (“living wills”) can be exploited in this context. We can also learn here from the experience with Lehman Brothers, where resolution over the weekend was not possible due to, among many other factors, legal differences between UK and U.S. regulatory and corporate governance frameworks. This emphasizes that living wills for cross-border SIFIs should be developed under the joint supervision of all relevant supervisory and resolution authorities. In the context of our model, these efforts would lead to a lowering of the bank failure costs in both countries, while staying with the domestic solution.

A second case arises when externalities among heterogeneous regions are very asymmetric. While externalities between the United States and Europe are probably fairly balanced in that European banks suffer from U.S. bank failures similarly as U.S. banks from European failures, this is not the case among countries that are predominantly either home or host to cross-border banks. For small host countries, where subsidiaries of large multi-national banks are market dominant but constitute only a small part of the overall banking group, there is little chance for an influential voice in the supervisory process, while at the same time, these countries face high external costs from the failure of such banks. In the context of our model, this would imply a small weight in the decision of a supranational supervisor, while at the same time a high c , so that any supranational decision process would be too lenient. While our analysis in section 4.2 suggests that small countries may also benefit from supranational solutions, this might not be the case for the large home countries. Insisting on stand-alone subsidiaries that can be

relatively easily fire-walled in times of crises might therefore be the preferred option for host-country regulators, such as in many African and Latin American countries. While this entails a certain efficiency cost, as subsidiaries cannot as easily exploit scale economies, this disadvantage might be more than outweighed by the benefits that arise because host countries have better incentives to appropriately supervise these institutions. For the small host country, this might involve lower external costs c , but possibly also lower externalities β from bank failure, as the stand-alone subsidiary would be treated as a domestic bank.

A third case arises among financially well-integrated countries that display somewhat lower heterogeneity. This applies especially for countries that have close economic and political links, but that are neither connected through a currency union nor coordinate their macroeconomic policies. For such countries, a complete supranational approach may still be too costly an option. However, the optimal level of supranational supervision in this case goes beyond the previous cases, as these countries can implement strong *ex ante* burden-sharing and resolution agreements. The MoU for burden sharing among the Nordic-Baltic countries is an example of such an arrangement. In the context of our model, this could be the intermediate option of *ex ante* agreed intervention thresholds. The adoption of such an agreement is also facilitated by the fact that externalities seem relatively evenly distributed and there is no dominating member, so that there are fewer political economy obstacles than in more asymmetric country groupings. Members of the EU that are currently not part of the euro-zone could benefit from similar arrangements.

Finally, there is the case of currency unions, possibly coupled with joint macroeconomic policies. For such regions externalities are very high because of the high degree of interdependence but also because asymmetric shocks are more costly within currency unions, as previously discussed. At the same time, such countries will display limited (*ex ante*) heterogeneity in the failure costs of banks. Thus, our analysis calls for a high degree of supranational delegation in this case. Such delegation should result in a joint bank supervision and resolution framework, with a central resolution authority that has both powers and resources to intervene in failing banks. However, our model can also explain the existence of political economy

obstacles to such an agreement if heterogeneity in bank failure costs is correlated with country size.⁹ Our model can also explain why the adoption of an ex post banking union will not be politically feasible, as ex post heterogeneity will always be higher than ex ante heterogeneity. This underlines the importance of differentiating between the resolution of legacy problems and forward-looking institutional solutions in the context of the current euro-zone crisis (Beck 2012).

6.3 The Role for International Bodies

Our “tailored approach” to international supervision does not deal well with the problem of regulatory arbitrage across jurisdictions and, related to this, the incentives for supervisors to engage in a race to the bottom. In particular, countries that are not strongly integrated with the regulatory system of other countries may develop very different standards and requirements, creating space and incentives for financial institutions to arbitrage across jurisdictions. By doing so, they might impose high external costs on other countries and—in the context of our model—face a low intervention threshold. In addition, these countries may find it optimal to refrain from closer integration with the expressed aim of becoming a “regulation haven.” The presence of jurisdictions with insufficiently regulated institutions can pose significant negative externalities for other countries.

This is where international bodies such as the Basel Committee come in. These bodies typically limit themselves to issuing minimum standards and regulation, but this is essential for containing regulatory arbitrage. For example, Basel-style capital requirements put a floor on how far individual jurisdictions can go in loosening regulation.

Another issue is that of coordinating across heterogeneous countries with different economic interests and political weights. During the 2007–9 crisis, a consortium of international bodies under the leadership of the European Bank for Reconstruction and Development (EBRD) convened regulators and banks from home and host countries in Europe to avoid aggressive capital repatriation and a

⁹See, for example, the recent discussions on rules setting the extent of bail-in and thus distribution of bank losses within the euro zone (*Financial Times* 2103b).

credit crunch in Central and Eastern Europe, with some success.¹⁰ Similar arrangements might be necessary to prevent regulatory runs across heterogeneous but well-integrated countries. In addition, a champion of the interests of small host countries of large cross-border banks in Africa and Latin American might be needed, given the limited influence with home-country supervisors in Europe or the United States.

7. Conclusions

We have argued that there is no universally applicable optimal degree of supervisory integration. We suggest that two factors should be used to judge whether a set of countries should delegate supervision to the supranational level at a given point in time: the degree to which there are externalities of bank failures across countries and the extent of country heterogeneity. Countries that face low externalities and are fairly heterogeneous should only display a modest level of coordination, such as through supervisory colleges and common stress tests. Moving to the other end of the spectrum, financially well-integrated countries that are not particularly heterogeneous should have a strong supranational approach to supervision and resolution. The clearest case for a full supranational solution is within currency unions—where externalities are very high and heterogeneity should be low or can most easily be reduced. Currency unions should use an integrated approach to the design of their regulatory architecture by moving both supervision and resolution to a supranational body.

It is important to note that the optimal supervisory structure is expected to change over time. Countries may converge in their institutional arrangements or overcome political constraints for closer cross-border cooperation, effectively lowering heterogeneity. Long-term trends towards more financial integration (even though partly reversed during the ongoing crisis) suggest that cross-border externalities will increase. This makes it likely that supranational supervision will become attractive for an increasingly larger set of countries in the future.

¹⁰See De Haas et al. (2015). In a broader sense, one could argue that international financial institutions, such as the EBRD, can thus play an important role by internalizing externalities from cross-border banking under national supervision.

One important dimension we have stressed is that of the political economy of supranational supervisory arrangements. Even if supranational supervision improves aggregate welfare, it might not be adopted if individual countries do not benefit from it. The recent discussions in the euro zone on establishing a banking union are a good example of this.

Appendix

Proof of Proposition 5

Consider first country A. The country's gain (or loss, if negative) from moving to a supranational solution is given by

$$\begin{aligned}\Delta W_A &= W_A(\lambda^S) - W_A(\lambda_A^D, \lambda_B^D) \\ &= w_A \int_{\lambda_A^D}^{\lambda^S} (1 - \lambda R + (1 - \beta)(1 - \lambda)c_A) d\lambda \\ &\quad - w_B \int_{\lambda^S}^{\lambda_B^D} \beta(1 - \lambda)c_B d\lambda.\end{aligned}\tag{25}$$

Taking derivative with respect to w_B gives

$$\begin{aligned}\frac{\partial \Delta W_A}{\partial w_B} &= - \int_{\lambda^S}^{\lambda_B^D} \beta(1 - \lambda)c_B d\lambda \\ &\quad + w_A(1 - \lambda^S R + (1 - \beta)(1 - \lambda^S)c_A) \frac{\partial \lambda^S}{\partial w_B} \\ &\quad + w_B \beta(1 - \lambda^S)c_B \frac{\partial \lambda^S}{\partial w_B}.\end{aligned}\tag{26}$$

The first term, $-\int_{\lambda^S}^{\lambda_B^D} \beta(1 - \lambda)c_B d\lambda$, arises because a larger country B means that externalities from bank failures in this country are larger. Supranational regulation will hence benefit country A more whenever it leads to a more stringent regulation in country B ($\lambda^S > \lambda_B^D$); otherwise, country A's gains from supranational regulation will decline ($\lambda^S < \lambda_B^D$). The second and third terms arise because a larger country B means that supranational regulation will become tighter, as country B is the country with the higher cost of failure (from equation (14)) we have that $\frac{\partial \lambda^S}{\partial w_B} > 0$ for $c_A < c_B$). This

lowers utility for country A arising from operations of its own bank since for this bank a lower threshold is optimal from the domestic perspective (we have $w_A(1 - \lambda^S R + (1 - \beta)(1 - \lambda^S)c_A) < 0$) but lowers the expected externalities from failure of the bank in the other country, as this bank is intervened more often, which then benefits country A ($w_B\beta(1 - \lambda^S)c_B > 0$).

Proof of Proposition 1

The net effect is ambiguous. Suppose that $\beta = 0$. In this case we have that

$$\frac{\partial \Delta W_A}{\partial w_B} = w_A(1 - \lambda^S R + (1 - \lambda^S)c_A) \frac{\partial \lambda^S}{\partial w_B} < 0, \quad (27)$$

and the incentives to join are hence lowered following an increase in w_B . Consider next $\beta = 1$ and $1 - \frac{w_A c_A + w_B c_B}{c_B(w_A + w_B)} < \beta$. From $\beta = 1$ we have

$$\frac{\partial \Delta W_A}{\partial w_B} = - \int_{\lambda^S}^{\lambda_B^D} (1 - \lambda)c_B d\lambda + w_B(1 - \lambda^S)c_B \frac{\partial \lambda^S}{\partial w_B}. \quad (28)$$

This expression is larger than zero because $1 - \frac{w_A c_A + w_B c_B}{c_B(w_A + w_B)} < \beta$ implies that $\lambda^S > \lambda_B^D$ (follows from (4) and (7)) and the first term is hence positive (the second term is positive anyway, as shown above).

Consider now country B. Country B's gain from moving to a supranational solution is given by

$$\begin{aligned} \Delta W_B &= W_B(\lambda^S) - W_B(\lambda_A^D, \lambda_B^D) = w_A \int_{\lambda_A^D}^{\lambda^S} \beta(1 - \lambda)c_A d\lambda \\ &\quad - w_B \int_{\lambda^S}^{\lambda_B^D} (1 - \lambda R + (1 - \beta)(1 - \lambda)c_B) d\lambda. \end{aligned} \quad (29)$$

Taking derivative with respect to w_B gives

$$\begin{aligned} \frac{\partial \Delta W_B}{\partial w_A} &= \int_{\lambda_A^D}^{\lambda^S} \beta(1 - \lambda)c_A d\lambda + w_B(1 - \lambda^S R \\ &\quad + (1 - \beta)(1 - \lambda^S)c_B) \frac{\partial \lambda^S}{\partial w_A} + w_A\beta(1 - \lambda^S)c_A \frac{\partial \lambda^S}{\partial w_A}. \end{aligned} \quad (30)$$

The net effect is again ambiguous. Consider first $\beta = 0$. In this case we have that

$$\frac{\partial \Delta W_B}{\partial w_A} = w_B(1 - \lambda^S R + (1 - \lambda^S)c_B) \frac{\partial \lambda^S}{\partial w_A} < 0, \quad (31)$$

since $1 - \lambda^S R + (1 - \lambda^S)c_B > 0$ and $\frac{\partial \lambda^S}{\partial w_A} < 0$ (a higher weight of the other country means interventions in the domestic bank will be less efficient for the country). Consider next $\beta = 1$. We have for the utility gain of country B

$$\frac{\partial \Delta W_B}{\partial w_A} = \int_{\lambda_A^D}^{\lambda^S} (1 - \lambda)c_A d\lambda + w_A(1 - \lambda^S)c_A \frac{\partial \lambda^S}{\partial w_A}. \quad (32)$$

The first term is positive (since $\lambda_A^D < \lambda^S$) but the second term is negative (since $\frac{\partial \lambda^S}{\partial w_A} < 0$). Let now $w_A \rightarrow 0$. We then have from equation (14) that $\lambda^S = \lambda^B$ and $\frac{\partial \Delta W_B}{\partial w_A}$ simplifies to

$$\frac{\partial \Delta W_B}{\partial w_A} = \int_{\lambda_A^D}^{\lambda^S} (1 - \lambda)c_A d\lambda, \quad (33)$$

which is strictly larger than zero since $\lambda^S > \lambda_A^D$.

Proof of Proposition 6

Part 1

Consider a minimum threshold of $\lambda_{\min} = \lambda_A^*$. Since country A's desired threshold is less than λ_A^* ($\lambda_A^D < \lambda_A^*$, from comparing (2) and (4)), country A will choose the lowest permitted intervention threshold, which is λ_A^* . Interventions in country A will hence lead to higher welfare (compared with the domestic solution), as they are now efficiently chosen. For country B we may either have $\lambda_B^D < \lambda_{\min}$ ($= \lambda_A^*$) or $\lambda_B^D \geq \lambda_{\min}$. In the first case ($\lambda_B^D < \lambda_{\min}$), country B's desired intervention point is also lower than the minimum one and it will hence choose the minimum one (λ_A^*). Welfare in this case is higher (compared with the domestic solution), as supervision is more efficient in both country A and country B. In the second case ($\lambda_B^D \geq \lambda_{\min}$), the minimum threshold is not binding and country B

chooses the same intervention point as under the domestic approach (λ_B^D). Overall welfare is still higher since supervision in country A is more efficient. We have thus shown that there exists a minimum threshold under which welfare will be higher than under the domestic solution. The optimal minimum threshold will hence also lead to higher welfare than can be obtained through domestic supervision.

Part 2

Consider a minimum threshold of $\lambda_{\min} = \lambda^S$. Since $\lambda_A^D < \lambda^S$, the threshold is binding for country A, which hence chooses λ^S . Interventions in country A are then identical to the ones obtained under supranational supervision. When $\lambda_B^D < \lambda^S$, the threshold is also binding for country B and it will hence choose λ^S . The outcome is then the same as under supranational supervision and welfare is unchanged. When $\lambda_B^D \geq \lambda^S$, the constraint is not binding and the country will choose λ_B^D . Supervision is hence tighter in country B (relative to the supranational approach) and since λ_B^D is still below the optimal level ($\lambda_B^D < \lambda_B^*$), interventions will be more efficient. Welfare thus increases. Overall, there thus exists a minimum threshold that (weakly) welfare-dominates the supranational solution. To complete the proof we still need to show that there are parameter values for which an intermediate solution cannot improve upon the supranational solution. Consider parameter values for which $\lambda_A^* = \lambda_B^D$ (that is, the efficient solution for country A coincides with the decentralized solution for country B). From (2) and (4) we obtain that this occurs when $c_A = (1 - \beta)c_B$. We then only have to consider two cases for the minimum threshold: (i) $\lambda_{\min} \in [\lambda_A^D, \lambda_A^*)$ and (ii) $\lambda_{\min} \in [\lambda_A^*, \infty)$. When $\lambda_{\min} \in [\lambda_A^D, \lambda_A^*)$ we have that $\lambda_{\min} \geq \lambda_A^D$. The constraint is hence binding for country A, which will thus choose λ_A^D . We also have that $\lambda_{\min} < \lambda_A^* = \lambda_B^D$, hence the constraint is not binding for country B. This country will hence choose λ_B^D . The outcome is then identical to the decentralized solution and in cases where the decentralized solution is not optimal, welfare will hence be lower than under supranational supervision. When $\lambda_{\min} \in [\lambda_A^*, \infty)$, the threshold will be binding also for country B (since $\lambda_A^* = \lambda_B^D$). Both countries will hence choose $\lambda_{\min}$. Such an outcome is also attainable under supranational regulation (by setting a mandatory intervention threshold of $\lambda_{\min}$); hence it cannot lead to higher welfare.

Proof of Proposition 8

Part 1

Taking derivative in equation (9) with respect to β gives

$$\begin{aligned} \frac{\partial \Delta W}{\partial \beta} = & -(1 - \lambda_A^D R + (1 - \lambda_A^D) c_A) \frac{\partial \lambda_A^D}{\partial \beta} - (1 - \lambda_B^D R \\ & + (1 - \lambda_B^D) c_B) \frac{\partial \lambda_B^D}{\partial \beta}. \end{aligned} \quad (34)$$

From (21) we have that $\frac{\partial \lambda_i^D}{\partial \beta} < 0$ (higher externalities make the domestic supervisor more lenient) and that $1 - \lambda_i^D R + (1 - \lambda_i^D) c_i > 0$ when $\beta_i > 0$ (at the domestic intervention threshold, the welfare gains from liquidation are higher than the gains continuation). It follows that $\frac{\partial \Delta W}{\partial \beta} > 0$. Hence, higher β -heterogeneity increases the benefits from supranational regulation.

Part 2

Taking derivative in equation (9) with respect to Δc (keeping constant the mean costs $\frac{c_A + c_B}{2}$) gives

$$\begin{aligned} \frac{\partial \Delta W}{\partial \Delta c} = & -\frac{\lambda_B^D - \lambda_A^D}{2} - (1 - \lambda_A^D R + (1 - \lambda_A^D) c_A) \frac{\partial \lambda_A^D}{\partial \Delta c} \\ & - (1 - \lambda_B^D R + (1 - \lambda_B^D) c_B) \frac{\partial \lambda_B^D}{\partial \Delta c}. \end{aligned} \quad (35)$$

We have for the derivatives of the cut-off points with respect to Δc :

$$\frac{\partial \lambda_A^D}{\partial \Delta c} = -\frac{(R-1)(1-\beta_A)}{2(R+(1-\beta_A)c_A)^2} \leq 0 \quad (36)$$

$$\frac{\partial \lambda_B^D}{\partial \Delta c} = \frac{(R-1)(1-\beta_B)}{2(R+(1-\beta_B)c_B)^2} \geq 0. \quad (37)$$

Consider first $\beta_A = 1$ and $\beta_B = 0$. We then have that $\lambda_A^D = \frac{1}{R}$ and $\lambda_B^D = \frac{1+c_B}{R+c_B}$. It follows that $\frac{\partial \lambda_A^D}{\partial \Delta c} = 0$ and $1 - \lambda_B^D R + (1 - \lambda_B^D) c_B = 0$ (the latter is because when there is no externality, the domestic

intervention decision is efficient). The third and fourth term in $\frac{\partial \Delta W}{\partial \Delta c}$ are hence zero and we have

$$\frac{\partial \Delta W}{\partial \Delta c} = -\frac{\lambda_B^D - \lambda_A^D}{2}, \quad (38)$$

which is smaller than zero because of $\lambda_B^D > \lambda_A^D$. The benefits from supranational regulation thus fall.

Consider next $\beta_A = 0$ and $\beta_B = 1$. We then have that $\lambda_A^D = \frac{1+c_A}{R+c_A}$ and $\lambda_B^D = \frac{1}{R}$. It follows that $\frac{\partial \lambda_B^D}{\partial \Delta c} = 0$ and $1 - \lambda_A^D R + (1 - \lambda_A^D)c_A = 0$. The third and fourth term in $\frac{\partial \Delta W}{\partial c}$ are hence zero and we have again

$$\frac{\partial \Delta W}{\partial \Delta c} = -\frac{\lambda_B^D - \lambda_A^D}{2}. \quad (39)$$

This term is now, however, larger than zero because of $\lambda_B^D < \lambda_A^D$. Thus welfare can either increase or decrease in response to higher cost heterogeneity.

The Heterogeneity-Externality Trade-Off at $t = 0$

We consider in the following the benefits from delegating the decision power about whether banks are allowed to operate at $t = 0$ to the supranational level. For this, let us denote interventions at $t = 1$ in each country by $\hat{\lambda}_i$ (as special cases, these interventions may be the optimal domestic or supranational ones). Similarly to equation (22), it is (welfare) optimal to let bank i operate if

$$\int_0^{\hat{\lambda}_i} l d\lambda + \int_{\hat{\lambda}_i}^1 (\lambda R - (1 - \lambda)c_i) d\lambda - 1 \geq 0. \quad (40)$$

The domestic decision maker will find it optimal to let the bank operate if

$$\int_0^{\hat{\lambda}_i} l d\lambda + \int_{\hat{\lambda}_i}^1 (\lambda R - (1 - \beta)(1 - \lambda)c_i) d\lambda - 1 \geq 0, \quad (41)$$

similar to equation (23). A supranational decision maker has to impose uniform decision across countries, as in the baseline analysis. He can thus either let no or both banks operate. He will decide for the second option if

$$\int_0^{\hat{\lambda}_A} l d\lambda + \int_{\hat{\lambda}_A}^1 (\lambda R - (1 - \lambda)c_A) d\lambda - 1 \\ + \int_0^{\hat{\lambda}_B} l d\lambda + \int_{\hat{\lambda}_B}^1 (\lambda R - (1 - \lambda)c_B) d\lambda - 1 \geq 0.$$

Consider first the case of heterogeneity ($c_A < c_B$) but zero externality ($\beta = 0$). The condition for domestic operation becomes then

$$\int_0^{\hat{\lambda}_i} l d\lambda + \int_{\hat{\lambda}_i}^1 (\lambda R - (1 - \lambda)c_i) d\lambda - 1 \geq 0, \quad (42)$$

which is identical to the efficiency condition (40). Thus each bank will operate precisely when it is efficient. Under supranational decision making, either zero or two banks will operate. Supranational decision making will hence be inefficient in all cases where it is optimal to have only one bank operating (that is, when condition (40) is fulfilled for bank A but not for bank B). It is thus optimal to leave the decision-making power in the hands of domestic authorities.

Consider next the case of no heterogeneity ($c_A = c_B$) but with externalities ($\beta > 0$). As discussed in the text, the domestic decision then suffers from a bias. In particular, there are cases where it is optimal not to let a bank operate but the domestic decision maker still lets the bank operate. The condition for operation under supranational decision making is now

$$\int_0^{\hat{\lambda}} l d\lambda + \int_{\hat{\lambda}}^1 (\lambda R - (1 - \lambda)c_i) d\lambda - 1 \geq 0, \quad (43)$$

which is identical to the efficiency condition. Decision making at the supranational level is hence preferable in this case.

Taken together, the analysis thus shows that the optimal allocation of banking policies at $t = 0$ is subject to a trade-off between heterogeneity and externalities as well.

References

- Acharya, V. 2003. "Is the International Convergence of Capital Adequacy Regulation Desirable?" *Journal of Finance* 58 (6): 2745–81.

- Allen, F., T. Beck, W. Wagner, P. Lane, D. Schoenmaker, and E. Carletti. 2011. "Cross-Border Banking in Europe: Implications for Financial Stability and Macroeconomic Policies." CEPR Policy Report.
- Beck, T. 2011. "Bank Resolution: A Conceptual Framework." In *Financial Regulation at the Crossroads: Implications for Supervision, Institutional Design and Trade*, ed. P. Delimatsis and N. Herger, 53–71 (chapter 3). Wolters Kluwer.
- . 2012. *Banking Union for Europe — Risks and Challenges*. VoxEU E-book.
- Beck, T., R. Todorov, and W. Wagner. 2013. "Bank Supervision Going Global? A Cost-Benefit Analysis." *Economic Policy* 28: 285–44.
- Bond, E., and J.-H. Park. 2002. "Gradualism in Trade Agreements with Asymmetric Countries." *Review of Economic Studies* 69 (2): 379–406.
- Calzolari, G., and G. Loranth. 2011. "Regulation of Multinational Banks: A Theoretical Inquiry." *Journal of Financial Intermediation* 20 (2): 178–98.
- Claessens, S., R. Herring, and D. Schoenmaker. 2010. "A Safer World Financial System: Improving the Resolution of Systemic Institutions." Geneva Report on the World Economy 12.
- Claessens, S., and N. van Horen. 2014. "Foreign Banks: Trends and Impact." *Journal of Money, Credit and Banking* 46 (s1): 295–326.
- De Haas, R., Y. Korniyenko, A. Pivovarsky, and T. Tsankova. 2015. "Taming the Herd? Foreign Banks, the Vienna Initiative and Crisis Transmission." *Journal of Financial Intermediation* 24 (3): 325–55.
- Dell'Ariccia, G., and R. Marquez. 2006. "Competition Among Regulators and Credit Market Integration." *Journal of Financial Economics* 79 (2): 401–30.
- Demirgüç-Kunt, A., and H. Huizinga. 2010. "Bank Activity and Funding Strategies: The Impact on Risk and Returns." *Journal of Financial Economics* 98 (3): 626–50.
- . 2013. "Are Banks Too Big to Fail or Too Big to Save? International Evidence from Equity Prices and CDS Spreads." *Journal of Banking and Finance* 37 (3): 875–94.
- Financial Times*. 2013a. "NY FED Warns on 'Go It Alone' Regulators." *Financial Times*, April 22.

- . 2013b. “Rush to EU Banking Union Hits Roadworks and Diversions.” *Financial Times*, June 26.
- Freixas, X. 2003. “Crisis Management in Europe.” In *Financial Supervision in Europe*, ed. J. Kremers, D. Schoenmaker, and P. Wierts, 102–19. Cheltenham: Edward Elgar.
- Goodhart, C., and D. Schoenmaker. 2009. “Fiscal Burden Sharing in Cross-Border Banking Crises.” *International Journal of Central Banking* 5 (1): 141–65.
- Holthausen, C., and T. Ronde. 2002. “Cooperation in International Banking Supervision: A Political Economy Approach.” ECB Working Paper No. 316.
- Krimminger, M. 2007. “Banking in a Changing World: Issues and Questions in the Resolution of Cross-Border Banks.” In *International Financial Instability: Global Banking and National Regulation*, ed. D. Evanoff, G. Kaufman, and J. LaBrosse. World Scientific.
- Loranth, G., and A. Morrison. 2007. “Deposit Insurance, Capital Regulations and Financial Contagion in Multinational Banks.” *Journal of Business Finance and Accounting* 34 (5–6): 917–49.
- Maloney, J., and M. Macmillen. 1999. “Do Currency Areas Grow Too Large for Their Own Good?” *Economic Journal* 109 (458): 572–87.
- Mundell, R. 1961. “Theory of Optimum Currency Areas.” *American Economic Review* 51: 657–65.
- Niepmann, F., and T. Schmidt-Eisenlohr. 2013. “Bank Bailouts, International Linkages and Cooperation.” *American Economic Journal: Economic Policy* 5 (4): 270–305.
- Oates, W. 1972. *Fiscal Federalism*. New York: Harcourt-Brace.
- Osterloo, S., and D. Schoenmaker. 2005. “Financial Supervision in an Integrating Europe: Measuring Cross-Border Externalities.” *International Finance* 8 (1): 1–27.
- Schoenmaker, D. 2010. “Burden Sharing for Cross-Border Banks.” *Estabilidad Financiera* 18 (March): 31–47.
- Schoenmaker, D., and A. Siegmann. 2013. “Efficiency Gains of a European Banking Union.” Discussion Paper No. 13-026/IV/DSF51, Tinbergen Institute.
- Shapiro, J., and D. Skeie. 2013. “Information Management in Banking Crises.” CEPR Discussion Paper No. 9612.

ECB Unconventional Monetary Policy and the Italian Economy during the Sovereign Debt Crisis*

Marco Casiraghi, Eugenio Gaiotti, Lisa Rodano, and
Alessandro Secchi
Banca d'Italia

We assess the impact of the main unconventional monetary measures adopted by the European Central Bank in 2011–12 (the Securities Markets Programme, the three-year longer-term refinancing operations, and the Outright Monetary Transactions) on the Italian economy. We first estimate the indirect effects on financial and credit markets and then we map them onto their macroeconomic implications. The results suggest that all operations have, to varying degrees, contributed to counteract the increase in government bond yields and to improve credit supply and money-market conditions. From a macroeconomic perspective, the measures have had a large positive effect, mainly through the credit channel, with a cumulative impact on GDP growth of 2.7 percentage points over the period 2012–13.

JEL Codes: E52, E58, E44.

1. Introduction

Since 2007, most central banks in advanced countries have implemented unconventional monetary measures to counteract the economic effects of the Global Financial Crisis. However, the definition of unconventional measures is far from being narrow, because the instruments used and the problems that they were intended to address have differed significantly across economies. Not

*The views expressed here are those of the authors and do not necessarily reflect those of Banca d'Italia. All remaining errors are our own. Corresponding author: Marco Casiraghi, Banca d'Italia, Via Nazionale 91, 00184 Rome, Italy. Tel.: +39 06 4792 4949. E-mail: marco.casiraghi@bancaditalia.it.

surprisingly, the debate on the effectiveness of such measures is still open.

Most of the empirical literature on unconventional measures focuses on the United States and the United Kingdom and aims at estimating the impact of asset purchase programs designed to provide stimulus when short-term rates are close to zero. The general finding is that such interventions were effective in sustaining the economy. The evidence is, however, still scant on whether unconventional monetary policy also has an impact when it aims at addressing market disruptions, which could arise because of a crisis of confidence or the coordination of expectations on a worst-case scenario in a situation of multiple equilibria (Meier 2009; Stone, Fujita, and Ishi 2011).

From a theoretical perspective, Cúrdia and Woodford (2011) argue that targeted asset purchases by the central bank can be effective if the financial markets are sufficiently disrupted and are likely to be ineffective otherwise (see also Gertler and Karadi 2011). Similarly, the consensus among European monetary policymakers is that monetary policy is a powerful tool to address the sovereign crisis, although it cannot overcome it by itself (Visco 2013).

According to an opposite view, however, monetary interventions are less effective in the presence of extremely tight credit (Kozicki, Santor, and Suchanek 2011), and increasing the liquidity supply may not produce more lending when banks are under stress or the value of collateral is too low (Stiglitz 2012). Weidmann (2012) argues that both liquidity provision and outright monetary operations may be ineffective in the euro area because they fail to get at the causes of the crisis of confidence, namely the need for structural adjustments in banking and in public finances.

In this paper we address a specific case: the impact on the Italian economy of the main non-standard measures adopted by the European Central Bank (ECB) during the most acute phase of the sovereign debt crisis.

Italy offers an interesting viewpoint. While the focus on a single country clearly allows us to obtain only a partial assessment of the effectiveness of the measures implemented by the ECB, which were directed at the entire euro area, the analysis of an economy that was at the core of the sovereign debt crisis offers important insights. Our results may provide a new perspective into the effectiveness

of non-standard policies aimed at offsetting the impact on the real economy of financial market disruptions.

During the summer of 2011, sovereign debt market tensions extended to two large euro-area countries, Italy and Spain. The strains were widespread in the area, but they affected Italy directly and were rapidly transmitted to the banking sector and other segments of the domestic financial market. Corporate bond yields and money-market spreads soared, interbank loans dried up, and stock indexes plummeted. The effects were amplified both by the abrupt interruption of cross-border capital flows in the euro area and by the sudden funding freeze faced by banks on international markets. The adverse impact on the cost and availability of credit to the private sector led to a sizable drop in aggregate demand.¹ In the summer of 2012, fears of a possible breakup of the euro area aggravated financial tensions and further increased the cross-country disparities in monetary conditions.

In response, the ECB took several measures designed to support dysfunctional market segments, foster bank liquidity, avert a credit crunch, and dispel the fears of a euro-area breakup. It extended the Securities Markets Programme (SMP) to Italian and Spanish government bonds in August 2011; it granted three-year loans to banks (three-year longer-term refinancing operations, LTROs) in December 2011 and in February 2012; and it announced the Outright Monetary Transactions (OMTs) in September 2012. The main features of these measures are reported in table 1.

The SMP was set up in May 2010 and enhanced in August 2011, when purchases were reactivated and extended to Italian and Spanish government securities. Over the life of the program, interventions in the Italian sovereign bond market amounted to around €100 billion. In December 2011 the ECB announced two LTROs with an extended maturity of three years, tendered at a fixed rate with full allotment; at the same time, collateral eligibility criteria were substantially broadened to ensure that banks had enough borrowing

¹According to estimates by Albertazzi et al. (2012), in Italy the cost of lending increased by 2 percentage points in 2011 due to the movements in sovereign spreads. Aggregate and cross-country evidence of the effects of the sovereign debt crisis on euro-area economies is provided by Neri and Ropele (2013).

Table 1. The ECB’s Three Main Unconventional Operations in 2011–12

	Description of the Measure	Date of Announcement	Date of Implementation	Objective	Details	Amounts: Euro Area and Italy
Securities Markets Programme	Outright transactions in the secondary euro-area public and private debt securities markets.	On May 10, 2010, the central banks of the Eurosystem started purchasing securities. On August 8, 2011, the program was enhanced, announcing that “the ECB will actively implement its Securities Markets Programme.”	Active from May 2010 (on Italian securities, from August 8, 2011) to February 2012. Formally terminated in September 2012.	To ensure depth and liquidity in those market segments that were dysfunctional, to restore an appropriate monetary policy transmission mechanism and effective conduct of monetary policy.	The impact of interventions is sterilized so as to ensure that the monetary policy stance is not affected.	Holdings of euro-area securities on December 2012 (nominal amount): €218 bn; holdings of Italian securities on December 2012 (nominal amount): €102.8 bn.

(continued)

Table 1. (Continued)

	Description of the Measure	Date of Announcement	Date of Implementation	Objective	Details	Amounts: Euro Area and Italy
Three-Year Longer-Term Refinancing Operations	Two longer-term refinancing operations with maturity of thirty-six months.	December 8, 2011	First auction: December 21, 2011, settlement December 22. Second auction: February 29, 2012, settlement March 1.	To avert a credit crunch, addressing the risk of a funding and liquidity crisis for the banking system.	Collateral eligibility was broadened. The operations were conducted as fixed-rate tender procedures with full allotment. The rate in these operations is fixed at the average rate of the main refinancing operations over the life of the respective operation. Banks are endowed with the option of early-repay three-year LTROs after one year.	Total gross borrowing by euro-area banks €1020 bn; total gross borrowing by Bank of Italy's counterparts: €255 bn.

(continued)

capacity to satisfy their current and future liquidity needs.² Italian banks borrowed a total of close to €250 billion. Finally, in a speech given at the end of July 2012, ECB President Draghi announced that the ECB would “do whatever it takes” to preserve the euro. In the next two months, the ECB announced the guidelines and the operational details of the OMTs, i.e., secondary market purchases of government bonds with a maturity between one and three years, with no *ex ante* volume limit.³ To date, the OMTs have not been activated for any country.

We assess the impact of these monetary policy actions on the Italian economy using a two-step approach. First, we estimate their direct effects on financial and credit markets using a specific econometric methodology for each measure so as to address the issue of heterogeneity among the policy instruments adopted. In detail, we use an event-study methodology to estimate the impact of the three-year LTROs on money-market interest rates and that of the OMTs on government bond yields, and we run several types of regressions to assess the effect of the SMP on government bond yields and of the three-year LTROs on credit availability. In the second step, we map the estimated effects on money-market interest rates, bond yields, and credit availability onto their macroeconomic implications using the Bank of Italy’s quarterly model of the Italian economy (BIQM). This model provides sound estimates of the impact of the unconventional measures on the main Italian macroeconomic variables; it also allows us to identify the transmission channels for each measure and isolate the specific contribution of changes in interest rates and in credit availability.

Our results suggest that the SMP, the three-year LTROs, and the OMTs have been effective in offsetting undue increases in government bond yields and easing money-market tensions, with a positive and significant impact on credit supply. Transmitted mainly through the credit channel, the policy measures induced a cumulative output

²The availability of collateral was significantly reduced in some banking systems by increased borrowing, the fall in collateral asset prices, and more frequent margin calls.

³OMTs would be considered by the ECB if deemed necessary from a monetary policy perspective and may be carried out only for the securities of countries that request a financial assistance program and that comply with its conditions. The liquidity created with the OMT would be sterilized.

growth response equal to 2.7 percentage points in 2012–13. In considering these findings, however, one should bear in mind that a full counterfactual scenario is beyond the scope of this paper. The ECB's unconventional policies may have avoided a generalized collapse of financial and credit markets, which cannot be studied using the standard econometric tools insofar as the effects would have been very large and highly non-linear. Even though it cannot be ruled out, the possibility that financial tensions would have eased without the ECB intervention seems remote.

The paper contributes to the literature in a number of ways. First, we study the most acute phase of the sovereign debt crisis, which has not yet been covered by research on the macroeconomic effects of the ECB's unconventional measures. Second, empirical results for the so-called peripheral countries are almost non-existent, as to date the literature has focused on the euro area as a whole. Yet it is precisely those countries that have been affected most severely by the market disruptions, and they accordingly constitute the most suitable gauge for assessing the effectiveness of the measures. Third, our estimation strategy overcomes one crucial weakness of the existing literature on the impact of non-standard policy measures (mainly based on VAR models), namely the use of very rough proxies for ECB interventions (e.g., the change in the size of the Eurosystem balance sheet), which fail to capture the peculiarities of the different instruments (in contrast, existing studies of the local effects of specific measures stop short of evaluating the macroeconomic impact). On the contrary, our two-step approach combines appropriate estimation methodologies to evaluate the specific effects of each measure on financial markets and credit availability with a consistent mapping of these effects to their macroeconomic consequences, through the BIQM. Finally, the flexibility of the BIQM allows us to take fully into account the impact of the sovereign debt crisis on the monetary transmission mechanism. In particular, we take into consideration that the financial tensions impaired the standard transmission channels and activated new ones that do not normally play a significant role.

The remainder of this paper is organized as follows. Section 2 reviews the evidence on the effects of the measures adopted by the ECB during the financial and the sovereign debt crisis. Section 3 describes the main channels of monetary transmission included in

the structure of the BIQM and discusses how they have been affected by the sovereign debt crisis and by the ECB's measures adopted in 2011–12. Section 4 presents the estimates of the effects of the SMP, the two three-year LTROs, and the OMTs on market yields and on credit supply in Italy based on regression analyses and on high-frequency event studies. In section 5 we assess the overall effects of the measures on the main Italian macroeconomic variables using the BIQM and, in particular, by simulating the response of the economy to a set of shocks on interest rates and credit availability of the same magnitude as those estimated in section 4. Section 6 concludes.

2. Existing Evidence on the Effectiveness of the ECB's Unconventional Policy Measures

A large part of the empirical literature on the effectiveness of unconventional monetary policy seeks to gauge the impact of large-scale asset purchases in the United States and the United Kingdom designed to provide additional monetary stimulus when short-term rates are at the zero lower bound. The general finding is that the purchases did affect market yields and sustain the economy, but there is still considerable uncertainty about the effective magnitude of their contribution.⁴

The evidence on the macroeconomic effects of the non-standard measures adopted by the ECB during the most acute phase of the sovereign crisis (i.e., after 2011) is still scanty. Most of the existing papers focus on ECB interventions in the previous period, i.e., between the Lehman Brothers bankruptcy and the summer of 2011,

⁴A survey of the impact of large-scale asset purchases on yields in the United States and in the United Kingdom is provided by Williams (2014). Surveys of the evidence on the macroeconomic impact of these measures are provided by Cecioni, Ferrero, and Secchi (2011), Gagnon and Hinterschweiger (2013), International Monetary Fund (2013), and Santor and Suchanek (2013). Chung et al. (2012) use stochastic simulations of the Federal Reserve's macroeconomic model (FRB/US) and find that QE1 and QE2 increased GDP by around 3 percentage points. Chen, Cúrdia, and Ferrero (2011) use a DSGE model and find a smaller effect of QE2 on U.S. GDP (0.3 percentage point). For the United Kingdom, Kapetanios et al. (2012) find a peak effect on GDP of around 1.5 percentage points.

therefore not bearing on the effectiveness of any of the unconventional measures we study.⁵

They mostly rely on VAR models augmented with very general proxies of the recourse to non-standard policy. Lenza, Pill, and Reichlin (2010) measure the impact of the liquidity-enhancing instruments adopted by the ECB after the collapse of Lehman Brothers with the reduction of the spread between unsecured and secured money-market rates and, relying on VAR-based forecasts, conclude that without the ECB intervention industrial output growth and inflation would have been 3 and 0.5 percentage points lower. Giannone et al. (2011) interpret their finding of no prediction error in an out-of-sample simulation of euro-area monetary and credit variables over 2008–10 as evidence of the success of the unconventional measures in offsetting the global shocks. Peersman (2011) estimates unconventional policy shocks based on changes in the size and composition of the Eurosystem balance sheet and finds that over 1999–2009 the effects on output and inflation are similar to those of conventional monetary policy shocks. Gambacorta, Hofmann, and Peersman (2012) use a similar approach in a panel VAR for eight advanced economies over the period from January 2008 to June 2011 and obtain similar results. Giannone et al. (2012) construct a gauge of the policy shock looking at the evolution of commercial banks' balance sheets and conclude that unconventional monetary policy increased industrial production by 2 percent two years after the Lehman Brothers collapse. Ciccarelli, Maddaloni, and Peydró (2013) suggest that the ECB unconventional measures partly mitigated the disruption of the credit channel in the distressed countries.

As for the sovereign debt crisis, there is an increasing amount of evidence on the “local” impact of the SMP asset purchases, i.e., on the sovereign yield on the specific market segment they were addressing, while there is very little evidence so far on the effect on the economy. De Pooter, Martin, and Pruitt (2013) use an asset pricing model to determine the liquidity premium implicit in sovereign bond prices and regress this premium on weekly SMP purchases;

⁵Eser et al. (2012) provide a detailed description of the non-standard measures implemented by the ECB since 2009. Evidence on the financial market effects of the measures adopted by the ECB before 2011 is in Cecioni, Ferrero, and Secchi (2011) and in ECB (2011).

they find that each percentage point of outstanding bonds purchased lowered liquidity premia by around 20 basis points on impact. Eser and Schwaab (2013) find that on average €1 billion of purchases under the SMP lowered five-year Italian government bond yields by 1–2 basis points both on impact and in the long run. Ghysels et al. (2014), regressing yield changes on SMP interventions at high frequencies (fifteen minutes), find that a €100 million intervention has an immediate impact on bond yields of between 0.1 and 25 basis points, depending on the size of the market.

The overall impact of the SMP, the three-year LTROs, and the OMTs on the interbank market is studied by Dubecq et al. (2013), who use a quadratic term structure model of the EURIBOR-OIS spreads and conclude that the SMP had no effect on interbank premia, the announcement of three-year LTROs reduced liquidity premia by around 50 basis points, and the OMTs helped ease liquidity risk.

Darracq-Paries and De Santis (2013) are among the few papers that provide some evidence on the macroeconomic impact of the two three-year LTROs. They define the policy shock as the innovation in credit conditions as measured in the euro-area Bank Lending Surveys and, based on a panel VAR for eight euro-area countries, conclude that the LTROs lifted the prospects for real GDP, with a peak effect between 0.7 and 1.0 percentage points by mid-2013.

To the best of our knowledge, there is no comprehensive country-level evidence on the macroeconomic effects of the whole range of unconventional measures adopted by the ECB during the most acute phase of the sovereign debt crisis.

3. The Sovereign Crisis, the ECB Measures, and the Channels of Transmission in the Bank of Italy's Quarterly Model

In order to estimate the macroeconomic impact of the ECB unconventional measures, we use the Bank of Italy quarterly model of the Italian economy.⁶

⁶The BIQM is used to provide short- and medium-term projections for policy evaluation exercises, for counterfactual analyses, and for the coordination

The BIQM includes several channels that allow greater detail in taking into account how the ECB unconventional measures affected the Italian economy, as well as the way in which the sovereign debt crisis impaired the monetary transmission mechanism.

In the monetary transmission mechanism as captured in the BIQM, changes in the key ECB rates are transmitted to the term structure of interest rates. The BIQM measures this effect through variations in the one-year Treasury-bill rate (BOTs) and the long-term yield on Treasury bonds (BTPs), which proxy for short-term and long-term rates. Changes in the term structure affect bank lending rates, which directly influence investment in construction, through different mortgage rates, and inventories accumulation. Bank lending rates and long-term interest rates jointly affect the cost of capital, which has an impact on business investment; real long-term rates also affect households' intertemporal consumption decisions.⁷

The sovereign debt crisis altered the monetary transmission mechanism, interfering with the standard channels and activating new ones. There were three main effects. First, the usual relationship between the ECB-driven short-term interest rates and long-term rates broke down: an unprecedented increase of the spread between the yield on ten-year BTPs and the corresponding risk-free rate started in summer 2011 (see figure 1), reflecting both an increased sensitivity to domestic fundamentals (a “wake-up call” form of contagion: Giordano, Pericoli, and Tommasino 2013) and the upsurge in the perceived risk of a euro-area breakup (Di Cesare et al. 2012).

Second, the surge in credit and liquidity risk, which was associated with growing segmentation of interbank markets across national lines, resulted in an unprecedented rise in risk premia on money-market interest rates. Italian banks had to pay a large premium on their secured as well as their unsecured borrowing (see figure 2, top panels and bottom left panel). The increase in secured money-market

of economic analysis within DG Economics, Statistics and Research at Banca d'Italia. Like most traditional macroeconomic models, it is Keynesian in the short run and akin to the Solow model of exogenous growth in the long run. It contains some 800 equations, nearly 100 of which are stochastic. See Buseti, Locarno, and Monteforte (2005).

⁷In the model, a decrease of 50 basis points of both the short- and long-term rates increases the GDP level by around 0.35 percent after two years.

Figure 1. Evolution of Risk Premia on Italian Ten-Year Sovereign Bonds (daily data, basis points)



Source: Bloomberg.

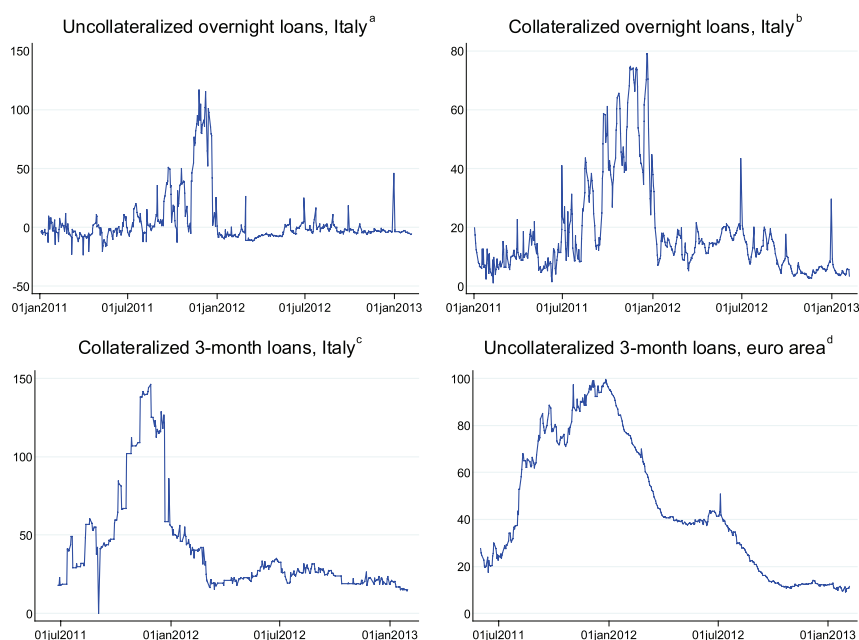
Notes: Spread between the yield on ten-year BTPs and the corresponding interest rate swap (IRS).

rates also reflected the lower collateral value of Italian sovereigns. On top of these country-specific shocks, in late 2011 tensions hit the whole area-wide interbank market, with a sharp rise in the spread between interest rates on unsecured three-month interbank loans and the risk-free rate of that maturity (the spread between EURIBOR and overnight indexed swaps, shown in figure 2, bottom right panel).

Third, the increase in sovereign yields and the tensions in the interbank market affected not only the cost but also the availability of funding for Italian banks. There ensued an unprecedented increase in quantitative constraints on the availability of credit to the private sector, exacerbating the disparity of monetary conditions between Italy and the countries less affected by the crisis. The index of credit supply restriction derived from the responses of Italian banks to the Bank Lending Survey peaked at end-2011 (see figure 3).

The BIQM can take account of the transmission of these changes. In the model, 90 percent of a change in government bond yields is transmitted to bank lending rates within six quarters, a feature that is broadly confirmed by recent studies on the pass-through of interest

Figure 2. Evolution of Risk Premia on the Interbank Market (daily data, basis points)



Sources: e-MID, RepoFund Rate - ICAP, European Banking Federation, and Reuters.

^aSpread between the interest rate on Italian uncollateralized overnight interbank loans and the EONIA rate.

^bSpread between the interest rate on Italian collateralized overnight interbank loans and the corresponding French and German interest rates (average, weighted by volume).

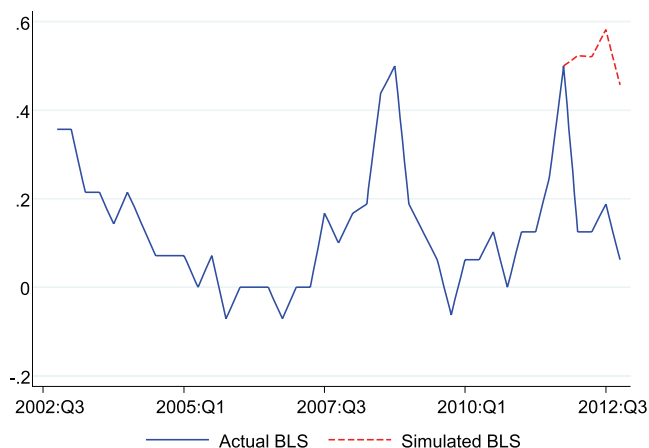
^cSpread between the interest rate on Italian collateralized three-month interbank loans and the corresponding French and German interest rates (average, unweighted).

^dSpread between the EURIBOR three-month and the rate on the corresponding overnight indexed swap.

rates during the sovereign debt crisis.⁸ Higher money-market spreads also affect both short- and long-term rates and, in turn, aggregate demand. Finally, whereas in the BIQM quantitative constraints to

⁸If anything, the results of Albertazzi et al. (2012) suggest that the lending rate impact of movements in sovereign yields tends to be slightly greater during periods of financial turmoil.

Figure 3. BLS Index of Credit Conditions: Actual and Simulated Dynamics (quarterly data, index)



Notes: Simulations based on the estimates presented in table 5, assuming that three-year LTROs have neither a “direct” nor an “indirect” effect on credit conditions (see section 4.2). The BLS survey admits five ordered answers, namely “tightened considerably,” “tightened somewhat,” “basically unchanged,” “eased somewhat,” and “eased considerably.” The index presented in the figure is constructed as the simple mean of the responses provided by the banks after assigning values 1, 0.5, 0, -0.5 , and -1 , respectively, to the possible responses.

credit availability are not a relevant channel of transmission in normal times, recent research suggests that when they are binding they may have a significant and non-linear impact on investment.⁹ We estimate and include these effects in the BIQM using the approach developed by Rodano (2011).

Simulations based on the BIQM confirm that these shocks played a major role in pushing the Italian economy into recession. Higher interest rates and tighter credit constraints cut about 1 percentage point from the growth rate in 2012 (see table 2), about one-third of the unexpected economic slowdown that year, an effect that would have been even larger if interest rates and credit constraints had not gradually receded from their peaks.

⁹The evidence provided in Gaiotti (2013), based on firm-level data, confirms that in recessions an increase in credit constraints has large effects on investment.

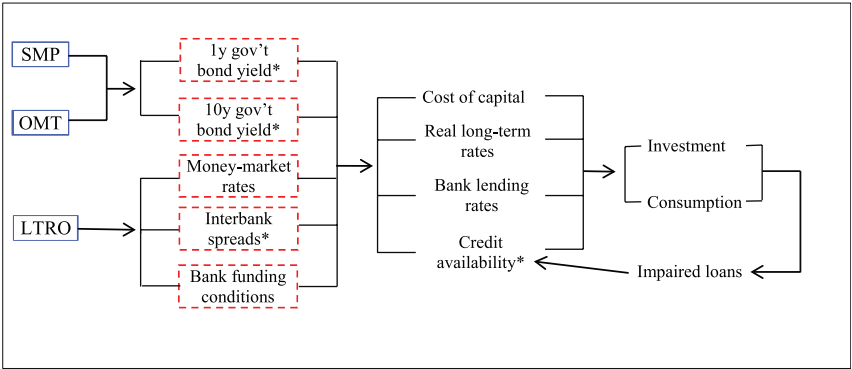
**Table 2. Determinants of the 2012 Recession in Italy
According to the Bank of Italy Quarterly Model
(percentage points)**

	2012
GDP Growth in a Scenario of No Sovereign Debt Crisis ^a	1.1
Determinants of the Revisions:	
Sovereign Interest Rates and Spreads	−0.4
Firms' Difficulties in Obtaining Credit	−0.6
Budgetary Measures	−1.1
Slowdown of the World Economy	−0.7
Uncertainty and Confidence	−0.6
Residual Component	−0.1
Actual GDP Growth	−2.4
Source: BIQM simulation, updated from Bank of Italy (2013). Notes: The contribution of the factors presented in the table is computed comparing a simulation of the model where the exogenous variables are set at the profiles expected in the summer 2011 projection exercise, i.e., before the sovereign debt crisis accelerated, with a simulation using their realized values. ^aGDP growth projection computed in July 2011.	

The channels through which the ECB measures were intended to counteract the effects of the sovereign debt crisis and restore proper monetary transmission are shown in figure 4. The SMP was designed to counter undue yield volatility and ensure depth and liquidity in dysfunctional government bond market segments; in the BIQM, the consequent reduction in risk premia would correspond to lower short- and long-term yields on public securities¹⁰ (with little impact on money-market interest rates because the liquidity effect was sterilized). The LTROs were intended to improve banks' liquidity conditions in order to defuse the threat of an impending funding crisis and avert a credit crunch; they ease credit availability conditions, which have a direct effect on investment, and decrease interbank market spreads, which affect the interest rate term structure (the increase in liquidity could also lower the overnight rate). By eliminating "tail risks" and precluding destructive scenarios in

¹⁰At the end of 2012 the average maturity of Italian sovereign securities in the SMP portfolio was 4.5 years.

Figure 4. Transmission of Unconventional Measures in the Bank of Italy Quarterly Model



Notes: Policy measures are reported in solid boxes, and variables directly affected by the sovereign debt crisis are reported in dashed boxes. The variables considered as exogenous in the simulations are indicated with an asterisk.

a context of multiple equilibria, the OMTs would affect mostly the shorter part of the yield curve, where they would operate, but long-term rates might also fall due to the attenuation of the perceived redenomination risk.

4. Approach and Results

The methodology is in two stages. The first uses specific estimation approaches to gauge the impact of each of the ECB's measures on financial market conditions and the availability of credit. We estimate two regressions, based on detailed data on the purchases of Italian sovereign bonds under the SMP and on the reaction of individual banks' credit conditions to three-year LTROs; we also perform high-frequency event studies on the effects on short- and long-term interest rates of the announcements related to LTROs and OMTs. In the second stage, we map the estimated effects onto their macroeconomic implications for Italy using the BIQM.¹¹

¹¹Locarno and Secchi (2009) is related to our approach, although much more limited in time horizon and scope. They estimate the effect of the provision of

There is a general caveat to mention when “exogenously” inserting in a model changes in variables that arose for different reasons than those in the estimation sample. A specific issue is mentioned by Stein (2012), who argues that decreases in yields associated with large-scale asset purchases may have a different macroeconomic effect than those built into standard models, because they reflect a compression of term premia due to large-scale asset purchases, but not necessarily a change in expected future short rates, as is instead the case in normal times. However, this particular problem may be less relevant for our case: unlike the Federal Reserve large-scale asset purchases, ECB interventions were not aimed at decreasing term premia but rather at contrasting market disruptions, which would otherwise have caused a surge in yields.

Still, it is important to keep in mind that the BIQM is not completely immune to the Lucas critique because the impact of bond yields and credit constraints on other variables may have changed during the crisis, and this may bias the results of our simulations. In this respect, however, we take comfort from the comparison of the model’s main properties with micro evidence relative to the sovereign debt crisis, which is more robust to state-dependent changes in the transmission and seems to broadly confirm the magnitude of the relevant responses in the BIQM. Albertazzi et al. (2012), working with a panel of bank-level data during the crisis, find a full pass-through of movements in sovereign yields to bank lending rates; the magnitude of the impact of credit constraints on investment during the global crisis estimated by Gaiotti (2013) on a panel of firm-level data is also consistent with the effects included in the BIQM.

4.1 Securities Markets Programme Interventions

To evaluate the impact of the SMP on Italian government bond yields, we regress daily changes in bond yields on SMP purchases and a series of additional control variables.¹² The inclusion of control variables is important to address endogeneity. Yields and

liquidity after the bankruptcy of Lehman Brothers on the spread between unsecured and secured interbank rates and on short-term lending rates in Italy, and then map it on output growth using the Bank of Italy quarterly model.

¹²The section updates results in Secchi (2012).

bond purchases under the SMP reacted to common factors, such as changes in market confidence and in risk appetite for Italian government bonds. Since valid instruments are not readily available, we include suitable control covariates that can proxy for the factors affecting yields.¹³ The econometric specification can be written as

$$\Delta r_t = f(SMP\_purchases_t, \Delta r_{t-1}, \Delta X_t), \quad (1)$$

where Δr_t is the daily change in the yield on Italian sovereign bonds at either two-year or ten-year maturity; *SMP_purchases* is the daily volume of purchases of Italian securities, in billions of euros; and ΔX_t is a vector of covariates that control for other factors affecting Italian yields, which serves as a benchmark, i.e., the yield that would have obtained in absence of interventions, given actual economic and financial developments. In particular, these controls include a measure of the “risk-free” interest rate (interest rate swaps, or IRS), which is intended to capture the evolution of the economic outlook and the expected course of policy rates. In addition to IRS, we take a series of other variables, which proxy for the severity of tensions in Italian and other European financial markets (credit default swaps, or CDS, spreads on Italian bonds; the slope of the Italian yield curve, computed as the difference between yields on ten- and two-year BTPs; risk premia on private and public European securities as the French OAT-German bund spreads; the spread between BBB and AAA European corporate non-financial bonds; stock market indices; the spread between the IRS and the yield on German bunds; volatility indexes; and capital outflows measured via Italian Target2 flows). As a robustness control, we include an *SMP_purchase_dummy*.¹⁴ This variable captures the average impact of unobservable factors (e.g., a change in confidence) that affected both yield dynamics and SMP interventions and, by their very nature, cannot be controlled by the other variables in the regression. A positive coefficient may indicate the presence of unobservable financial strains on the days when the Eurosystem decided to intervene in the Italian government bond market.

¹³ An analogous approach is adopted by Eser and Schwaab (2013).

¹⁴ This dummy variable is equal to 1 in those days in which the SMP purchased Italian government bonds (0 otherwise).

The estimates of equation (1), reported in table 3, show a substantial effect of purchases of Italian securities on daily yield movements: €1 billion in bond purchases lower both the two- and the ten-year yields by between 2 and 5 basis points. Most of the control variables have the expected sign and in many cases are highly significant.¹⁵ The results of the regressions are robust to the inclusion of the *SMP_purchase_dummy* (columns 2 and 5), to the exclusion of CDS spreads on Italian bonds and the slope of the BTP term structure (which may have been directly affected by SMP interventions) and of the covariates that are looser proxies for financial tensions (columns 3 and 6).¹⁶

The results are also robust to a range of further controls and specifications. In particular, the results are not sensitive to variations in the sample period, such as restricting it to the dates on which the SMP intervened in the Italian government bond market or considering only the period up to late February 2012 when the SMP made its last purchases; nor are they sensitive to the inclusion of extra covariates (e.g., a Monday dummy to control for recurrent patterns of financial market performance).

Overall, the magnitude of the effects is broadly consistent with the range of existing estimates of the effectiveness of the SMP mentioned in section 2. According to our most conservative estimates, the total impact comes to around 200 basis points for both two- and ten-year BTP yields, since the overall purchases of Italian securities over the whole life of the SMP amounted to slightly more than €100 billion. As a comparison, Eser and Schwaab (2013) conclude that SMP permanently reduced Italian yields by about 190 basis points; Ghysels et al. (2014) conclude that SMP permanently reduced Italian yields by 100 basis points.

¹⁵As expected, increases in IRS and in Italian and other European risk premia increase BTP yields, while higher stock market returns and a steeper yield curve (which are inverse measures of financial market tensions) decrease BTP yields.

¹⁶Capital outflows measured via Italian Target2 flows, the spread between the IRS and the yield on German bunds, and the bund volatility index are almost never significant in the first two specifications (columns 1, 2, 4, and 5). A possible explanation is that settlements via Target2 also reflect commercial transactions, while changes in the other two variables were mainly due to the “flight to quality” associated with the high liquidity and strength of the bund.

Table 3. Effects of SMP on Italian Government Bond Yields
(OLS regressions, daily data)

Yield Change On:→	BTP Two-Year			BTP Ten-Year		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable ↓						
SMP Purchases (bn euros)	−0.024*** (0.009)	−0.046*** (0.013)	−0.022* (0.013)	−0.024** (0.009)	−0.046*** (0.014)	−0.019** (0.009)
SMP Intervention Dummy ^a		0.051** (0.020)			0.051** (0.021)	
ΔYield 2y (10y), Lagged	−0.002 (0.041)	−0.001 (0.042)	0.092 (0.073)	0.043 (0.057)	0.034 (0.057)	0.082 (0.054)
ΔIRS 2y (10y)	0.447** (0.179)	0.421** (0.171)	0.613** (0.291)	0.298** (0.145)	0.282* (0.145)	0.182 (0.154)
ΔCDS Sov. 2y (10y), Italy	0.159*** (0.043)	0.163*** (0.041)		0.189*** (0.052)	0.195*** (0.051)	
ΔSlope BTP Term Structure	−1.108*** (0.091)	−1.108*** (0.090)		−0.109 (0.082)	−0.107 (0.082)	
ΔSlope BTP Term Structure, Lagged	−0.124 (0.095)	−0.100 (0.095)	−0.366** (0.162)	−0.095 (0.092)	−0.071 (0.092)	−0.139 (0.087)
ΔSpread OAT-Bund 2y	0.308 (0.235)	0.284 (0.233)	0.797* (0.422)	0.182 (0.220)	0.160 (0.219)	0.258 (0.205)
ΔSpread OAT-Bund 10y	0.506*** (0.129)	0.502*** (0.126)	0.536** (0.242)	0.707*** (0.136)	0.699*** (0.135)	0.762*** (0.140)

(continued)

A comparison of our results with the existing evidence on the SMP, as well as with selected results on the effect of large-scale asset purchases in the United States surveyed by Williams (2014), is presented in table 4. The comparison systematically shows a larger effect on Italian yields, consistent with the conjecture that asset purchases are more effective when they are designed to fix a particular impairment in financial markets than when they are intended to provide additional stimulus at the zero lower bound. To properly compare the results, in the last column the effect of purchases equal to 1 percent of GDP is shown. The finding of a larger effect on Italian yields is confirmed: the range of estimates for the United States suggests that purchases of government bonds equal to 1 percent of GDP in the United States had an impact on ten-year Treasury yields between 3 and 8 basis points (except for D'Amico and King 2013, who estimate a larger effect), which compares with the estimates for Italy that range between 16 and 30 basis points.

Figure 5 compares the actual values of the two- and ten-year BTP yields with the values obtained simulating equation (1) under the assumption of no SMP purchases; it confirms that, according to our estimates, if SMP asset purchases had been held to zero, the yields on Italian government bonds would have been higher than those actually observed.

As the figure shows, the worsening of sovereign spreads was nonetheless not interrupted after the start of the SMP program but rather continued to widen throughout the second half of 2011, peaking in November, due to the deterioration in the covariates in the equation, which likely suffered from continuing uncertainty on the prospects for the Italian economy and on European policies.

4.2 The Three-Year Longer-Term Refinancing Operations and Credit Supply

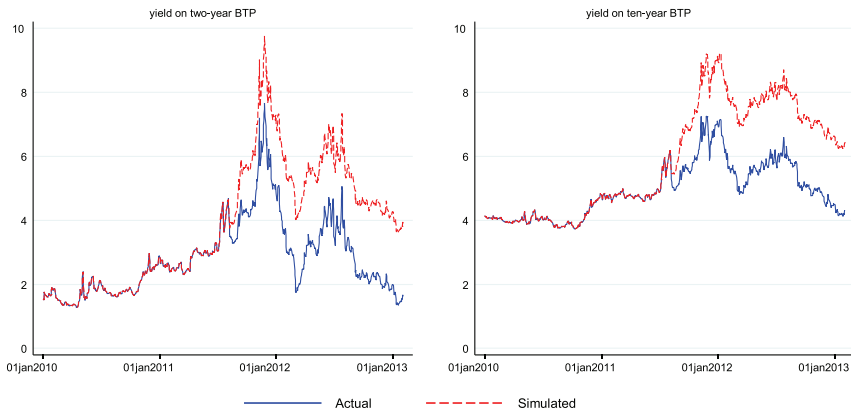
The effects of the three-year LTROs are estimated by two different approaches. First we use event studies, discussed in the next section, to evaluate the impact on Italian interbank interest rate spreads. Second, we exploit the Eurosystem's Bank Lending Survey (BLS) index of credit supply to estimate the effect on credit availability. These effects are both "direct," in that the LTROs relaxed banks' liquidity constraints, and "indirect" because they also eased

Table 4. Selected Estimates of the Effects of Large-Scale Asset Purchases on Long-Term Rates

Study	Sample	Method	Estimates of Effect ^a	Effect per Purchases of 1% GDP (in bp)
This Paper	Italy SMP	Time Series	200 bp per €100bn	31
Ghysels et al. (2014)	Italy SMP	Time Series	100 bp per €100bn	16
Eser and Schwaab (2013)	Italy SMP	Time Series	190 bp per €100bn	30
Krishnamurthy and Vissing-Jorgensen (2011)	Post-War United States, LSAP1, and LSAP2	Time Series	15 bp per €600bn	4
Gagnon et al. (2011)	LSAP1	Event Study	30 bp per €600bn	8
Gagnon et al. (2011)	LSAP1	Time Series	18 bp per €600bn	5
D'Amico and King (2013)	LSAP1 Treasury Purchases	Security-Specific Event Study	100 bp per €600bn	27
Hamilton and Wu (2011)	United States, 1990–LSAP2	Affine No-Arbitrage Model	17 bp per €600bn	5
Christensen and Rudebusch (2012)	LSAP1, LSAP2, and UK LSAPs	Event Study, Affine No-Arbitrage Model	10 bp per €600bn	3

^aEstimates for the United States are from the survey in Williams (2014).

Figure 5. Yields on Italian BTP: Actual and Simulated Dynamics (daily data, percentage points)



Notes: Dashed lines: simulations based on equation (1) under the assumption of no SMP interventions.

individual banks' access to the interbank market and lowered their funding costs. To this end, we take advantage of the possibility to merge bank-specific answers to the BLS with bank-level information on impaired loans and interbank market rates.

In our empirical approach, the BLS index of credit supply has a crucial role. In this respect we borrow from some existing literature (Ciccarelli, Maddaloni, and Peydró 2013 and Darracq-Paries and De Santis 2013) that exploits the information in the BLS to achieve identification, but we also go one step further to directly estimate the effects of the LTROs on credit availability conditions.

We construct an unbalanced panel at quarterly frequency that includes the degree of tightening of credit supply conditions as reported by each of the eleven Italian banks that have ever participated in the BLS. This variable consists of a qualitative index that admits five ordered answers, namely "tightened considerably," "tightened somewhat," "basically unchanged," "eased somewhat," and "eased considerably." Following the literature, we assign values 1, 0.5, 0, -0.5, and -1, respectively, to those responses. We complement this qualitative information with bank-specific liquidity conditions, measured by the rates paid on the interbank market, and

with their credit risk, proxied by the flow of new impaired loans. We also consider aggregate information on interbank market tensions and economic prospects, such as the EURIBOR-EONIA swap spread, the spread between Italian and German government bond yields, and the Purchasing Managers' Index (PMI).

To assess the impact of the three-year LTROs on credit availability, we estimate several different regression equations linking the bank-level BLS index with the aforementioned set of aggregate and individual variables, which control for the main factors influencing credit supply conditions. We include an LTRO dummy to capture the “direct” impact of the measure on credit availability. Our baseline specification is

$$\begin{aligned} BLS_{i,t} = f(BLS_{i,t-1}, LTRO\_dummy_t, Euribor\_spread_t, \\ overnight\_spread_{i,t}, BTP\_spread_t, \\ \Delta impaired\_loans_{i,t}, y_t, \Delta y_t), \end{aligned} \quad (2)$$

where i denotes the bank, t indicates the quarter, BLS is the BLS supply index, $LTRO\_dummy$ takes value 1 in 2012:Q1, $Euribor\_spread$ is the difference between the three-month EURIBOR and the corresponding EONIA swap, $overnight\_spread$ is the difference between the overnight rate paid on the Italian interbank market and EONIA, BTP_spread is the spread between the ten-year Italian government bond yield and the corresponding German rate, $\Delta impaired\_loans$ is the ratio of the flow of new impaired loans in the previous four quarters to total loans, and y and Δy correspond to the PMI index and its quarter-on-quarter growth.

We use a fixed-effect estimator that controls for unobserved bank-level effects. The baseline estimation results are reported in the first two columns of table 5.¹⁷ The LTRO dummy has a significant “direct” impact on credit supply conditions, reducing the BLS index by around 0.2. Credit conditions respond significantly to changes in the availability of liquidity, tightening when the aggregate or the bank-specific interbank rate increases. The coefficients on the EURIBOR spread and the individual overnight spread are positive and

¹⁷It has been shown that in panels with a limited number of periods, a fixed-effect estimator may result in downward-biased estimates, but we consider the time dimension of our panel (thirty-six quarters) to be long enough.

Table 5. Effects of LTROs on Credit Availability (quarterly data)

Dependent Variable	BLS _{<i>i,t</i>} , Bank-Level Degree of Tightening of Credit Conditions ^a					
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged BLS _{<i>i,t</i>}	0.37*** (0.08)	0.37*** (0.09)	0.37*** (0.08)	0.37*** (0.08)		0.32*** (0.10)
Dummy LTRO _{<i>t</i>} (2012:Q1)	-0.15** (0.06)	-0.18*** (0.04)	-0.16** (0.04)	-0.18*** (0.04)	-0.58*** (0.20)	-0.15*** (0.04)
Dummy LTRO _{<i>t</i>} (2012:Q2-2012:Q4)				-0.04 (0.07)		
EURIBOR-OIS Spread _{<i>t</i>}	0.15*** (0.05)	0.13** (0.05)	0.08 (0.05)	0.13** (0.05)	0.82*** (0.30)	0.15*** (0.05)
Overnight (e-Mid)-EONIA Spread _{<i>i,t</i>}	0.28** (0.11)	0.24*** (0.08)	0.11 (0.16)	0.25*** (0.09)	0.98*** (0.33)	0.20* (0.10)
BTP-Bund Ten-Year Spread _{<i>t</i>}	-0.01 (0.02)					
ΔBanks' Impaired Loans _{<i>i,t</i>} (one-quarter lead)	0.06 (0.04)	0.04 (0.03)	0.05* (0.03)	0.05 (0.03)	0.37** (0.18)	0.01 (0.03)
PMI _{<i>t</i>}	0.00 (0.01)					

(continued)

significant. The BLS index is persistent over time, as shown by the lagged dependent variable's coefficient, which is around 0.4. Credit conditions also depend on the economic outlook, given that the coefficient on the quarterly growth of the PMI index is significant. By contrast, changes in impaired loans do not appear to be significant.

Columns 3–6 in table 5 present a series of robustness checks. Column 3 shows that our estimate of the impact of the LTROs is robust to the inclusion of dummies for the Lehman Brothers failure (2008:Q3) and the Italian sovereign crisis (2011:Q4).¹⁸ Column 4 shows that the estimate is also robust to the inclusion of an additional LTRO dummy that takes value 1 from 2012:Q2 to 2012:Q4 and 0 in the rest of the time sample.

One further econometric issue is related to possible biases connected with the way in which we mapped the qualitative answers to the BLS survey onto numerical values. In order to control for this issue, we consider two additional econometric specifications, the outcomes of which are presented in columns 5 and 6 of table 5. In detail, column 5 presents the results of an ordered probit estimation, which is the most appropriate approach for ordered qualitative dependent variables. The magnitude of the ordered probit and fixed-effects linear regression estimates reported in the table is not directly comparable, but it can be shown that the results are substantially equivalent not only in terms of the statistical significance and signs of the coefficients but also in their quantitative implications.¹⁹ Finally, column 6 shows that the estimates do not change even when very few extreme answers to the BLS (seven observations) are excluded so as to have a binary dependent variable and thus largely circumvent the problems connected with the ordinal nature of the BLS index.

¹⁸The inclusion of the Lehman Brothers failure and the Italian sovereign crisis dummies reduces the impact of the interbank spreads. This result is hardly surprising, as the two events are very important for measuring the spreads' effect on credit conditions. Further regressions, not presented here, show that, as theory suggests, the Lehman event is more important for the assessment of the impact of EURIBOR-OIS spreads on credit conditions, and the Italian sovereign debt crisis is essential in gauging the effect of the bank-level Italian overnight spread.

¹⁹The quantitative implications, not shown here, can be easily derived by considering the effect of the LTROs on the marginal probabilities for each of the admissible answers, implied by columns 5 and 6 in table 5, and mapping them in the credit conditions indicators by the same metrics used to construct the BLS supply index.

All in all, the magnitude of the correlation coefficients indicates that the LTROs had a “direct” impact on credit supply and that interbank market spreads are an important determinant of lending conditions. The next section addresses the conjecture that the operations may have helped to normalize interbank market conditions and spreads and thus had a more persistent “indirect” effect on credit supply.

4.3 Event Study—Three-Year Longer-Term Refinancing Operations

In order to estimate the impact of the three-year LTROs on financial market yields, we use a high-frequency event-study methodology, evaluating the statistical significance of the effects of an announcement on a financial asset, based on yield changes in a small temporal window surrounding the event.²⁰

We identify three major events: the announcement of the three-year LTROs and the settlement of the first and second operations. For each we focus on the change in selected interest rates in the two days around the event and test the null hypothesis of no effect to determine whether the change is statistically significant. In particular, we consider two sets of interest rates. The first includes interbank interest rates, namely the spread between the overnight rate on the Italian interbank market (e-MID, “mercato interbancario dei depositi”) and EONIA, and the spread between the yield on three-month interbank loans collateralized by Italian sovereign securities and the average yield on those backed by French and German sovereigns. The second set includes yields on the sovereign bonds, namely medium- and long-term yields on Italian securities (secondary market Treasury-bond yield at the two-year and ten-year maturity). We also analyze the changes in the spread between those bond yields and the corresponding spread vis-à-vis the interest rate swap with the same maturity, which can be interpreted as a proxy for variations in risk and liquidity premia.

²⁰Event studies have been used widely to measure the impact of the unconventional measures adopted by the major central banks (see, for example, Gagnon et al. 2011 and Swanson 2011).

Table 6 reports the results. All in all, they indicate that the LTROs affected money-market rates substantially. The initial announcement of the LTROs on December 8 was not followed by any significant change in short-term rates, but both the first and the second auctions were followed by statistically and economically significant reductions in money-market spreads.²¹ As a reference, the last two rows of the table report the cumulative change in each interest rate over the three events considered and over the entire period between the announcement of LTROs and the settlement of the second operation. These figures suggest that the changes that took place around the event dates were persistent, since they are close to the total change over the period considered. The interest rates paid by Italian banks on the interbank market dropped by 70 to 100 basis points.

Although the direct effects of the LTROs on long-term sovereign yields also played a prominent role in the public discussion, our event studies do not find any immediate reaction of government bond yields to the announcements. While this may at first seem surprising, our results do not necessarily contradict the widespread view that the LTROs, prompting a sovereign debt carry trade, contributed to the subsequent gradual but steady and significant fall in Italian long-term yields that took place in the three months following the LTROs. However, over the same period, the financial markets were also affected by other news; this raises a substantial identification problem and prevents attributing this particular decline in sovereign spreads to the monetary operations, which therefore we refrain from doing in this paper.²²

The overall effect of the LTROs on credit supply conditions implied by both our regression analysis and our event study can be estimated by combining the two sets of results. Figure 3 reports

²¹If anything, the effect of the announcement on the overnight rate and on ten-year yields had the wrong sign. An interpretation is that the market was disappointed by the announcement, because it was expecting an enhancement of the SMP.

²²The decrease of the yields on Italian sovereign bonds started in the second half of January 2012, after a series of successful auctions on the primary market for Italian securities. In January and February, there was positive news on the conclusion of the Greek PSI, on the German contribution to the European Stability Mechanism, and on the new support program for Greece.

Table 6. Effects of LTROs Announcements on Italian Interest Rates^a (basis points)

Event	Money-Market Interest Rates		Sovereign Bond Yields			
	Spread Italian Overnight ^b	Spread Italian Collat. Three-Month ^c	Two-Year BTPs	Two-Year BTPs over IRS	Spread Two-Year BTPs over IRS	Spread Ten-Year BTPs over IRS
Announcement LTROs (Dec. 8, 2011)	23**	-2	31	37**	29	41*
Settlement First LTRO (Dec. 22, 2011)	-76***	-63***	1	19	3	21
Settlement Second LTRO (Mar. 1, 2012)	-37***	-5	-39	-28	-33	-27
Cumulated Change over the Above Events	-90	-70	-8	-28	0	35
Cumulated Change over the Period (Dec. 7, 2011–Mar. 2, 2012)	-103	-99	-391	-108	-356	-64

Notes: ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent level, respectively; statistical significance is not provided for cumulative changes.
^aCumulative two-day change around the announcement.
^bSpread between the overnight interest rates on e-MID and EONIA; overnight interest rate on e-MID computed as a weighted average (by volume of transactions) of the interest rates observed in the small-size and large-size segments of the market.
^cSpreads between the Italian collateralized three-month interest rates and the average collateralized three-month interest rates observed in France and in Germany.

the outcome of a dynamic simulation of equation (2) assuming no LTROs. That is, *LTRO_dummy* is set to 0 and it is assumed that each bank faced an overnight rate 90 basis points higher beginning in 2012:Q1, consistently with the result of the event study. The EURIBOR spread is held constant at the level reached before the LTROs, which corresponds to a maximum of 60 basis points more at the end of 2012.²³ In this simulation the BLS credit conditions index would have been persistently higher by 0.4, mainly reflecting the permanent decrease in the interbank market rates paid by Italian banks. The effect is economically significant, considering that the range of variation of the BLS index is between -1 and 1 .

4.4 Event Study—Outright Monetary Transactions

We perform a second event study to determine the effect of the ECB's OMTs on interest rates. In this case, we consider three events: the speech by ECB President Draghi on July 26, 2012, announcing that the ECB would do "whatever it takes" to contrast yield movements due to redenomination risk, and the ECB Governing Council meetings of August 2 and September 6, 2012, first making public the broad guidelines of the OMTs and then communicating the complete operational details for the operations. For each event, we consider the same set of money-market rates and of sovereign yields as in the previous section.

The results, shown in table 7, are broadly symmetrical to those set out in the previous section. The estimates suggest that the impact of the OMTs on money-market rates was negligible but that on sovereign yields was sizable and almost entirely front-loaded.²⁴

Concerning the yield on government bonds, a large and significant decrease took place around Draghi's speech (table 7, first row). The effect was concentrated on the shorter end of the term structure, where yields decreased by more than 100 basis points, but it also affected the longer end. After the August meeting of the Governing Council, long-term rates did not move, but short-term rates fell

²³Our assessment of the impact of the three-year LTROs on EURIBOR-OIS spreads is in line with the results of Dubecq et al. (2013) summarized in section 2.

²⁴It is not surprising that money markets were not significantly affected, since the OMTs did not involve changes in excess liquidity (at any rate, liquidity was abundant at that time, as a consequence of the three-year LTROs).

Table 7. Effects of OMT Announcements on Italian Interest Rates^a (basis points)

Event	Money-Market Interest Rates		Sovereign Bond Yields			
	Spread Italian Overnight ^b	Spread Italian Collat. Three-Month ^c	Two-Year BTPs	Two-Year BTPs over IRS	Spread Two-Year BTPs over IRS	Spread Ten-Year BTPs over IRS
Draghi's London Speech (Jul. 26, 2012)	-2	-1	-116***	-49***	-112***	-62***
ECB Governing Council (Aug. 2, 2012)	2	-2	-64**	12	-67**	6
ECB Governing Council (Sep. 6, 2012)	-3	-1	-21	-46**	-23	-55**
Cumulative Change over the Above Events	-3	-3	-201	-83	-202	-112
Cumulative Change over the Period (Jul. 25, 2012-Sep. 7, 2012)	-5	4	-270	-139	-255	-145

Notes: ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent level, respectively; statistical significance is not provided for cumulative changes.
^aCumulative two-day change around the announcement.
^bSpread between the overnight interest rates on e-MID and EONIA; overnight interest rate on e-MID computed as a weighted average (by volume of transactions) of the interest rates observed in the small-size and large-size segments of the market.
^cSpreads between the Italian collateralized three-month interest rates and the average collateralized three-month interest rates observed in France and in Germany.

further (table 7, second row). This result is likely to be a consequence of the announcement that interventions were to be concentrated on bonds with short maturities. Long-term rates fell again around the Council's September meeting (table 7, third row). The last two rows of the table suggest that most of the movements in government bond yields and risk premia around event dates were persistent.

5. Macroeconomic Assessment

Using the Bank of Italy's quarterly econometric model, we combine all the estimates obtained in the previous section to assess the effect that the three measures considered had on the main Italian macroeconomic variables. Note that our purpose is not to construct a complete counterfactual macroeconomic scenario, which cannot be done by standard econometric methodologies in view of the powerful non-linear dynamics that would have marked the economic variables in an extreme scenario of complete market collapse, which the ECB's measures may well have averted.²⁵

In order to derive the macroeconomic impact, we construct the time series of the overall effect of the unconventional measures on interbank rates, on the yields on one- and ten-year Treasury securities, and on the index of credit conditions over the period 2012–13. We then impose these “shocks” on the BIQM and run a simulation. By comparing the results with actual data, we derive a measure of the responses of the main Italian macroeconomic variables to the unconventional monetary measures.

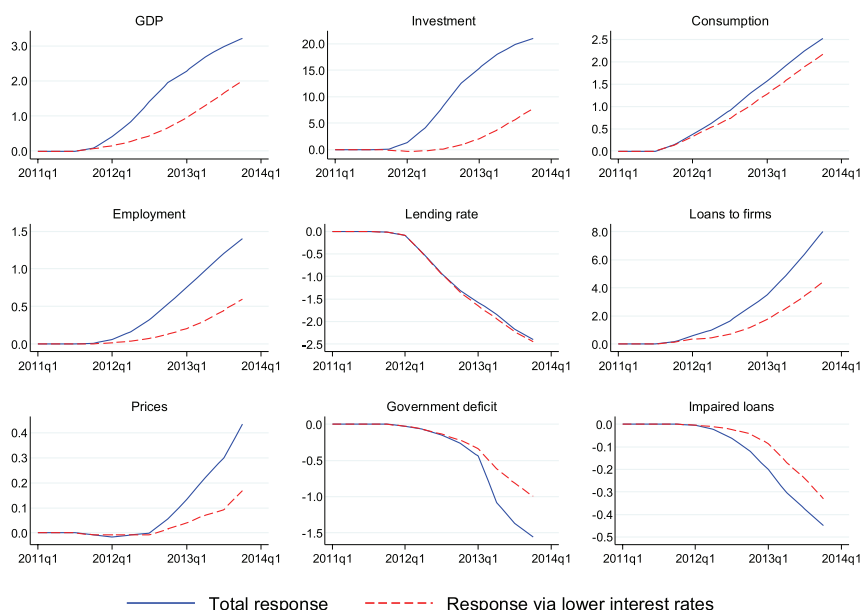
The set of shocks imposed on the model is described in table 8. The Italian overnight unsecured rate and the three-month collateralized rate are 70 and 90 basis points higher, respectively, from the first quarter of 2012 on. Absent the impact of SMP, the one-year and ten-year yields are 120 basis points higher in third-quarter 2011

²⁵The possible counterfactual of a larger, non-linear market collapse would imply that our estimates of the effects of policy interventions may be significantly understated. However, it must also be considered the existence of a different alternate scenario, in which credit and financial markets would have gradually stabilized within the simulation horizon even without the adoption of unconventional monetary measures. In that case, the ECB actions would have had a temporary effect that dissipated over time and our estimates would be overstated, at least in terms of their permanent effect.

Table 8. Summing-Up of the Main Results

	Approach	Main Findings	Overall Estimated Effects
SMP	Time-Series Regressions	Interventions by the Eurosystem significantly affect the level of Italian government bond yields.	Ten-year and two-year BTP: Cumulative decrease by about 200 bp starting from 2011:Q3.
Three-Year LTROs	Time-Series Regressions	The Italian BLS credit supply index was significantly affected by the LTROs (both directly and through reduction of premia in interbank market).	BLS supply index: permanent decrease by about 0.4 beginning in 2012:Q1.
	Event Study	When the LTROs were implemented, premia on the Italian interbank market fell (while bond yield did not react).	Premia on Italian interbank market: permanent decrease by 70–100 bp starting from 2012:Q1.
OMTs	Event Study	At dates of OMTs announcements, premia on Italian medium- and long-term BTPs fell (while interbank interest rates did not react).	Ten-year BTP yields: cumulative decrease by 95 bp starting from 2012:Q3. Two-year BTP yields: cumulative decrease by 180 bp starting from 2012:Q3.

Figure 6. Response of Selected Variables to the Unconventional Monetary Measures



Notes: The difference between the solid line and the dashed line represents the response via improvement in credit availability.

and 200 points higher starting the next quarter. When excluding the effect of the OMTs, the short-term and the long-term rates on sovereign bonds increase by an additional 180 and 95 basis points starting from the fourth quarter of 2012. Finally, we consider a permanent upward shift of the BLS credit supply index (by 0.4), starting from the first quarter of 2012.

Figure 6 reports the responses of output, investment, consumption, employment, loan rates, credit supply, prices, the government budget deficit, and banks' new non-performing loans to the unconventional monetary measures. For each variable, the solid line shows the response over the period 2011–13, which is the percent deviation from the “no-policy” scenario.²⁶ The dashed line corresponds to the

²⁶The responses of interest rates, the deficit-to-GDP ratio, and the ratio of bad loans are in terms of absolute differences.

portion of the response due to the interest rate component of the unconventional instruments.²⁷ The distance between the solid and the dashed lines represents the portion of the effect on each variable that is due to the improved credit availability.

Four considerations stand out. First, the effects of the unconventional measures on the real economy are certainly substantial. At the end of 2013, GDP is higher by around 3 percent. Most of the positive impact results from an increase in investment, which is 21 percent higher, due to its large sensitivity to credit conditions. Consumption reacts comparatively less, being about 2.5 percent higher at the end of 2013. The more subdued response of consumption to changes in interest rates and credit availability reflects, among other factors, the relatively low indebtedness of Italian households. Moreover, a relatively large share of Italian household wealth consists in housing and is thus associated with a low propensity to consume out of capital gains. Overall, the effect on the labor market is substantial, with employment almost 1.5 percent higher at the end of the simulation horizon. Given these results, we conclude that while the considered unconventional measures were unable to prevent recession, they avoided a much deeper depression for the Italian economy. The average yearly effect of the unconventional policy measures, summarized in table 9, indicates that the Italian GDP growth rate would have been lower by 1.1 percentage points in 2012 and 1.6 points in 2013.²⁸

Second, the cost and quantity of bank loans respond strongly, indicating the relevance of the credit channel. Lending rates are almost 2.5 percentage points lower than in the “no-policy” scenario at the end of 2013, while lending to firms is 8 percent higher, due to the loosening of credit constraints and the decrease in rates. Once again, the credit responses indicate that the unconventional operations may have averted an even worse situation. Although bank lending continued to decrease in Italy in 2012, the direct effect on supply conditions measured by the BLS and the transmission of lower sovereign yields to bank lending rates via the interest rate structure greatly attenuated the decline in lending to firms, both in

²⁷This is calculated as the response obtained keeping credit availability in line with actual data.

²⁸Italian GDP shrank by 2.4 percent in 2012 and 1.9 percent in 2013.

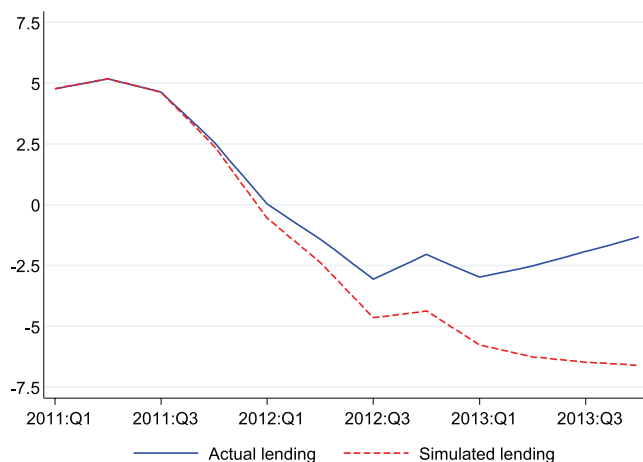
Table 9. Macroeconomic Effects of the Unconventional Shocks (growth rates, differences with respect to the “no-policy” scenario; percentage points)

	Total		Via Interest Rates		Via Credit Availability	
	2012	2013	2012	2013	2012	2013
GDP	1.1	1.6	0.4	1.1	0.7	0.6
Exports	0.1	0.0	0.0	0.0	0.1	0.0
Imports	2.6	3.1	0.5	1.8	2.2	1.6
Household Consumption	0.7	1.2	0.6	1.0	0.1	0.2
Investment	5.4	10.3	0.1	4.3	5.4	6.5
– In Machinery	12.5	21.7	0.0	6.3	12.7	16.5
– In Construction	0.4	3.8	0.3	3.0	0.1	0.8
– Residential	0.4	3.7	0.4	3.3	0.0	0.4
Lending to Firms	1.4	4.0	0.6	2.3	1.0	1.8
Consumer Credit	0.8	3.0	0.8	2.9	0.0	0.2
Mortgages	1.5	6.5	1.4	6.1	0.0	0.4
Consumption Deflator	0.0	0.2	0.0	0.1	0.0	0.1
Unemployment Rate	−0.2	−1.5	−0.2	−0.9	0.0	−0.5
Government Deficit (%GDP)	−1.1	−1.6	−0.4	−1.1	−0.7	−0.6

Source: Bank of Italy quarterly model simulation.

Notes: The effects via interest rates and credit availability may not add up to the total effect reported in the table due to rounding and non-linearities in the BIQM.

Figure 7. Lending to Firms: Actual and Simulated Dynamics (twelve-month percent growth)



Notes: The simulated profile posits the absence of unconventional policy measures.

2012 and in 2013 (see figure 7).²⁹ The former effect is consistent with recent work by Del Giovane, Nobili, and Signoretti (2013) who, using micro data on bank loans and information from the BLS survey, estimate the effect of the tightening of credit conditions triggered by the sovereign debt crisis on credit growth. The latter is consistent with the findings of Albertazzi et al. (2012) that sovereign spreads were largely transmitted to bank lending rates.

Third, the improvement in credit availability is an important channel for the transmission of unconventional measures to the economy. As shown in figure 6, the loosening of constraints on credit availability, measured by the difference between the solid and the dashed lines, accounts for two-thirds of the GDP response at the end of 2012 and for almost half at the end of 2013. For investment in machinery, the contribution is greater still. The effects of lower interest rates build up more slowly, but they are economically significant at the end of the simulation horizon.

²⁹Lending to Italian firms fell by 2.0 percent year on year in 2012.

Fourth, unconventional operations also had major effects on other variables. For instance, the ratio of the government budget deficit-to-GDP ratio decreases by 1.6 percentage points at the end of the simulation horizon, and the improvement is due not only to the effect of lower yields on interest outlays but also to higher growth. The flow of new impaired bank loans, as a ratio to outstanding credit, also decreases substantially, a decline estimated at almost 0.4 percentage point at the end of 2013. The amelioration in credit quality reflects the effect of lower interest rates and higher growth on firms' profits and cash flow.

6. Conclusions

In order to estimate the impact of the non-standard measures adopted by the ECB in 2011 and 2012 (SMP, three-year LTROs, OMTs) on the Italian economy, we first adopted specific estimation approaches to measure the impact on money-market interest rates, government bond yields, and credit availability and then mapped the estimated effects onto their macroeconomic implications, taking advantage of the Bank of Italy quarterly model of the Italian economy.

The first conclusion is that the SMP has been effective in contrasting undue increases in government bond yields. This conclusion is based on a set of regressions linking daily changes in bond yields with SMP purchases and a series of control variables. The estimates indicate that the effect of the SMP on Italian government bond yields is around 2 basis points per billion euros purchased. Once standardized for the different size of the economy, the impact on yields was much larger than the range of those reported for U.S. large-scale asset purchases. This finding is consistent with the view that asset purchases are more effective when addressing market disruptions than when aimed at addressing a zero-lower-bound problem.

Second, the LTROs had a significant impact on credit supply, mainly through a sizable reduction in money-market spreads, associated with the revival of the interbank market. Although bank lending continued to decrease in Italy in 2012, this result suggests that the unconventional operations may have avoided a much more severe credit restriction and helped to counteract the decline in lending to firms in both 2012 and 2013.

Third, the announcement and the design of the OMTs had very large front-loaded effects on the sovereign bond market. Yields on Italian government bonds decreased sharply after President Draghi's speech at the end of July 2012, and the improvement was reinforced by the ECB Governing Council announcements in early August and September.

From a macroeconomic perspective, our simulations indicate that the unconventional measures have had a powerful effect on the Italian economy through several channels. Based on the standard elasticities included in the BIQM, the cumulative GDP growth response comes to 2.7 percentage points over the period 2012–13. One of the main channels of transmission is the improvement in credit availability—in particular, through its impact on investment.

The simulations also show that the set of unconventional operations had a favorable effect on relevant macroeconomic variables that are usually not emphasized in discussions on the effectiveness of monetary policy. We find that the deficit-to-GDP ratio improves greatly thanks to the combination of lower interest expenses and higher growth. The flow of new impaired bank loans decreases, as lower interest rates and higher growth support businesses' profits and cash flow. There accordingly appears to be good reason to believe that the unconventional policies helped avoid a further worsening of the adverse spiral between sovereigns, banks, and growth.

The Securities Markets Programme, the three-year longer-term refinancing operations, and the Outright Monetary Transactions, however, did not prevent the Italian economy from falling into recession. Over the time horizon considered in this paper, interest rates did not completely regain their pre-crisis levels, credit conditions remained relatively tight, and business lending continued to contract, although less sharply than would otherwise have been the case. Partly, this reflects the incomplete institutional framework of the monetary union that prevented a more intensive use of other tools, like fiscal policy.³⁰ It may also suggest, however, that more aggressive monetary policy could have been beneficial for countries under stress, and ultimately for the whole euro area.³¹

³⁰See Draghi (2014).

³¹See Rossi (2014).

All in all, however, the evidence presented in this paper strongly supports the argument that the unconventional monetary measures implemented by the ECB were far from ineffective; they significantly supported economic activity by avoiding a further downward spiral of the crisis of confidence and a much more severe credit crunch.

References

- Albertazzi, U., T. Ropele, G. Sene, and F. M. Signoretti. 2012. "The Impact of the Sovereign Debt Crisis on the Activity of Italian Banks." Occasional Paper No. 133, Bank of Italy.
- Bank of Italy. 2013. "The Sovereign Debt Crisis and the Revision of the Growth Projections." In *Economic Bulletin* No. 67 (box on p. 37).
- Busetti, F., A. Locarno, and L. Monteforte. 2005. "The Bank of Italy's Quarterly Model." In *Econometric Models of Euro Area Central Banks*, ed. G. Fagan and J. Morgan. Cheltenham, UK: Edward Elgar.
- Cecioni, M., G. Ferrero, and A. Secchi. 2011. "Unconventional Monetary Policy in Theory and in Practice." Occasional Paper No. 102, Bank of Italy.
- Chen, H., V. Cúrdia, and A. Ferrero. 2012. "The Macroeconomic Effects of Large-scale Asset Purchase Programmes." *Economic Journal* 122 (564): F289–F315.
- Christensen, J., and G. Rudebusch. 2012. "The Response of Interest Rates to US and UK Quantitative Easing." *Economic Journal* 122 (564): F385–F414.
- Chung, M., J.-P. Laforte, D. Reifschneider, and J. C. Williams. 2012. "Have We Underestimated the Likelihood and Severity of Zero Lower Bound Events?" *Journal of Money, Credit and Banking* 44 (s1): 47–82.
- Ciccarelli, M., A. Maddaloni, and J.-L. Peydró. 2013. "Heterogeneous Transmission Mechanism: Monetary Policy and Financial Fragility in the Euro Area." ECB Working Paper No. 1527.
- Cúrdia, V., and M. Woodford. 2011. "The Central-Bank Balance Sheet as an Instrument of Monetary Policy." *Journal of Monetary Economics* 58 (1): 54–79.

- D'Amico, S., and T. King. 2013. "Flow and Stock Effects of Large-Scale Treasury Purchases: Evidence on the Importance of Local Supply." *Journal of Financial Economics* 108 (2): 425–48.
- Darracq-Paries, M., and R. De Santis. 2013. "A Non-Standard Monetary Policy Shock: The ECB's 3-year LTROs and the Shift in Credit Supply." ECB Working Paper No. 1508.
- De Pooter, M., R. F. Martin, and S. Pruitt. 2013. "The Liquidity Effects of Official Bond Market Intervention." International Finance Discussion Paper No. 1138, Board of Governors of the Federal Reserve System. Available at <http://ssrn.com/abstract=2143326>.
- Del Giovane, P., A. Nobili, and F. M. Signoretti. 2013. "Supply Tightening or Lack of Demand: Is the Sovereign Debt Crisis different from Lehman?" In *The Sovereign Debt Crisis and the Euro Area*, Bank of Italy Workshops and Conferences Series No. 14.
- Di Cesare, A., G. Grande, M. Manna, and M. Taboga. 2012. "Recent Estimates of Sovereign Risk Premia for Euro-Area Countries." Occasional Paper No. 128, Bank of Italy.
- Draghi, M. 2014. "Unemployment in the Euro Area." Speech at the Economic Policy Symposium, Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, August 22.
- Dubecq, S., A. Monfort, J.-P. Renne, and G. Roussellet. 2013. "Credit and Liquidity in Interbank Rates: A Quadratic Approach." Working Paper No. 446, Bank of France.
- Eser, F., M. Carmona Amaro, S. Iacobelli, and M. Rubens. 2012. "The Use of the Eurosystem's Monetary Policy Instruments and Operational Framework Since 2009." ECB Occasional Paper No. 135.
- Eser, F., and B. Schwaab. 2013. "Assessing Asset Purchases within the ECB's Securities Markets Programme." ECB Working Paper No. 1587.
- European Central Bank. 2011. "The ECB's Non-Standard Measures — Impact and Phasing Out." *Monthly Bulletin* (July): 55–69.
- Gagnon, J., and M. Hinterschweiger. 2013. "Responses of Central Banks in Advanced Economies to the Global Financial Crisis." In *Responding to Financial Crisis: Lessons from Asia Then, the United States and Europe Now*, ed. C. Rhee and A. Posen, chapter 3. Washington, DC: Peterson Institute for International Economics and Asian Development Bank.

- Gagnon, J., M. Raskin, J. Remache, and B. Sack. 2011. "The Financial Market Effects of the Federal Reserve's Large-Scale Asset Purchases." *International Journal of Central Banking* 7 (1): 3–43.
- Gaiotti, E. 2013. "Credit Availability and Investment: Lessons from the 'Great Recession'." *European Economic Review* 59 (April): 212–27.
- Gambacorta, L., B. Hofmann, and G. Peersman. 2012. "The Effectiveness of Unconventional Monetary Policy at the Zero Lower Bound: A Cross-Country Analysis." BIS Working Paper No. 384.
- Gertler, M., and P. Karadi. 2011. "A Model of Unconventional Monetary Policy." *Journal of Monetary Economics* 58 (1): 17–34.
- Ghysels, E., J. Idier, S. Manganelli, and O. Vergote. 2014. "A High Frequency Assessment of the ECB Securities Markets Programme." ECB Working Paper No. 1642.
- Giannone, D., M. Lenza, H. Pill, and L. Reichlin. 2011. "Non-Standard Monetary Policy Measures and Monetary Developments." ECB Working Paper No. 1290.
- . 2012. "The ECB and the Interbank Market." *Economic Journal* 122 (564): 467–86.
- Giordano, R., M. Pericoli, and P. Tommasino. 2013. "'Pure' or 'Wake-up-Call' Contagion? Another Look at the EMU Sovereign Debt Crisis." Working Paper No. 904, Bank of Italy.
- Hamilton, J., and J. C. Wu. 2011. "The Effectiveness of Alternative Monetary Policy Tools in a Zero Lower Bound Environment." *Journal of Money, Credit and Banking* 44 (s1): 3–46.
- International Monetary Fund. 2013. "Unconventional Monetary Policies—Recent Experience and Prospects." IMF Policy Paper (April).
- Kapetanios, G., M. Haroon, S. Ibrahim, and T. Konstantinos. 2012. "Assessing the Economy-wide Effects of Quantitative Easing." *Economic Journal* 122 (564): F316–F347.
- Kozicki, S., E. Santor, and L. Suchanek. 2011. "Unconventional Monetary Policy: The International Experience with Central Bank Purchases." *Bank of Canada Review* (Spring): 13–25.
- Krishnamurthy, A., and A. Vissing-Jorgensen. 2011. "The Effects of Quantitative Easing on Interest Rates." *Brookings Papers on Economic Activity* (Fall): 215–65.

- Lenza, M., H. Pill, and L. Reichlin. 2010. "Monetary Policy in Exceptional Times." ECB Working Paper No. 1253.
- Locarno, A., and A. Secchi. 2009. "Unconventional Monetary Policies: Some Tentative Evidence for Italy." Mimeo, Bank of Italy.
- Meier, A. 2009. "Panacea, Curse or Non-Event? Unconventional Monetary Policy in the United Kingdom." IMF Working Paper No. 09/163.
- Neri, S., and T. Ropele. 2013. "The Macroeconomic Effects of the Sovereign Debt Crisis in the Euro Area." In *The Sovereign Debt Crisis and the Euro Area*, Bank of Italy Workshops and Conferences Series No. 14.
- Peersman, G. 2011. "Macroeconomic Effects of Unconventional Monetary Policy in the Euro Area." ECB Working Paper No. 1397.
- Rodano, L. 2011. "Simulating the Impact of Credit Restrictions on the Italian Economy." Mimeo, Bank of Italy.
- Rossi, S. 2014. "Monetary Policy and the Independence of Central Banks: The Experience of the European Central Bank in the Global Crisis." Speech at the University of Verona, November 19.
- Santor, E., and L. Suchanek. 2013. "Unconventional Monetary Policies: Evolving Practices, Their Effects and Potential Costs." *Bank of Canada Review* (Spring): 1–15.
- Secchi, A. 2012. "The Effectiveness of the Securities Market Programme: A First Assessment." Mimeo, Bank of Italy.
- Stein, J. 2012. "Evaluating Large-Scale Asset Purchases." Speech at the Brookings Institution, Washington, DC, October 11.
- Stiglitz, J. 2012. "Monetary Mystification." *Project Syndicate*, October 4.
- Stone, M., K. Fujita, and K. Ishi. 2011. "Should Unconventional Balance Sheet Policies Be Added to the Central Bank Toolkit? A Review of the Experience So Far." IMF Working Paper No. 11/145.
- Swanson, E. T. 2011. "Let's Twist Again: A High-Frequency Event-Study Analysis of Operation Twist and Its Implications for QE2." *Brookings Papers on Economic Activity* (Spring).
- Visco, I. 2013. Speech at the 19th ASSIOM FOREX Congress, Bergamo, Italy, February 9.

- Weidmann, J. 2012. "Monetary Policy Is No Panacea for Europe." *Financial Times*, May 7.
- Williams, J. 2014. "Monetary Policy and the Zero Lower Bound: Putting Theory into Practice." Hutchins Center for Fiscal and Monetary Policy at the Brookings Institution.

The Transmission of Federal Reserve Tapering News to Emerging Financial Markets*

Joshua Aizenman,^a Mahir Binici,^b and Michael M. Hutchison^c

^aUniversity of Southern California and NBER

^bCentral Bank of Turkey

^cUniversity of California, Santa Cruz

This paper evaluates the impact of tapering “news” announcements by Federal Reserve senior policymakers on financial markets in emerging economies. We apply a panel framework using daily data, and find that emerging-market asset prices respond most to statements by Federal Reserve Chairman Bernanke, and much less to other Federal Reserve officials. We group emerging markets into those with “robust” fundamentals (current account surpluses, high international reserves, and low external debt) and those with “fragile” fundamentals and, intriguingly, find that the exchange rates of the robust group (and, to a lesser extent, equity prices and CDS spreads) were more adversely affected by tapering news than the fragile group. The cumulative effects of tapering announcements after a month, however, appear to be quite similar for both robust and fragile emerging markets.

We also show that more financially developed economies are more affected by tapering news, and a plausible interpretation is that more financially developed economies are more exposed, at least in the short term, to external news announcements.

JEL Codes: F3, F36, G14.

*We thank the editor of this journal and three anonymous referees for very helpful suggestions on an earlier draft of this paper. Author e-mails: aizenman@usc.edu; mahir.binici@tcmb.gov.tr; and hutch@ucsc.edu.

1. Introduction

The quantitative easing (QE) policies of the U.S. Federal Reserve in the years following the crisis of 2008–9 included monthly securities purchases of long-term Treasury bonds and mortgage-backed securities totaling \$85 billion in 2013. The cumulative outcome of these policies has been the unprecedented increase of the monetary base, mitigating the deflationary pressure of the crisis. The resultant lower interest rates and flattened yield curve improved financial conditions and helped stimulate real economic activity, yet the QE policy raised pertinent questions regarding the timing and the nature of the exit strategy (Williams 2011, 2012). These issues came to the fore in 2013, with vigorous and intensifying debate among policymakers and market participants about the exit strategy from the massive monetary stimulus. The growing frequency of public statements by the Federal Reserve's governors and presidents, combined with occasional press releases, have been the focus of the financial media, changing expectations and moving market prices. This process culminated on December 18, 2013, when the Federal Reserve decided at the Federal Open Market Committee (FOMC) meeting (as announced in the public statement) to taper its quantitative easing policy by \$10 billion per month, to \$75 billion. Chairman Bernanke also projected the program to wind down steadily through 2014 and conclude by year-end, assuming the economy remained healthy. Subsequent announcements gave news of a gradually reduced QE, and the pattern continued after the appointment of Chair Yellen.

An important feature of quantitative easing and unprecedentedly low U.S. interest rates is that it led to large short-term capital inflows to a number of emerging markets, which in turn led several to impose capital controls, such as Brazil, Indonesia, South Korea, and others (Ahmed and Zlate 2013). Quantitative easing led the U.S. dollar to be the funding currency in large-scale carry-trade activity with emerging markets as the target currencies. The concern with tapering is the flip side: potentially disruptive large-scale capital outflows from emerging markets as carry-trade activity is unwound in expectation of tapering (and, eventually, reduction in the Federal Reserve balance sheet through sales of assets, not just reduction in the pace of purchases) and hints at future interest rate increases.

Large capital outflows could create disruptions in financial markets and eventually real economic activity in emerging markets.

This paper evaluates whether tapering announcements have disrupted financial markets in emerging economies. We investigate the impact of tapering “news” announcements by Federal Reserve senior policymakers on financial asset prices in emerging markets. The emerging markets’ financial asset prices of interest are national stock markets, exchange rates, and credit default swaps (CDS) spreads. These reflect a broad spectrum of the potential effects of tapering, where we would expect greater likelihood of tapering, and hence capital outflows, from emerging markets, to cause a fall in equity markets, depreciation of exchange rates, and an increase in CDS spreads (reflecting greater uncertainty and risk in sovereign bond markets). In terms of Federal Reserve “news,” we focus on statements from Federal Reserve Chairman Bernanke, Federal Reserve Board governors, and Federal Reserve Bank presidents, as well as FOMC statements and minutes. Our presumption is that it is important to differentiate between announcements/statements by the Chair, who is the public face and most important Federal Reserve policymaker, and other Federal Reserve policymakers (governors and presidents).

We employ daily data during November 2012 and October 2013. Statements about the likelihood of future tapering, or scaling back the large-scale asset purchase program (LSAP), began to emerge in late 2012, marking the beginning of our sample period. However, during this period there were also frequent and forceful statements by Federal Reserve officials about the need to continue quantitative easing, so these statements were also included as “news” in our investigation both to address issues of symmetry and to judge market impacts.

The methodology of the paper is a quasi-event study, akin to Dooley and Hutchison (2009), tracing the impact of evolving narrative about the expectation of future tapering, as revealed to the public through the news media, on key emerging-market prices. We use a panel fixed-effect framework using daily data with a variety of models to evaluate the impact of “news” on the three assets prices (stock market, exchange rate, and CDS spreads). Moreover, we explore whether market responses to tapering “news” are different across emerging markets, perhaps differentiated by the relative strength of their economic fundamentals. In particular, we exploit

the heterogeneity among the emerging markets, evaluating the association between asset price movements and key characteristics associated with “fragility” or “robustness” of a country, where these characteristics are defined by their current account, international reserve, and foreign indebtedness positions.

Previewing results, we find that emerging-market asset prices respond most to statements by Federal Reserve Chairman Bernanke, and much less to the frequent, divergent, and sometimes inconsistent statements by other Federal Reserve officials. This finding is consistent with the power of the Chairman to set and affect the agenda, and with the advantage of more frugal and clear communication. We group emerging markets into those with “robust” fundamentals (ten countries) and those with “fragile” fundamentals (sixteen countries) and, intriguingly, find that stronger countries, on average, were generally more adversely exposed in the short run to tapering news than the countries with weak fundamentals, especially in the depreciation of their currencies. In particular, the exchange rate depreciated in both groups immediately following tapering news from Chairman Bernanke, yet the depreciations of the stronger group were three times as large as the weaker group. Looking at these linkages in detail, we find that higher current account balances, higher foreign exchange rate reserves, and lower external debt are associated with greater exchange rate depreciation following Bernanke tapering announcements. Over the period of a month, however, we find asset price movements to tapering announcements are quite similar for both the fragile and robust groups. Finally, we find that more financially developed emerging markets were also more affected by Bernanke tapering announcements.

A possible interpretation of these findings is that countries with weaker fundamentals and less financial development were less exposed to the inflows triggered by quantitative easing, and exchange rates responded less, in line with the conjecture that being closer to financial autarky provides deeper insulation from financial news. The flip side is that tapering news had less impact on exchange rates in these countries. Yet, these findings are also consistent with a less sanguine interpretation, reflecting financial markets’ initial inattention to tail risks, overlooking the vulnerability of the weaker emerging markets to the adverse implications of higher future global interest rates. Indeed, in the last quarter of 2013, financial markets refocused

attention on the fragile emerging markets, with depressed financial asset prices of the “Fragile Five”—Brazil, India, Indonesia, South Africa, and Turkey—a subgroup of the weaker emerging markets.¹ Interestingly, however, it appears that differential responses between the fragile and robust group tend to dissipate over time.

The methodology of our paper complements Eichengreen and Gupta (2014), who used data for exchange rates, foreign reserves, and equity prices between April and August 2013 to analyze who was hit and why. They concluded that better fundamentals did not provide insulation. Instead, countries with larger markets experienced more pressure on the exchange rate, foreign reserves, and equity prices. Our focus on the event methodology allows us to trace the immediate impact effect of the coming news on expectation of adjustment, as reflected in the changes of key prices triggered by the news.

The next section presents the data and methodology of the study. Section 3 presents the main results. Section 4 presents extensions and robustness checks of the basic models. Section 5 concludes.

2. Data and Methodology

2.1 Data

Our objective is to evaluate the transmission of U.S. tapering “news” to financial markets in emerging markets. In undertaking this analysis, we consider announcements associated with support (or actions) of quantitative easing as well as tapering. During the period of time under investigation—November 27, 2012 through October 3, 2013—there were numerous statements in support of both policies by Chairman Bernanke, Federal Reserve governors, Federal Reserve Bank presidents, and the FOMC statement following meetings, as well as FOMC minutes from past meetings. This allows us to evaluate the symmetry of the effects of the announcements, not only for QE and tapering but also for different sources of the statements. In

¹The market inattention to tail risks was vividly illustrated by the euro crisis, where the pre-crisis sovereign spreads of Greece, Portugal, and Spain were comparable to that of Germany and other euro-zone core countries (Aizenman, Hutchison, and Jinjarak 2013). See also Aizenman, Binici, and Hutchison (2013) for an overview of other issues in the pricing of risk during the euro crisis.

particular, we focus on six types of announcements from the Federal Reserve: statements by Federal Reserve Chairman Bernanke, either in support of further quantitative easing (QE) or tapering (Tap); release of statements following the FOMC meetings either supporting further QE or Tap; and statements by governors of the Federal Reserve System (other than Bernanke) or by presidents of the Federal Reserve Banks either supporting QE or Tap.

To gather this information, we conducted two sets of news searches on Bloomberg. The first search was for the keywords “QE Federal.” Additionally, to focus on the tapering aspect of the QE announcements, another search was performed for the keywords “Federal Reserve Bank of,” “QE,” and “Fed Taper.” A filter was applied to select “News” for both searches. To verify whether the announcement and speech “news” were coded consistently with how they were perceived by the markets in the United States (not emerging markets), we examined articles and other publications from the Factiva database. We utilized the date and topic filtering available in the database to solicit descriptions of the perception as well as the corresponding market reactions of the announcement/speech. We closely examined each of the original Bloomberg coding for announcements to determine whether they matched the perceptions found in the Factiva publications. There were many more announcements/statements/speeches on these topics than were coded. In order to be coded as either supporting further (or continuing) QE or tapering, the announcements needed to be unambiguous.

Table 1 presents some summary statistics on our announcements as well as examples of announcement coding and the division between “tapering” and “quantitative easing.” We found three cases (seven cases) where Chairman Bernanke clearly indicated tapering was a favored policy option (further or continuing QE was a favored policy option); five cases where the FOMC statements/minutes clearly favored QE (and none clearly favored tapering); and a rough balance between governors/presidents speaking unambiguously in favor of QE (twenty-two cases) or tapering (twenty-six cases).

We consider three main conduits through which these variables may affect emerging markets: daily changes in national stock markets (log first differences), daily changes in foreign exchange rates (log first differences), and daily changes in CDS spreads (in basis points). If tapering is expected to reduce financial flows to emerging

Table 1. Number and Examples of Taper and QE “News” Events
(November 27, 2012–October 3, 2013)

No. of Events	Source of Events					
	Chairman Bernanke		Governor/President		FOMC	
	Tapering	QE	Tapering	QE	Tapering	QE
	3	7	26	22	0	5
	Aggregate					
					29	33
Examples of Announcements (Congressional Testimony, Speeches, FOMC Statements, etc.)						
Ben Tap (Bernanke Tapering)	May 22, 2013: Bernanke said the Federal Reserve could “take a step down in our pace of purchases” in the “next few meetings” in testimony to the Joint Economic Committee of Congress. January 24, 2013 Testimony to Senate Banking Committee: “We do not see the potential costs of the increased risk-taking in some financial markets as outweighing the benefits of promoting a stronger economic recovery. Inflation is currently subdued, and inflation expectations appear well anchored.” Bernanke used his testimony to push back against colleagues on the FOMC who favored curtailing the \$85 billion in monthly bond buying. June 3, 2013: Federal Reserve Bank of San Francisco President John Williams said policymakers may start reducing the pace of bond purchases over the next three months and potentially end quantitative easing by year-end. He said that with continued “good signs” on jobs and confidence in a “substantial improvement” he could see as “early as this summer some adjustment, maybe modest adjustment downward, in our purchase program.”					
Ben QE (Bernanke Quantitative Easing)						
Gov/Pres Tap (Federal Reserve Governor or Federal Reserve Board President Tapering)						

(continued)

Table 1. (Continued)

	Source of Events					
	Chairman Bernanke		Governor/President		FOMC	
	Tapering	QE	Tapering	QE	Tapering	QE
No. of Events	3	7	26	22	0	5
<i>Examples of Announcements (Congressional Testimony, Speeches, FOMC Statements, etc.)</i>						
Gov/Pres QE (Federal Reserve Governor or Federal Reserve Board President Quantitative Easing)	March 27, 2013: Two regional Federal Reserve presidents said they want the Federal Reserve to keep buying bonds through the end of 2013, while a third official said the central bank isn't doing enough to spur economic growth. "We should continue our large-scale asset purchases of Treasury and mortgage-backed securities through this year—although the amount may need to be adjusted up or down, depending on how the economic situation evolves," Federal Reserve Bank of Boston President Eric Rosengren said in a speech in Manchester, New Hampshire. "This is a point when we have to be patient and let our policies work," with stimulus "firing on all cylinders," Federal Reserve Bank of Chicago President Charles Evans said to reporters.					
FOMC QE (FOMC Quantitative Easing)	May 1, 2013 FOMC Meeting Statement: The Federal Reserve said it will keep buying bonds at a monthly pace of \$85 billion while standing ready to raise or lower purchases as economic conditions evolve. The purchases will remain divided between \$40 billion a month of mortgage-backed securities and \$45 billion a month of Treasury securities.					

markets, then we would expect national equity markets to fall, exchange rates to depreciate, and (perhaps) CDS spreads to rise. We focus on twenty-six emerging markets, shown in table 2. (The “fragile” and “robust” groups and statistics are explained below.) Emerging markets were required to have stock market and CDS price data for the entire sample period to be included in the sample.

2.2 Methodology

We employ panel fixed-effect estimation techniques to estimate the impact of U.S. Federal Reserve announcements on financial market prices in emerging markets. We estimate a panel data model of the following form:

$$\begin{aligned} \Delta P_{it} = & \beta_0 + \beta_1 Ben\ Tap_t + \beta_2 Ben\ QE_t + \beta_3 GovPres\ Tap_t \\ & + \beta_4 GovPres\ QE_t + \beta_5 FOMC\ QE_t + \mu_i + \varepsilon_{it}, \end{aligned} \quad (1)$$

where ΔP_{it} is the log first difference in foreign exchange rates, national equity markets, or the change in CDS spread for country i at time t . $Ben\ Tap_t$ ($Ben\ QE_t$) are statements supporting tapering (further quantitative easing) by Chairman Bernanke at time t ; $GovPres\ Tap_t$ ($GovPres\ QE_t$) are statements by Federal Reserve Board governors or Federal Reserve Bank presidents in support of tapering (further quantitative easing); and $FOMC\ QE_t$ are official statements following FOMC meetings supporting further quantitative easing. (No official FOMC statements supporting tapering were identified during this sample period.)

We find no evidence of dynamic adjustment in asset price movements (log first differences in equity markets and exchange rates, first differences in CDS spreads) and considered all news events emanating from the United States as strictly exogenous for emerging markets. We therefore estimate the model as a static panel with country fixed effects. We report robust standard errors clustered with countries, and do not find any evidence of serial correlation in residuals. To take time differences between U.S. and Asian markets countries into account, all Federal Reserve announcements (independent variables) are lagged one day for South Korea, Malaysia, Philippines, Thailand, China, Indonesia, India, and Pakistan. For the rest of the countries, news events are entered in the model contemporaneously.

Table 2. Emerging-Market Sample

Country	CAB/GDP (%)	Reserves/GDP (%)	External Debt/GDP (%)
<i>Robust Group</i>			
Peru	-4.89	31.11	25.72
Israel	2.33	28.68	37.00
Korea	4.61	26.86	37.74
Malaysia	3.49	43.11	32.87
Philippines	2.51	27.04	30.34
Thailand	0.11	41.09	37.04
Bulgaria	1.15	32.66	72.56
Russia	2.89	22.44	31.56
China	2.50	39.32	8.99
Hungary	2.22	34.22	136.53
<i>Fragile Group</i>			
Turkey	-7.38	12.85	43.30
South Africa	-6.07	11.82	34.40
Argentina	-0.75	7.13	24.25
Brazil	-3.38	16.75	19.74
Chile	-4.58	14.55	42.61
Colombia	-3.22	10.82	22.18
Mexico	-1.34	12.37	29.90
India	-4.41	15.02	20.85
Indonesia	-3.41	12.55	25.86
Pakistan	-0.97	3.10	24.49
Ukraine	-7.29	12.37	78.49
Czech R.	-1.76	21.75	52.33
Latvia	-1.14	23.82	140.82
Lithuania	-0.26	15.15	79.00
Poland	-3.03	20.03	75.37
Romania	-1.96	22.95	77.38
Notes: Current account balance (in percent of GDP) and international reserves (in percent of GDP) data is taken from the International Monetary Fund's World Economic Outlook Database, and external debt (in percent of GDP) is from the Central Intelligence Agency's <i>World Factbook</i>. A country is grouped under "robust" or "fragile" based on whether it has current account surplus, high reserves, and low external debt. Thus, if at least two of three (or three of three) of the above criteria holds, then a country is in the "robust group"; otherwise, it is in the "fragile group." Low international reserve level is defined as a reserves/GDP ratio below 20 percent, and low external debt is defined as an external debt/GDP ratio less than 34 percent. Both cut-off points are the median values of their respective samples.			

Recognizing the substantial heterogeneity among the twenty-six emerging markets, we grouped the emerging markets according to three fragility/strength criteria: current account deficits or surpluses; low or high international reserves; and high or low external debts.² We estimated the effects of “news” on the full sample as well as the two subgroups (“robust” and “fragile”). We also grouped countries by their level of financial development (“low” or “high”). As discussed in the introduction, we anticipate different reactions to news depending on the state of the emerging-market economy.

3. Results

3.1 *Full-Sample Results*

Table 3 reports the impact of the tapering and QE news on the stock market indices, exchange rates, and sovereign spreads for the full sample of twenty-six emerging markets from November 27, 2012 to October 3, 2013. These regression results summarize the change of market prices in the twenty-four-hour window following the news.

Tapering. Bernanke’s tapering news was associated with significant drops in stock market indices and exchange rate depreciations, but had no significant impact on sovereign spreads. This may reflect the expectation of reduced capital inflows and carry-trade activity to emerging markets, with less investment in equity markets. Not surprisingly, tapering news doesn’t seem to affect CDS spreads on sovereign debt. By contrast, numerous and frequently quite vigorous statements in support of tapering by Federal Reserve Bank presidents had little discernible effect on emerging-market financial prices—equities, exchange rates, or CDS spreads—during our sample period. (No tapering news was attributable to Federal Reserve governors during this period, only Federal Reserve Bank presidents.) This may be because one of the Federal Reserve Bank presidents—Fisher of the Federal Reserve Bank of Dallas—made many public statements advocating tapering (nine of our twenty-six events) that may have been discounted by financial markets due to their frequency and

²Low international reserve level is defined as a reserves/GDP ratio below 20 percent, and low external debt is defined as an external debt/GDP ratio less than 34 percent. Both cut-off points are the median values of their respective samples.

Table 3. Full Sample—Asset Market Reaction to Federal Reserve Announcements

	Stock Market (1)	Exchange Rate (2)	CDS Spreads (3)
Ben Tap	−0.328* (0.164)	0.219*** (0.064)	−0.550 (4.075)
Ben QE	0.128 (0.128)	−0.141*** (0.037)	−1.419 (1.122)
Gov/Pres Tap	0.035 (0.043)	−0.010 (0.012)	0.564 (0.717)
Gov/Pres QE	−0.176*** (0.052)	−0.097*** (0.018)	−3.689 (4.417)
FOMC QE	0.164** (0.079)	−0.252*** (0.045)	−3.535* (1.936)
Constant	0.047*** (0.009)	0.033*** (0.004)	0.421 (0.497)
Observations	5,590	5,375	5,156
R-squared	0.004	0.012	0.001
No. of Countries	26	25	24
Notes: The table presents panel fixed-effect estimation results with robust standard errors in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively. Independent variables are log first difference of stock market index, foreign exchange rate, and change in CDS spreads in specification 1, 2, and 3, respectively. Exchange rate estimation excludes China; CDS spread estimation excludes China and Pakistan.			

predictability of the message. (The other most vocal advocate for tapering was Philadelphia Federal Reserve Bank President Plosser, with five news events during the sample period.) No explicit and unambiguous news in support of tapering in FOMC announcements was coded during this period.

Quantitative Easing. Bernanke’s QE news, symmetrically, was associated with strong exchange rate appreciation in table 3. Exchange rates also significantly appreciated in response to QE news contained in FOMC statements and in announcements by governors/presidents, where the FOMC had the largest impact and governors/presidents had the least impact. The support for QE was broader than tapering, including governors (Vice Chair Yellen and Governors Duke and Stein) and many presidents. President

Rosengren (Boston) and President Bullard (St. Louis) spoke the most frequently (four times each) in support of continuing QE. In addition, consistent with the very strong impact of FOMC QE news exchange rate appreciation, these statements also had a large impact on pushing up stock market prices.

3.2 *Differential Effects of Tapering*

As discussed above, we expect tapering news to have different effects depending on the strength of a country's international "fundamentals." Full-sample results, in turn, could mask differential effects due to group heterogeneity associated with disparate fundamentals. To address this issue, tables 4–6 report the impact of the tapering and QE news on market prices, allowing comparison between countries having current account deficits/surpluses (table 4), low/high international reserves (table 5), and high/low external debts (table 6). (Table 2 presents the external positions of countries and the grouping between "robust" and "fragile" countries.) We also group countries in terms of these fundamentals, robust and fragile, where the robust group are countries that meet at least two "strong" criteria (current account surplus, higher reserves, and low debt), and the fragile group meet at least two "weak" criteria (current account deficits, low reserves, and high debt). The countries in each group are shown in table 2, and table 7 reports the regression results for these two groups.

This comparison reveals asymmetric and divergent patterns, depending on whether the news is emanating from Bernanke's statements, as opposed to governors/presidents and the FOMC, and between the groups with robustness or fragile fundamentals. In particular, Bernanke's tapering news had much larger exchange rate *depreciation* effects on countries with (i) current account surpluses as opposed to deficits (four times larger, table 4), (ii) high international reserves contrasted with low reserves (three times larger, table 5), and (iii) low external debt rather than high debt (about half as much larger, table 6).³ The analysis of the two groups—fragile or robust,

³The differences between the groups are statistically significant in the cases of exchange rates (chi-square of 4.56 and probability of 0.033) and international reserves.

Table 7. Differential Effects—Robust and Fragile Countries

	Stock Market		Exchange Rate		CDS Spreads	
	Fragile (1a)	Robust (1b)	Fragile (2a)	Robust (2b)	Fragile (3a)	Robust (3b)
Ben Tap	-0.234 (0.211)	-0.478 (0.266)	0.111* (0.060)	0.409** (0.124)	-3.289 (6.432)	4.008** (1.381)
Ben QE	0.205** (0.084)	0.006 (0.306)	-0.134*** (0.041)	-0.154* (0.077)	-2.316 (1.764)	0.058 (0.399)
Gov/Pres Tap	0.004 (0.063)	0.085 (0.080)	-0.016 (0.017)	-0.001 (0.017)	1.167 (1.118)	-0.452* (0.234)
Gov/Pres QE	-0.163** (0.076)	-0.196** (0.063)	-0.110*** (0.026)	-0.073*** (0.017)	-6.403 (6.987)	0.928** (0.291)
FOMC QE	0.210* (0.107)	0.089 (0.116)	-0.250*** (0.068)	-0.256*** (0.040)	-4.877 (3.006)	-1.218 (0.740)
Constant	0.058*** (0.013)	0.029** (0.011)	0.042*** (0.005)	0.018** (0.007)	0.706 (0.789)	-0.062 (0.047)
Observations	3,464	2,126	3,464	1,911	3,245	1,911
R-squared	0.004	0.005	0.009	0.023	0.002	0.015
No. of Countries	17	10	17	9	16	9

Notes: This table presents panel fixed-effect estimation results with robust standard errors in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively. Independent variables are log first difference of stock market index, foreign exchange rate, and change in CDS spreads in specification 1, 2, and 3, respectively. A country is grouped under “robust” or “fragile” based on whether it has current account surplus, high reserves, and low external debt. Thus, if at least two of three (or three of three) of the above criteria holds, then a country is in the “robust group”; otherwise, it is in the “fragile group.” Exchange rate estimation excludes China; CDS spread estimation excludes China and Pakistan.

shown in table 7—also indicates that exchange rate depreciation is statistically significant in both cases at the time of Bernanke's tapering announcements but more than three times larger in the robust group (0.409) compared with the fragile group (0.111).⁴

By contrast, tapering announcements by Federal Reserve governors or presidents had little or no discernible impact on exchange rates in emerging markets, regardless of whether they were classified as robust/weak in fundamentals, had current account surpluses or deficits, had high/low international reserves, or had low/high external debt. This is consistent with the full-sample results.

Bernanke's tapering news *increased* CDS spreads very substantially for countries with robust fundamentals (4.0 points; table 7), and especially for those countries with current account surpluses (3.8 points; table 4) and high international reserves (3.2 points; table 5), while having little or no effect on fragile countries (except for increasing spreads marginally, 0.77 points, for those with high external debt positions). And, similar to the full-sample results, tapering announcements by Federal Reserve governors/presidents had little effect on CDS spreads, lowering them overall by only -0.45 (table 7; significant at the 10 percent level), apparently attributable to the small decline in CDS in the high-reserves group (-0.37; table 5).

Bernanke's tapering news *lowered* equity market values in emerging markets for the full sample (-3.28 percent; table 3) and in the countries with low external debt positions (table 6). And, similar to the full-sample results, group results based on fundamentals indicated that tapering announcements from governors/presidents did not have any significant impact on stock markets.

Intriguingly, tables 4–7 imply that Bernanke's tapering news depreciated exchange rates most in countries typically associated with strong international positions—countries running current account surpluses, having high reserves, and having low debt—and our aggregate of robust countries. A possible interpretation is that fragile economies were less exposed to financial flows in search of higher yields during the earlier QE years; thereby they were expected to be less exposed to the immediate impact of the tapering news.

⁴This difference is statistically significant, with a chi-square of 4.31 (probability 0.038).

3.3 *Differential Effects of Quantitative Easing*

The effects of QE news also showed substantial variation depending on who made the statement and the international position of the country. Bernanke's QE news was associated with strong *exchange rate appreciation* in the full sample (-0.14 ; table 3) as well as in both fragile and robust groups (table 7), where the impact effects were virtually identical (-0.13 and -0.15 , respectively). Appreciation was an even more dominating characteristic of countries with strong current account positions, high international reserves, and high international debt.⁵

Significant exchange rate *appreciations* were also associated with FOMC QE statements in the full sample, in both fragile and weak groups (table 7), and in all of the subsamples (table 4). Interestingly, no asymmetric effects were found between those with weak or strong fundamentals—the coefficients on the exchange rate response to FOMC QE support news were virtually identical (and significant) across subgroups.

Differential effects emerge again in stock market and CDS responses to QE. Bernanke's and the FOMC's QE news were associated with *higher* stock prices of the fragile group but did not affect the stock prices of the strong group. By contrast, QE news from governors/presidents was associated with *lower* stock market indices for both fragile and robust groups (table 7), and coefficient estimates are similar in magnitudes regardless of international fundamental positions. In terms of CDS spreads, QE news from Federal Reserve governors/presidents had no discernible effect in the full sample but appears to raise spreads for the robust group of countries (table 7). This result stems from the rise in CDS spreads in countries with high international reserve positions. However, somewhat at odds with the other results, spreads climbed in those countries with relatively high external debt positions. The differential impacts of the news source reflect the much higher frequency of news from governors/presidents (twenty-six tapering, twenty-two QE) in comparison with news from Bernanke (three tapering and seven QE) and FOMC QE news (five).

⁵The difference between depreciation in countries with high and low international debt positions is statistically significant with a chi-square value of 3.25 (probability 0.072).

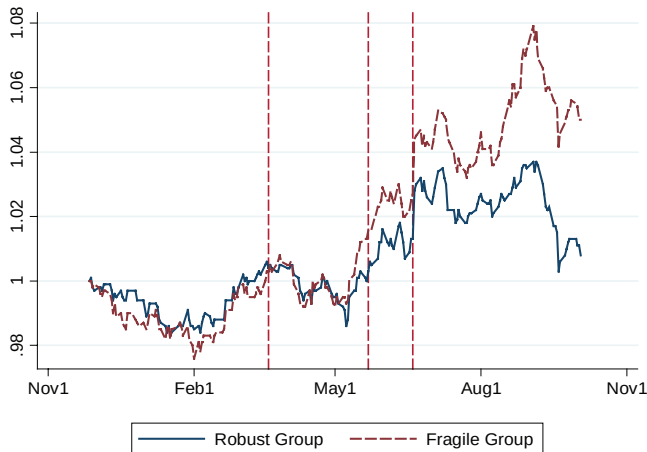
On balance, the market was focused and reacted more to the scarcer and more coherent news from Bernanke and the FOMC than to the frequent and diffused news from governors/presidents. Governors'/presidents' news reflected the inner debate among heterogeneous and non-coordinated views of the Federal Reserve's senior officials, whereas Bernanke's and FOMC QE news were viewed as much clearer signals regarding the stance of the Federal Reserve's policies. These interpretations are also supported by the results reported for the full sample (table 3).

3.4 Robust and Fragile Fundamentals and Tapering Dynamics

Emerging-market countries with robust (fragile) fundamentals—those with current account surpluses (deficits), high (low) international reserves, and low (high) external debt—were most (less) affected by tapering announcements, particularly with respect to exchange rates. Robust (fragile) economies seemed to have been more (less) exposed to financial flows in search of higher yields during the earlier QE years, and also more (less) exposed when tapering started, i.e., markets may have expected capital flow reversals to occur mainly in countries that had experienced the largest inflows initially. However, this may simply be the impact effect. Fragile economies could have experienced tapering effects with some delay.

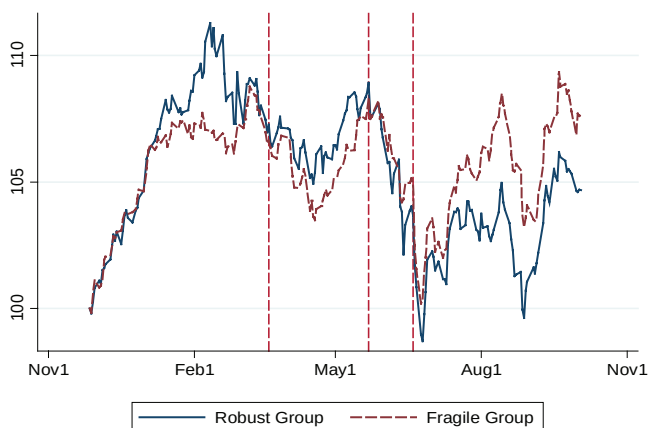
This interpretation is consistent with figures 1–6. Figures 1, 2, and 3 show the impact of Bernanke's tapering announcements on stock prices, exchange rates, and CDS spreads, respectively, for the fragile and strong groups. Though we find the *impact* effects of Bernanke's tapering news depreciated exchange rates most in the robust group, the fragile group experienced more depreciation after several months (figure 1). And while Bernanke's tapering news caused CDS spreads to rise substantially more in the robust group, CDS spreads eventually climbed more in the fragile group (figure 3). Stock prices did not show significant differential impact effects across the fragile and robust groups, but over time it appears that the robust group has performed less well.

More formally, table 8 considers the differential impact of announcements on cumulative asset price changes over twenty-one business days (approximately one month). The negative cumulative

Figure 1. Foreign Exchange Rate and Tapering “Events”

Notes: Vertical dashed lines indicate Bernanke’s tapering announcement dates (March 20, 2013; May 22, 2013; June 19, 2013) as described in the data section. For each country, the nominal exchange rate (national currency per U.S. dollar) index is constructed by setting the value equal to “1” at the beginning of our sample, November 27, 2012. The (unweighted) average for the “robust group” (Peru, Israel, South Korea, Malaysia, Philippines, Thailand, Bulgaria, Russia, and Hungary) and the “fragile group” (Turkey, South Africa, Argentina, Brazil, Chile, Colombia, Mexico, India, Indonesia, Pakistan, Ukraine, Czech Republic, Latvia, Lithuania, Poland, and Romania) is taken on each day over the sample.

effect of Bernanke’s tapering news on fragile economies is somewhat larger on equity prices than in robust economies. The cumulative impact on exchange rate depreciation in fragile and robust economies following Bernanke’s tapering announcements is very similar. By contrast, fragile countries experienced twice the average cumulative increase in CDS spreads (45 basis points) as did robust countries (18 basis points) in response to Bernanke’s tapering announcements. The cumulative impacts of tapering announcements by the Federal Reserve governors/presidents is more mixed—relatively small declines in equity markets for the fragile group, greater exchange rate depreciation for the fragile group, and a much larger (though not statistically significant) rise in CDS spreads for the fragile group.

Figure 2. Stock Market Index and Tapering “Events”

Notes: Vertical dashed lines indicate Bernanke’s tapering announcement dates (March 20, 2013; May 22, 2013; June 19, 2013) as described in the data section. For each country, the stock market index is constructed by setting the value equal to “100” at the beginning of our sample, November 27, 2012. The (unweighted) average for the “robust group” (Peru, Israel, South Korea, Malaysia, Philippines, Thailand, Bulgaria, Russia, and Hungary) and the “fragile group” (Turkey, South Africa, Argentina, Brazil, Chile, Colombia, Mexico, India, Indonesia, Pakistan, Ukraine, Czech Republic, Latvia, Lithuania, Poland, and Romania) is taken on each day over the sample.

Overlapping events is a major drawback when measuring longer-duration effects using our methodology. To address this issue, we estimated the effects of Bernanke’s tapering news alone on cumulative asset price changes for non-overlapping announcements. Non-overlapping events in this instance led to a nineteen-day post-event window for the asset price changes and are presented in table 9. The results are virtually identical to the results presented in the previous table.

Figures 4, 5, and 6 report the stock market indices, exchange rates, and sovereign spreads of Brazil and Turkey (relatively fragile countries) and Hungary (a relatively robust country), from November 27, 2012 to October 3, 2013. Again, toward the end of the sample period, the fragile countries were not insulated from the tapering news. Indeed, over time the fragile countries were hit harder than the stronger countries.

Figure 3. CDS Spreads and Tapering “Events”

Notes: Vertical dashed lines indicate Bernanke’s tapering announcement dates (March 20, 2013; May 22, 2013; June 19, 2013) as described in the data section. For each country, the CDS spread index is constructed by setting the value equal to “100” at the beginning of our sample, November 27, 2012. The (unweighted) average for the “robust group” (Peru, Israel, South Korea, Malaysia, Philippines, Thailand, Bulgaria, Russia, and Hungary) and the “fragile group” (Turkey, South Africa, Argentina, Brazil, Chile, Colombia, Mexico, India, Indonesia, Pakistan, Ukraine, Czech Republic, Latvia, Lithuania, Poland, and Romania) is taken on each day over the sample.

The impact of the tapering news focused first on the strong countries, probably in anticipation of large short-run outflows of past hot money inflows. Market attention shifted over time to the possibility that fragile countries would find it harder to adjust to the higher U.S. interest rates induced by future tapering, leading to large adjustments in the last quarter of 2013. Arguably, the initial large effect of the tapering news, affecting mostly the strong countries, may also reflect financial markets’ initial inattention to tail risks, overlooking the vulnerability of the weaker emerging markets to the adverse implications of higher future global interest rates. Indeed, in the last quarter of 2013, financial markets refocused attention on the fragile emerging markets and hammered the prices of the “Fragile Five”—Brazil, India, Indonesia, South Africa, and Turkey—a subgroup of the weaker emerging markets.

Table 8. Differential Effects Over One-Month Event Window and Asset Price Changes—Robust and Fragile Countries

	Stock Market		Exchange Rate		CDS Spreads	
	Fragile (1a)	Robust (1b)	Fragile (2a)	Robust (2b)	Fragile (3a)	Robust (3b)
Ben Tap	-3.378** (1.194)	-2.644** (0.833)	1.437*** (0.312)	1.558*** (0.257)	45.417* (24.965)	18.484*** (2.612)
Ben QE	0.903 (0.647)	1.488** (0.596)	-0.062 (0.275)	0.471 (0.327)	9.829 (15.972)	3.129 (2.665)
Gov/Pres Tap	-1.377*** (0.352)	-2.302*** (0.651)	0.838*** (0.232)	0.275** (0.115)	68.036 (57.096)	5.615*** (1.092)
Gov/Pres QE	-1.216*** (0.406)	-1.424** (0.628)	-0.706** (0.288)	-0.190 (0.337)	-34.842 (37.065)	0.899 (1.423)
FOMC QE	0.967 (0.580)	2.001* (0.983)	-1.282*** (0.271)	-0.843*** (0.227)	-31.166 (21.313)	-10.358*** (2.917)
Constant	3.601*** (0.768)	3.168** (1.097)	0.338 (0.284)	-0.301 (0.417)	-33.890 (25.013)	-7.843*** (1.990)
Observations	3,784	2,326	3,784	2,091	3,537	2,091
R-squared	0.124	0.179	0.169	0.188	0.026	0.267
No. of Countries	17	10	17	9	16	9

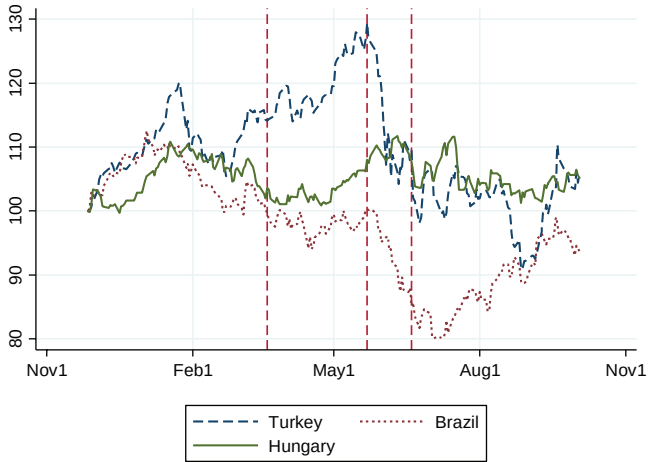
Notes: See notes to table 7. Event windows are extended to twenty-one days (starting from the day of announcements), and cumulative asset price changes over the same event window are considered.

Table 9. Differential Effects Over Non-Overlapping (One-Month) Events—Robust and Fragile Countries

	Stock Market		Exchange Rate		CDS Spreads	
	Fragile	Robust	Fragile	Robust	Fragile	Robust
Ben Tap	-4.246*** (1.152)	-3.998*** (0.992)	1.661*** (0.364)	1.638*** (0.294)	46.049** (20.701)	21.173*** (2.892)
Constant	2.170*** (0.297)	1.447*** (0.260)	-0.094 (0.094)	-0.434*** (0.077)	-9.695* (5.349)	-5.847*** (0.759)
Observations	3,784	2,326	3,784	2,091	3,537	2,091
R-squared	0.114	0.129	0.091	0.127	0.010	0.198
No. of Countries	17	10	17	9	16	9

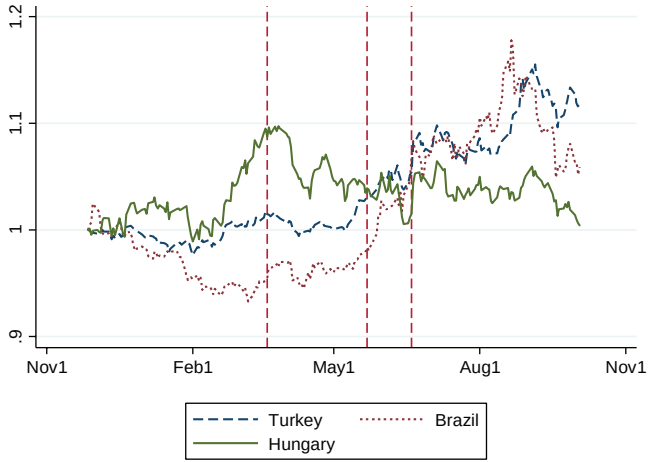
Notes: See notes to table 7. The effects of Bernanke’s tapering news are estimated alone on cumulative asset price changes for non-overlapping announcements over a nineteen-day post-event window.

Figure 4. Selected Countries: Stock Market and Tapering “Events”



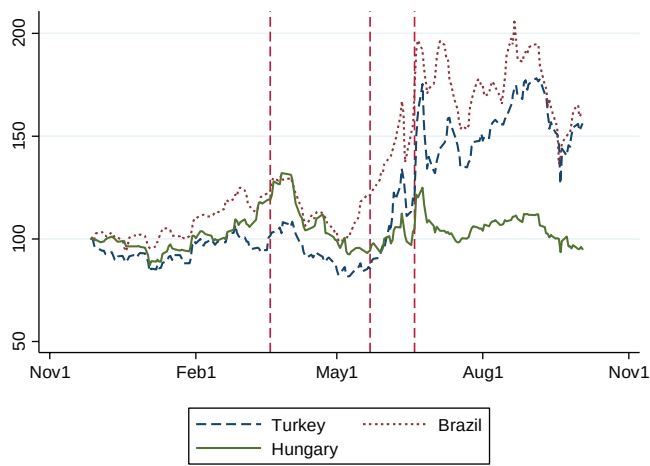
Notes: Vertical dashed lines indicate Bernanke’s tapering announcement dates (March 20, 2013; May 22, 2013; June 19, 2013) as described in the data section. For each country, the stock market index is constructed by setting the value equal to “100” at the beginning of our sample, November 27, 2012.

Figure 5. Selected Countries: Foreign Exchange Rate and Tapering “Events”



Notes: Vertical dashed lines indicate Bernanke’s tapering announcement dates (March 20, 2013; May 22, 2013; June 19, 2013) as described in the data section. For each country, the nominal exchange rate (national currency per U.S. dollar) index is constructed by setting the value equal to “1” at the beginning of our sample, November 27, 2012.

Figure 6. Selected Countries: CDS Spreads and Tapering “Events”



Notes: Vertical dashed lines indicate Bernanke’s tapering announcement dates (March 20, 2013; May 22, 2013; June 19, 2013) as described in the data section. For each country, the CDS spread index is constructed by setting the value equal to “100” at the beginning of our sample, November 27, 2012.

4. Extensions

4.1 Fragile and Robust Groupings

In the previous sections we distinguished between fragile and robust economies using the following criteria: (i) median values for external debt (above the median indicates fragile and below median indicates robust) and international reserves (above median indicates robust and below median indicates fragile), and (ii) current account surpluses (robust) and deficits (fragile). We modify these criteria to be median values for all three fundamentals, i.e., changing our criteria for current accounts from surplus/deficits to above/below the median values in the sample. In table 10 we present results where the classification of a “robust” current account is any value above the median (−1.24) and a “fragile” current account is any value below the median. This gives somewhat different groupings for robust/fragile, with Argentina, Latvia, and Pakistan moving from the fragile to the robust group. Results shown in table 10 are almost identical to

those in table 4, however, and the main results are qualitatively not affected by this change in the robust/fragile groups.

4.2 Financial Development

Another issue is whether the degree of financial development is a critical distinguishing characteristic between countries in how they respond to tapering announcements. That is, is this institutional feature important in how tapering and quantitative easing announcements affect asset prices in emerging markets? To address this issue we use the World Economic Forum's Financial Development Index, and use the median value of the sample to divide countries into "high" and "low" degrees of financial development. Table 11 reports the results in an analogous fashion to table 4.

The results indicate that countries with a high degree of financial development had larger declines in equity markets in response to Bernanke's tapering announcements than did those with low degrees of financial development. They also experienced greater exchange rate depreciation and larger increases in CDS spreads than did countries with low levels of financial development. The "tapering response" of more financially developed (less financially developed) emerging economies is broadly similar to those with the robust (fragile) fundamentals, providing an alternative explanation for why these countries were hardest hit by tapering announcements.

4.3 U.S. Interest Rates

Another important question is whether tapering and QE announcements are transmitted to emerging-market equity prices, exchange rates, and CDS spreads through U.S. interest rates only, or whether there is an additional transmission channel at work. To address this issue, we included in the baseline regression (table 3) U.S. interest rates of various maturities. In particular, we considered one-month, three-month, six-month, one-year, five-year, ten-year, and twenty-year U.S. Treasury interest rates, each entered separately in the regression equations.

The response of equity prices to Bernanke tapering results was very stable regardless of which U.S. interest rate was included in the regression, with coefficients ranging from -0.321 to -0.428 , all

Table 11. Differential Effects—Financial Development (WEF Index)

	Stock Market		Exchange Rate		CDS Spreads	
	Less Developed (1a)	More Developed (1b)	Less Developed (2a)	More Developed (2b)	Less Developed (3a)	More Developed (3b)
Ben Tap	−0.232 (0.267)	−0.424* (0.198)	0.110 (0.078)	0.337*** (0.096)	−3.786 (8.164)	2.684** (0.974)
Ben QE	0.233* (0.125)	0.024 (0.224)	−0.097* (0.054)	−0.188*** (0.050)	−2.585 (2.209)	−0.254 (0.387)
Gov/Pres Tap	0.017 (0.066)	0.053 (0.058)	−0.003 (0.018)	−0.018 (0.017)	1.260 (1.434)	−0.128 (0.110)
Gov/Pres QE	−0.185* (0.094)	−0.166*** (0.049)	−0.085*** (0.025)	−0.110*** (0.027)	−7.873 (8.853)	0.495** (0.223)
FOMC QE	0.204 (0.137)	0.125 (0.084)	−0.245*** (0.068)	−0.260*** (0.062)	−6.125 (3.766)	−0.946 (0.534)
Constant	0.057*** (0.014)	0.037*** (0.011)	0.042*** (0.005)	0.024*** (0.006)	0.846 (0.997)	−0.004 (0.035)
Observations	2,795	2,795	2,795	2,580	2,576	2,580
R-squared	0.005	0.004	0.008	0.017	0.002	0.009
No. of Countries	13	13	13	12	12	12

Notes: The table presents panel fixed-effect estimation results with robust standard errors in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively. Independent variables are log first difference of stock market index, foreign exchange rate, and change in CDS spreads in specification 1, 2, and 3, respectively. Less (more) financial development is based on the World Economic Forum (WEF) Financial Development Index (2012) value of less (more) than 3.29 (overall index value). The WEF index is not reported for Lithuania, Latvia, and Bulgaria; thus, based on their credit/GDP measures, we include Lithuania in the less developed group, and Latvia and Bulgaria in the more developed group.

of which were statistically significant (compared with the baseline regression coefficient of -0.327). Similarly, the baseline coefficient on the exchange rate from Bernanke tapering was 0.129 , compared with coefficients ranging from 0.123 to 0.225 (six of seven are statistically significant) when U.S. interest rates were included. Bernanke tapering did not have a significant impact on CDS spreads in the baseline regression, and was also not significant in the seven regressions where U.S. interest rates were included. The other results are also very similar to the baseline regressions, indicating that controlling for U.S. interest rates does not change the transmission of tapering (or quantitative easing) “news” announcements on emerging-market asset prices. (Detailed results are not included for brevity but are available from the authors upon request.)

While we focused above on price transmission channels, operating via the exchange rate and asset prices, some transmission may operate through quantities, impacting the emerging markets via capital flows (Caruana 2012). Specifically, tapering information may change the expected future cross-border bank lending (the credit channel) and portfolio flows (market risk taking).⁶

4.4 Interactions with Fundamentals

An alternative approach to grouping countries with respect to their common fundamentals (“robust” or “fragile”) is to interact announcements with the level of the fundamental (e.g., $BenTap \times Reserves/GDP$). We conduct this analysis for exchange rates and the five types of announcements, reporting the results in table 12. Table 13 reports the joint significance tests (of the announcement coefficient and the interaction term coefficient). If countries

⁶The value of aggregate cross-border bond and equity investment in emerging-market economies increased from \$3.29 trillion at the end of 2007 to \$4.46 trillion at the end of 2012, according to the International Monetary Fund’s Coordinated Portfolio Investment Survey. About 85 percent of the increase was in the form of debt, with a much smaller part in equity. Thus, cross-border debt investment has been a significant driver of credit growth in many emerging markets (Mohanty 2014). These developments may have increased the emerging markets’ vulnerability. Such borrowing may be highly procyclical, increasing the borrowers’ exposure to exchange rate risk—at times of stress, sharp exchange rate depreciations may result in further selling pressure on emerging-market economies.

Table 12. Interactions with Fundamentals—Exchange Rate Estimations

	(1)	(2)	(3)	(4)	(5)
Ben Tap	0.219*** (0.064)	0.272*** (0.069)	-0.024 (0.084)	0.392*** (0.110)	0.239* (0.128)
Ben QE	-0.141*** (0.037)	-0.151*** (0.048)	-0.054 (0.067)	-0.004 (0.055)	-0.000 (0.082)
Gov/Pres Tap	-0.010 (0.012)	-0.009 (0.013)	-0.017 (0.026)	-0.009 (0.024)	-0.010 (0.032)
Gov/Pres QE	-0.097*** (0.018)	-0.094*** (0.016)	-0.091* (0.047)	-0.081** (0.031)	-0.066 (0.050)
FOMC QE	-0.252*** (0.045)	-0.253*** (0.037)	-0.145 (0.101)	-0.214** (0.085)	-0.090 (0.096)
Ben Tap * CAB/GDP		0.040** (0.017)			0.026 (0.017)
Ben QE * CAB/GDP		-0.007 (0.012)			-0.003 (0.012)
Gov/Pres Tap * CAB/GDP		0.001 (0.003)			0.001 (0.003)
Gov/Pres QE * CAB/GDP		0.002 (0.005)			0.003 (0.006)
FOMC QE * CAB/GDP		-0.001 (0.012)			0.010 (0.013)
Ben Tap * Reserves/GDP			0.012** (0.004)		0.014*** (0.004)

(continued)

Table 12. (Continued)

	(1)	(2)	(3)	(4)	(5)
Ben QE * Reserves/GDP			-0.004 (0.003)		-0.001 (0.003)
Gov/Pres Tap * Reserves/GDP			0.000 (0.001)		0.000 (0.001)
Gov/Pres QE * Reserves/GDP			-0.000 (0.002)		-0.000 (0.002)
FOMC QE * Reserves/GDP			-0.005 (0.003)		-0.007* (0.004)
Ben Tap * ExternalDebt/GDP				-0.003** (0.001)	-0.005*** (0.001)
Ben QE * ExternalDebt/GDP				-0.003*** (0.001)	-0.003*** (0.001)
Gov/Pres Tap * ExternalDebt/GDP				-0.000 (0.000)	-0.000 (0.000)
Gov/Pres QE * ExternalDebt/GDP				-0.000 (0.000)	-0.000 (0.000)
FOMC QE * ExternalDebt/GDP				-0.001 (0.001)	-0.000 (0.001)
Constant	0.033*** (0.004)	0.033*** (0.004)	0.033*** (0.004)	0.033*** (0.004)	0.033*** (0.004)
Observations	5,375	5,375	5,375	5,375	5,375
R-squared	0.012	0.013	0.013	0.013	0.015
Notes: Robust standard errors are in parentheses. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.					

Table 13. Significance Test Results

	Columns from Table 12			
	(2)	(3)	(4)	(5)
Significance of Sum of the Coefficients				
F-statistics	15	0.02	12.64	4.04
Prob > F (p-value)	(0.001)	(0.883)	(0.002)	(0.056)
Joint Significance of the Coefficients				
F-statistics	7.76	7.84	6.94	12.39
Prob > F (p-value)	(0.003)	(0.002)	(0.004)	(0.000)
Notes: The table reports the significance test results for the Ben tapering and Ben tapering interaction with the fundamentals from table 12, specifications 2–5.				

with stronger fundamentals are affected more by tapering (consistent with the earlier analysis), then we would expect a positive coefficient on $BenTap \times CAB/GDP$ (i.e., the larger the current account surplus, the larger is exchange rate depreciation associated with a Bernanke tapering announcement), a positive coefficient on $BenTap \times Reserves/GDP$ (i.e., the larger the level of reserves, the larger is exchange rate depreciation associated with a Bernanke tapering announcement), and a negative coefficient on $BenTap \times ExternalDebt/GDP$ (i.e., the larger the level of external debt, the less is exchange rate depreciation associated with a Bernanke tapering announcement).

Column 1 of table 12 reports the baseline results without interaction terms (as in table 3) for comparison purposes. Column 2 reports the interactions of tapering announcements with the current account (CAB/GDP), column 3 reports interactions with reserves ($Reserves/GDP$), column 4 reports interactions with external debt ($ExternalDebt/GDP$), and column 5 combines the three sets of interaction terms into one regression.

Focusing on Bernanke’s tapering announcements ($BenTap$) in columns 2–4, the results indicate that larger current account surpluses are associated with *greater* exchange rate depreciation (coefficient of 0.040), larger reserves are associated with *greater* exchange rate depreciation (0.012), and high external debt is associated with

less exchange rate depreciation. It is useful to calculate the estimated effect for the robust and fragile groups using mean and median values (for each group) of the fundamentals. The estimated impact on exchange rates from *BenTap* for a country with a mean “robust” (“fragile”) current account is 0.37 (0.14), for reserves is 0.37 (0.16), and for external debt is 0.26 (0.25). The same basic results hold up in the combined regression (column 5), with the exception of the interaction term with current account balances.

The bulk of these results are therefore consistent with our earlier results, i.e., countries with stronger fundamentals appear to be more affected by tapering announcements.

4.5 *Excluding Bernanke’s May 22 Tapering Announcement*

A natural question that arises is whether the Bernanke tapering results are entirely driven by the market shock of the May 22 announcement. To address this issue, we reestimate the basic models estimated in table 3 with the modification that the Bernanke tapering announcements exclude the May 22 observation. Interestingly, the effect of the Bernanke tapering announcements excluding May 22 is greater on equity markets (an estimated coefficient of -0.416 , compared with -0.327 in table 3) but less on exchange rate depreciation (0.116 , and not statistically significant, compared with 0.219). The effect on CDS spreads remains insignificant. The impact of the other announcements (e.g., other tapering and QE) is not affected by excluding Bernanke’s May 22 tapering statement.

4.6 *Individual Country Effects*

We estimated our models with country fixed effects and in several formulations divided the sample into fragile and robust economies. This subsection shows the effects of tapering announcements by individual countries. In particular, in table 14, we show the effects of Bernanke’s tapering announcements and governors’/presidents’ tapering announcements on asset prices for individual countries. In the table we report the *sum* of the common tapering event coefficient β_1 from $\beta_1 \times \text{Ben Tap}_t$ (or β_3 from $\beta_3 \times \text{GovPres Tap}_t$) and the coefficient of the interaction term from Ben T_t (GovPres Tap_t) and the country-specific dummy variable.

This measures the effect of tapering on a particular country. (All responses are statistically significant at the 10 percent level or higher unless indicated.)

The results reported in table 14 show substantial diversity of response across countries. For example, Bernanke's tapering announcements are associated with decreases (increases) in stock prices in sixteen of twenty-five (nine of twenty-five) cases, and all responses are statistically significant. While the results for the full sample indicate an average response of -0.327 to Bernanke's tapering announcements (table 3), the average response of the countries experiencing declines (increases) in stock prices is -0.734 (0.498). Similarly, Bernanke's tapering announcements are associated with depreciating currencies in fourteen of twenty-four countries, and with appreciating currencies in ten of twenty-four countries. Again the results are consistent with the full-sample response (0.219) reported in table 3—the average response of the fourteen depreciating countries in table 14 is 0.438 , compared with an average response of -0.046 for the ten appreciating countries.

5. Concluding Remarks

Chairman Bernanke's tapering news had large effects on emerging markets, resulting in substantial drops in stock market indices and large exchange rate depreciations. This indicates the expectation of reduced capital inflows and carry-trade activity to emerging markets, with less investment in equity markets. By contrast, numerous and frequently quite vigorous statements in support of tapering by Federal Reserve presidents had little discernible effect on emerging-market financial prices—equities, exchange rates, CDS spreads—during our sample period. This may be because one of the Federal Reserve presidents—Fisher of the Federal Reserve Bank of Dallas—made many public statements advocating tapering (nine of our twenty-six events) that may have been discounted by financial markets due to the frequency and predictability of the message. QE statements by governors/presidents were associated with significant exchange rate appreciation, however, as were statements by Bernanke and the FOMC in favor of continuing the program. Statements in support of continuing QE were across a broad spectrum of Federal Reserve governors (including Vice Chair Yellen) and

Federal Reserve Bank presidents during our sample period, perhaps accounting for the strong impact on the markets.

Our analysis also identified strong and systematic heterogeneity of adjustment to Federal Reserve tapering (and QE) news across emerging markets. The initial impact of Chairman Bernanke's tapering news had the largest effect on exchange rates in the emerging markets that had robust/strong international positions (i.e., current account surpluses, low foreign debt, high international reserves) or had more developed financial sectors. Tapering news by Federal Reserve presidents had little or no discernible impact on exchange rates regardless of whether they were classified as robust/weak in a combination of fundamentals, had current account surpluses or deficits, had high/low international reserves, or had low/high external debt. However, when we considered the differential impact of announcements on cumulative asset price changes over twenty-one business days (approximately one month), the effect of Bernanke's tapering news on fragile economies is (i) somewhat larger on equity prices than in robust economies; (ii) very similar to robust economies on exchange rate depreciation; and (iii) much greater (twice the average cumulative increase) on CDS spreads than in robust economies.

In terms of the dynamics of financial markets in robust and fragile economies, it appears that emerging markets with more fragile international positions were also affected, especially the "Fragile Five," over periods extending beyond the initial effects of Federal Reserve tapering announcements. These results suggest that, in the era of financial globalization, emerging-market financial markets are not insulated from expected changes in the Federal Reserve's policy stance, although it is sensitive to the heterogeneity among countries (Powell 2013 and Nechio 2014). The factors accounting for the timing and the intensity of market reactions deserve further exploration. The greater impact of Federal Reserve news on the robust emerging markets may be explained by anticipated balance sheet adjustments, where the size of positions and the liquidity of markets play a role (Eichengreen and Gupta 2014). Alternatively, market attention may shift over time from the short-run adjustment of positions to the reassessment of the greater adjustment challenges facing the fragile countries to the post-tapering world (Mondria, Wu, and Chang 2010 and Sims 2010). Investigating the possible linkages between faster

price adjustment and less volatile future growth patterns is left for future research.

References

- Ahmed, A., and A. Zlate. 2013. "Capital Flows to Emerging Market Economies: A Brave New World?" International Finance Discussion Paper No. 1081, Board of Governors of the Federal Reserve System.
- Aizenman, J., M. Binici, and M. Hutchison. 2013. "Credit Ratings and the Pricing of Sovereign Debt during the Euro Crisis." *Oxford Review of Economic Policy* 29 (3): 582–609.
- Aizenman, J., M. Hutchison, and Y. Jinjarak. 2013. "What Is the Risk of European Sovereign Debt Defaults? Fiscal Space, CDS Spreads and Market Pricing of Risk." *Journal of International Money and Finance* 34 (1): 37–59.
- Caruana, J. 2012. "International Monetary Policy Interactions: Challenges and Prospects." Speech given at the CEMLA-SEACEN conference, Punta del Este, Uruguay, November 16.
- Dooley, M., and M. Hutchison. 2009. "Transmission of the U.S. Subprime Crisis to Emerging Markets: Evidence on the Decoupling-Recoupling Hypothesis." *Journal of International Money and Finance* 28 (8): 1331–49.
- Eichengreen, B., and P. Gupta. 2014. "Tapering Talk: The Impact of Expectations of Reduced Federal Reserve Security Purchases on Emerging Markets." Policy Research Working Paper No. 6754, World Bank.
- Mohanty, M. S. 2014. "The Transmission of Unconventional Monetary Policy to the Emerging Markets—An Overview." BIS Paper No. 78.
- Mondria, J., T. Wu, and Y. Zhang, 2010 "The Determinants of International Investment and Attention Allocation: Using Internet Search Query Data." *Journal of International Economics* 82 (1): 85–95.
- Nechio, F. 2014. "Fed Tapering News and Emerging Markets." *Economic Letter* (Federal Reserve Bank of San Francisco) 2014-06 (March 3).
- Powell, J. 2013. "Advanced Economy Monetary Policy and Emerging Market Economies." Speech at the Federal Reserve Bank

- of San Francisco's 2013 Asia Economic Policy Conference, San Francisco, California, November 4.
- Sims, C. A. 2010. "Rational Inattention and Monetary Economics." In *Handbook of Monetary Economics*, Edition 1, Vol. 3, ed. B. M. Friedman and M. Woodford, 155–81 (chapter 4). Elsevier.
- Williams, C. J. 2011. "Unconventional Monetary Policy: Lessons from the Past Three Years." *Economic Letter* (Federal Reserve Bank of San Francisco) 2011-31 (October 3).
- . 2012. "Monetary Policy, Money, and Inflation." *Economic Letter* (Federal Reserve Bank of San Francisco) 2012-21 (July 9).

Optimal Inflation Weights in the Euro Area*

Daniela Bragoli,^a Massimiliano Rigon,^b and Francesco Zanetti^c

^aUniversità Cattolica del Sacro Cuore

^bBank of Italy

^cUniversity of Oxford

This study investigates the appropriate measure for stabilizing inflation in the euro area. We use a model that accounts for both the heterogeneity observed in the degree of price rigidities across regions and sectors, and asymmetry of real disturbances in relative prices. Our work shows that the optimal weights to assign to each region or sector result from complex interactions between the degree of price stickiness, economic size, and the distribution of shocks within regions.

JEL Codes: E52, F41.

1. Introduction

The importance given to stabilizing inflation is not only in line with the European Central Bank's (ECB's) primary objective as imposed by the Maastricht Treaty but also with opinion in the academic literature, where complete price stability within the class of sticky-price models constitutes a robust optimal monetary policy.¹ However, heterogeneity in the degree of price stickiness across regions and sectors, and asymmetry in the shocks, is characteristic of the

*We would like to thank Anna Agliari, Carlo Altavilla, Gianni Amisano, Adib Bagh, Pierpaolo Benigno, Tim Cogley, Domenico Giannone, Michele Lenza, Giovanni Lombardo, Marco Mazzoli, Andrea Tambalotti, John Williams, and two anonymous referees for extremely useful comments and suggestions. Some of this work was completed while Francesco Zanetti was visiting De Nederlandsche Bank; he would like to thank the Bank and its staff for their hospitality and support. All remaining errors are our own. The opinions expressed are those of the authors and do not reflect views of the Bank of Italy. Corresponding author: Bragoli: Università Cattolica del Sacro Cuore, Department of Math and Econometrics, via Necchi 9, 20123 Milano (Italy), e-mail: daniela.bragoli@unicatt.it. Other authors' emails: massimiliano.rigon@bancaditalia.it and francesco.zanetti@economics.ox.ac.uk.

¹See Woodford (2003) and references therein.

euro area. Therefore the practical implementation of targeted inflation policy crucially depends on which measure of inflation the ECB needs to establish to offset the distortions caused by price volatility. This paper investigates optimal inflation targeting for the euro area using a multi-region and multi-sector model with asymmetric demand shocks.

At present, the ECB stabilizes the Monetary Union Index of Consumer Prices (MUICP), which is a sum of the single region's HICP indexes, weighted by the economic size of each region. This practice is in stark contrast with recent academic results that conclude that in a two-region model, optimal monetary policy must target inflation in the region with the highest degree of nominal rigidities instead of using an aggregate measure of inflation across regions.² This naturally raises the question of whether monetary policy should take into account the dispersion of inflation across regions and sectors in the euro area, which is characterized by different degrees of nominal price rigidities and asymmetric shocks across regions and sectors.

The idea of stabilizing a core price index is in the Keynesian tradition of focusing on a core rather than an overall cost-of-living index. This is also in line with the monetarist recommendation to stabilize a long-run index and ignore relative price movement such as oil price shocks (Goodfriend and King 1997). In the empirical literature, Bryan and Cecchetti (1994) and Cogley (2002) identify core inflation as a more persistent component of inflation and consider it, from a policy point of view, to be a more important indicator than broader inflation measurement, since fluctuations in food and energy prices are regarded as transitory components of overall movements in inflation.

Aoki (2001) and Benigno (2004) use a theoretical model to formalize these main empirical results. Aoki (2001) develops a two-sector dynamic general equilibrium model with a flexible-price sector along with a sticky-price sector and shows that the optimal monetary policy (characterized as an inflation-targeting regime) stabilizes core inflation rather than a broader measure of inflation. Benigno (2004) focuses on the optimal policy in a currency area and develops a two-region model. Benigno's main conclusion is that the optimal

²See Benigno (2004). A similar result holds in a two-sector model, as shown in Aoki (2001). We discuss these studies in the rest of the introduction.

plan can be approximated by what he calls a second-best solution. This allows for a context of asymmetric shocks and a different level of price rigidities between regions, and minimizes a welfare criterion that accounts for the exact magnitude of all the distortions in the economy. This is an inflation-targeting policy in which greater weight is given to inflation in those regions characterized by a higher degree of nominal rigidity.

Our paper extends this line of research. We use the microeconomic evidence on the frequency of price adjustments in the euro area to verify whether the “stickiness principle” underlined by the baseline models (Aoki 2001 and Benigno 2004) still holds in a more realistic multi-region setting. Moreover, given that differences in the frequency of price adjustment are significant not only across regions but also across sectors, we also investigate the difference between sectoral inflation targeting and regional inflation targeting. This aspect is of crucial importance for the ECB, which faces the challenge of aggregating euro-area inflation across sectors and regions.

We develop a multi-region/multi-sector model by focusing on ten regions and ten sectors, and go on to derive a microfounded welfare function. We then use this criterion to determine the unconditional optimal monetary policy as described in Woodford (2003), and we compare it with two alternative policy regimes: first, a pure inflation-targeting regime, in which aggregate inflation is based on weighting inflation for each region/sector according to its economic size, and second, an optimal inflation-targeting regime, in which the weights for each region’s/sector’s inflation are chosen optimally. We calculate the welfare deadweight loss of these two alternative regimes against the optimal policy that minimizes the microfounded welfare function.

The analysis establishes the following results. First, a pure inflation-targeting regime, in which aggregate inflation is based on inflation weighting for each region/sector according to its economy size, is always sub-optimal. The only exception is the case in which all regions/sectors have the same price stickiness. In all the other cases there is an optimal set of weights that do not coincide with the relative size of the regions/sectors. In addition, the optimal inflation target turns out to be a close proxy of optimal monetary policy since the welfare loss implied by these two monetary regimes is very similar.

Differing from a two-region model, the presence of multiple regions and asymmetric demand shocks that impact the natural level of relative prices produces optimal weights from complex interactions between the degree of price stickiness, economic size, and the distribution of the shocks within regions. In this case the “stickiness principle” is less evident. Our results show that implementing the optimal inflation target is a difficult task for the ECB, and there is not a simple rule-of-thumb rule that can be used to choose weights optimally.

Numerous related studies investigate optimal monetary policy under a variety of imperfections. Erceg, Henderson, and Levin (2000) consider the case of distortions in goods and labor markets, Huang and Liu (2005) study the effect of nominal rigidities in the production of intermediate goods, and Bodenstein, Erceg, and Guerrieri (2008) focus on optimal policy when shocks originate in an energy sector. The common policy prescription across these studies is that inflation stabilization should attach more weights to the sectors in which nominal rigidities are more pronounced, as they create larger real distortions. More recently, some studies have extended the design of monetary policy for a currency area in different directions, making such “stickiness principles” less clear cut. Lombardo (2006) considers a second source of heterogeneity across regions (i.e., a different degree of competition) together with the different degrees of nominal rigidity and shows that the weights attached to the region-specific inflation rates should increase with the degree of competition, implying an ambiguous outcome on the inflation weights if the model requires a positive correlation between price flexibility and degree of competition.

Benigno and Lopez-Salido (2006) deepen Benigno’s (2004) framework by assuming that a fraction of firms set prices in a backward-looking fashion. They find that the optimal inflation-targeting policy model, which reweights countries according to degrees of rigidity and their component of backward-looking firms and their output-gap stabilization policy, performs better than the HICP inflation targeting only for some calibrations of the model in terms of welfare, thus suggesting that it may not be desirable for the ECB to abandon HICP targeting. Finally, Eusepi, Hobijn, and Tambalotti (2011) develop a multi-sector New Keynesian model, calibrated to match U.S. data on price stickiness, labor shares, and inflation across sectors, to show that optimal inflation targeting can be closely approximated

by a core inflation target which does not include the more volatile components of the PCE-based price index.

The remainder of the paper is structured as follows. Section 2 provides evidence on heterogeneity in the euro-area across regions and sectors. Section 3 lays out the theoretical model. Section 4 derives the welfare function and outlines the optimal monetary policy and inflation-targeting plans. Section 5 describes the calibration of the model. Section 6 reports the results of the simulations. Section 7 contains the conclusions.

2. Heterogeneity in Euro-Area Regions and Sectors

In this section, we compare the size and frequency of price adjustment for regions and sectors within the euro area, using the micro evidence of price setting for euro-area countries in Dhyne et al. (2006). We focus on ten regions within this area and on ten macro sectors. The number of regions and sectors considered is primarily related to data availability on the frequency of price changes. We will use this information to calibrate the theoretical model described in the next section.

Consumer price inflation in the euro area is measured by the Harmonised Index of Consumer Prices (HICP), compiled by Eurostat and the national statistical institutes using harmonized statistical methods. Each member state measures the month-to-month movements in sector prices as an average of price indexes, using expenditure weights (n_s), which are an appropriate reflection of consumption patterns. The HICP is classified according to the four-digit categories and subcategories of the Classification of Individual Consumption by Purpose (COICOP). HICPs provide the basis for compiling the Monetary Union Index of Consumer Prices (MUICP), which provides the official measure of inflation in the euro area. The MUICP is calculated as a weighted average of the HICPs of the participating regions of the EMU, where the weights (n_r) are represented by the economic size of each region.³

³Up to 2000 the weight of a member state is calculated as the share of private domestic consumption expenditure in the EMU; from 2001 the region weight of a member state is calculated as the share of household final monetary consumption expenditure of the euro area.

The ECB remit is to maintain annual MUICP inflation rates below, but close to, 2 percent over the medium term. According to the theoretical academic results highlighted in the introduction, the ECB's choice to target aggregate inflation should consider not only the economic size of regions/sectors but also the distribution of price stickiness. The second column in table 1 reports the economic size of each region (top panel) and the economic size of each sector (bottom panel) in the economy, calculated according to consumer expenditure in each region or sector. Most of the larger regions measured in terms of consumption expenditure (e.g., Germany, Italy, and Spain), with the exception of France, show a higher degree of price stickiness. Looking at sectors, restaurants and hotels (which account for about 30 percent of total expenditure) show the lowest frequency of price adjustment, while the energy sector is the most flexible sector in terms of price changes. The importance of the frequency of price adjustment is evaluated in the fourth column by the duration of price contracts, which can be approximated by the reciprocity of price-change frequency.⁴

The frequency of price changes, calculated within the Eurosystem Inflation Persistence Network as an average over the period 1996–2001, represents the average share of prices that are revised in a given month (see Dhyne et al. 2006 for its calculation). The monthly frequency of price changes for the euro area is equal on average to 15 percent, while this works out to 24.8 percent for the United States, according to Bils and Klenow's (2004) calculations on a subsample of fifty products. According to Dhyne et al. (2006), the source of cross-region variation is likely to be both structural (consumption structure, outlet composition) and methodological (the treatment of sales and quality adjustment by each national statistical institute), or reflects differences in the relative importance of regulated prices across regions. Nevertheless, table 1 shows that there is a high degree of heterogeneity in price adjustments across both regions and sectors in the euro area, which may represent an effective challenge for the conduct of monetary policy.

⁴The duration of price contracts should be read with caution, given that according to Dhyne et al. (2006) the inverse frequency calculated as a proxy of average duration turns out to be systematically much lower than the average duration.

Table 1. Economic Size and Frequency of Price Adjustment in Europe

	Economic Size (n_r)	Frequency of Price Adjustment	Average Duration in Quarters
Italy	19.9	10.0	3.3
Spain	12.5	13.3	2.5
Germany	30.0	13.5	2.5
Austria	3.3	15.4	2.1
Netherlands	5.4	16.2	1.9
Belgium	3.5	17.6	1.6
Finland	1.6	20.3	1.6
France	21.2	20.9	1.6
Portugal	2.3	21.1	1.6
Luxembourg	0.3	23.0	1.4
Euro Area		15.1	2.2
United States		24.8	1.3
	Economic Size (n_s)	Frequency of Price Adjustment	Average Duration in Quarters
Restaurants and Hotels	30.3	4.2	7.9
Housing	2.7	6.5	5.1
Recreation and Culture	6.5	6.6	5.1
Furnishing and Household Equipment	5.0	7.2	4.6
Transport and Communications	8.5	7.2	4.6
Miscellaneous Goods and Services	4.8	7.3	4.5
Clothing	16.2	8.4	4.0
Processed Food	7.4	12.5	2.7
Unprocessed Food	7.8	37.2	0.9
Energy	10.8	78.8	0.4
Source: Dhyne et al. (2006) for euro-area data; Bils and Klenow (2004) for the United States. Notes: n_r: region share of household monetary consumption expenditure. n_s: expenditure weights which reflect the consumption patterns of households. Frequency of Price Adjustment: represents the average share of prices revised in a given month. Average Duration in Quarters: inverse of the frequency of price adjustment.			

3. The Model

We develop a multi-region model similar to Aoki (2001) and Benigno (2004) to accommodate the microeconomic evidence on price stickiness across regions and sectors described in the previous section. This addresses the question of what is the optimal inflation-targeting policy in a currency area such as the euro area.⁵ Ideally one would have to consider regions and sectors in a joint model with two degrees of heterogeneity within regions and between regions. In this paper, we are going to consider this model but with two different calibrations, focusing respectively on different frequencies of price adjustment across both regions and sectors.⁶

The economy is made up of a continuum of agents defined over the unit interval $[0, 1]$. Each agent manufactures a single differentiated product, u , and consumes a fraction of all the goods produced in the economy. In each region, a measure n_i of goods is produced, with $i = 1, 2, \dots, K$, and the total sum of produced goods is normalized equal to 1, such that $\sum_{i=1}^K n_i = 1$. All produced goods are traded across regions, and there is no migration across regions. Goods are differentiated and prices are set on a staggered basis. In the economy there is a single central bank and K fiscal authorities, each of which has sovereignty over one region only.

The demand side of the model comprises a household's j preferences defined by

$$U_t^j = E_t \sum_{s=t}^{\infty} \beta^{s-t} \left[U(C_s^j) + L \left(\frac{M_s^j}{P_s}, \xi^i \right) - V(y_s^j, z_s^j) \right],$$

where the upper index j denotes a variable that pertains to agent j , while the upper index i denotes a variable specific to region i . The term E_t denotes the expectation conditional on the information set at date t , and the parameter β is the intertemporal discount factor $0 \leq \beta \leq 1$. During each period s , each agent j gains utility from a consumer basket, C_s^j , of goods produced in region i , defined as

⁵The theoretical framework is also close and extends the works by Galí and Monacelli (2005) and Soffritti and Zanetti (2008).

⁶We thank an anonymous referee for this suggestion.

$$C_i^j \equiv \left[\left(\frac{1}{n^i} \right)^{\frac{1}{\sigma}} \int_{u \in i} c^j(u)^{\frac{\sigma-1}{\sigma}} du \right]^{\frac{\sigma}{\sigma-1}},$$

and this applies to the liquidity services of holding money (M_s^j/P_s), while he/she receives disutility from producing goods, $V(y_s^j, z_s^j)$.

The terms ξ^i and z_s^j denote exogenous shocks to (region-specific) money holdings and (agent-specific) disutility from production, respectively. The consumption index, C^j , is defined as $C^j \equiv [\prod_{i=1}^K (C_i^j)^{n_i}] [\prod_{i=1}^K n_i]^{-1}$, for $i = 1, 2, \dots, K$. The parameter $\sigma > 1$ is the elasticity of substitution across goods produced within a region,⁷ whereas the elasticity of substitution between the bundles C_i is set equal to 1. The total demand for each good u produced in region i is

$$y_i^d(u) = \left(\frac{p(u)}{P_i} \right)^{-\sigma} \left(\frac{C^W}{P_i^R} + G_i \right),$$

where $p(u)$ is the price of the product u ; C^W is union aggregate consumption (defined as $C^W \equiv \int_0^1 C^j dj$); P_i^R is the relative price in region i , defined as $P_i^R \equiv P_i/P$, where $P_i = \int_0^1 p(u) du$ and $P = [\prod_{i=1}^K (P_i)^{n_i}] [\prod_{i=1}^K n_i]^{-1}$; and G_i is public expenditure in region i .

Aggregate demand is represented by standard Euler equations derived by maximizing the utility function subject to budget constraints for each household j in each region i .

The supply side of the model comprises imperfectly competitive firms that set prices as in Calvo (1983). In each period, a seller faces a fixed probability $1 - \alpha$ of adjusting its price, and receives a subsidy τ^i that offsets the distortions generated by monopolistic competition in the steady state. Producers in the same region set similar prices since they face the same discounted future demands and future marginal costs under the hypothesis that the new price is maintained. The optimal price, $\tilde{p}_t(u)$, is given by

⁷In this model σ is common to all regions. For a heterogeneous degree of competition, see Lombardo (2006).

$$\tilde{p}_t(u) = \frac{\sigma}{(\sigma - 1)(1 - \tau^i)} \frac{E_t \sum_{k=0}^{\infty} (\alpha^i \beta)^k V_y(\tilde{y}_{t,t+k}^d(u), z_{t+k}^i) \tilde{y}_{t,t+k}^d(u)}{E_t \sum_{k=0}^{\infty} (\alpha^i \beta)^k \lambda_{t+k} \tilde{y}_{t,t+k}^d(u)}, \quad (1)$$

where $\tilde{y}_{t,t+k}^d(u)$ is the total demand for good u at time $t + k$, $\lambda_{t+k} = U_C(C_{t+k})/P_{t+k}$ with $U_C(C_{t+k})$ denoting the marginal utility of consumption, and $V_y(\tilde{y}_{t,t+k}^d(u), z_{t+k}^i)$ is the derivative of the disutility function $V(\cdot)$ with respect to total demand. The state equation for aggregate prices in each region is

$$P_{i,t}^{1-\sigma} = \alpha^i P_{i,t-1}^{1-\sigma} + (1 - \alpha^i) \tilde{p}_t(u)^{1-\sigma}, \quad (2)$$

for $i = 1, 2, \dots, K$. Aggregate supply is represented by standard New Keynesian Phillips curves derived by combining equations (1) and (2) for each region i .

The model is closed by requiring that the government of each region i maintain a balanced budget, and assuming that the instrument of monetary policy is set in terms of the one-period risk-free interest rate on the nominal bonds denominated in the common currency.

3.1 Equilibrium under Flexible and Sticky Prices

We first focus on fluctuations around the steady state in the flexible-price model since it is the relevant equilibrium for welfare evaluation. We then describe the model with sticky prices.

Before proceeding with the analysis, some of the notation we use should be clarified. We denote the log-deviation of X_t from its steady state in the flexible-price model with $\tilde{X}_t$, while $\hat{X}_t$ denotes the deviation of the same variable in the sticky-price model. A world variable X^W is defined as $X^W \equiv \sum_{i=1}^K n_i X_i$. In addition, X_i^R denotes a relative variable with respect to the world, defined as $X_i^R \equiv X_i - X^W$.

The solution of the model with flexible prices is described by the equations

$$\tilde{C}_t^W = \frac{\eta}{\rho + \eta} (\bar{Y}_t^W - g_t^W), \quad (3)$$

$$\tilde{Y}_t^W = \frac{\eta}{\rho + \eta} \bar{Y}_t^W + \frac{\rho}{\rho + \eta} g_t^W, \quad (4)$$

$$\tilde{P}_{i,t}^R = \frac{\eta}{1+\eta}(g_{i,t}^R - \bar{Y}_{i,t}^R), \quad (5)$$

where $\bar{Y}_{i,t}^R$ ($\bar{Y}_t^W$) and $g_{i,t}^R$ (g_t^W) are region-specific (world) shocks to supply and government purchase, respectively, and η and ρ are, respectively, the inverse elasticity of goods production and the intertemporal elasticity of consumption substitution. The natural interest rate, $\hat{R}_t$, in equilibrium, under zero inflation rate, is

$$\hat{R}_t = \frac{\rho\eta}{\rho+\eta} E_t[(\bar{Y}_{t+1}^W - \bar{Y}_t^W) - (g_{t+1}^W - g_t^W)]. \quad (6)$$

The solution of the model with sticky prices is described by the standard Euler and aggregate output equations:

$$E_t \hat{C}_{t+1}^W = \hat{C}_t^W + \rho^{-1}(\hat{R}_t - E_t \pi_{t+1}^W), \quad (7)$$

$$\hat{Y}_{i,t} = -\hat{P}_{i,t}^R + \hat{C}_t^W + g_t^i, \quad (8)$$

defined for each region $i = 1, 2, \dots, K$. Similarly, the aggregate supply equation for each region $i = 1, 2, \dots, K$, is equal to

$$\pi_t^i = \beta E_t \pi_{t+1}^i - k_P^i (\hat{P}_{i,t}^R - \tilde{P}_{i,t}^R) + k_C^i (\hat{C}_t^W - \tilde{C}_t^W), \quad (9)$$

which shows that region-specific inflation rates depend on the expectations of future price-setting behavior⁸ as well as on the deviations of both the union output gap from zero and relative prices from their natural rates.⁹ In addition, the definition of relative price for each region $i = 1, 2, \dots, K$ implies

$$\hat{P}_{i,t}^R = \hat{P}_{i,t-1}^R + \pi_t^i - \pi_t^W. \quad (10)$$

The equilibrium dynamics of the variables $\{\tilde{C}_t^W, \tilde{Y}_t^W, \tilde{P}_{i,t}^R, \tilde{R}_t, \hat{C}_t^W, \hat{Y}_{i,t}, \hat{P}_{i,t}^R, \hat{P}_{i,t}^R, \pi_t^i, \pi_t^W, \hat{R}_t\}$ is described by equations (3)–(10) together with the equation for the monetary policy rule and the definitions of world variables $\hat{C}_t^W$ and π_t^W .

⁸Benigno and Lopez-Salido (2006) allow for a hybrid model in which past inflation plays a role in the inflation dynamics that we do not consider.

⁹Note that $k_C^i \equiv [(1 - \alpha^i \beta)(1 - \alpha^i)/\alpha^i][(\rho + \eta)/(1 + \rho\eta)]$ and $k_P^i = k_C^i[(1 + \eta)/(\rho + \eta)]$.

3.2 Shocks Structure

Following Benigno (2004), we impose an asymmetric demand shock. We implement this shock by assuming that the natural level of relative prices $\tilde{P}_{i,t}^R$ moves proportionally to the exogenous process ζ_t defined as follows:

$$\tilde{P}_{i,t}^R = p_i \zeta_t$$

with

$$\zeta_t = \phi \zeta_{t-1} + \varepsilon_t,$$

where ε_t is a white-noise shock with zero mean and variance equal to σ_ε^2 . We assume that all regions show the same persistence of the shock affecting the flexible relative prices whose variance is $\sigma_{\tilde{P}_{i,t}^R}^2 = p_i^2 \sigma_\varepsilon^2$.

In order for the shock structure to be consistent, given that the shocks refer to relative prices, we need to impose the following constraint:

$$\sum_{i=1}^K n_i p_i = 0. \quad (11)$$

Equation (11) describes how the shock is distributed across regions. In a two-region model only the shock to one region needs to be imposed for the shock to the other region to be automatically calculated. In a multi-region case we can assume different distributions of the shock across regions that are consistent with equation (11).

In section 6 we investigate how both optimal inflation weights and welfare losses are affected by such alternative distributions.

4. Welfare Comparison

The main goal of the ECB is to stabilize the Monetary Union Index of Consumer Prices (MUICP), which is a weighted average of the single region's HICP index, where the weights are the economic size of each region. However, Benigno (2004) shows that in a two-region model with asymmetries in price rigidity, the optimal policy involves

giving higher weights to the inflation in regions with a higher degree of nominal rigidity. In order to investigate to what extent the two-region results hold in a multi-region setting, we derive the optimal monetary policy and then evaluate it against two alternative policy regimes: (i) a pure inflation-targeting regime, in which aggregate inflation weights the inflation of each region according to its economy size, and (ii) an optimal inflation-targeting regime, in which the weights to each region's inflation are chosen optimally.

The optimal monetary policy is obtained as the minimization of a deadweight loss from the discounted sum of a weighted average of the average utility flows of all households across all regions K , assuming that the liquidity services provided from holding real money balances are small. The welfare criterion is therefore defined as

$$\mathbf{W}_t = E_0 \sum_{j=0}^{\infty} \sum_{i=1}^K \beta^j n_i \left[U(C_{t+j}^i) - \int_0^1 V(y_{t+j}^i, z_{t+j}^i) dj \right]. \quad (12)$$

To evaluate welfare we use a second-order Taylor expansion of $\mathbf{W}_t$ around the steady state, as in Woodford (2003) and Benigno (2004), which leads us to rewrite equation (12) as $\mathbf{W}_t = -\Omega E_t \sum_{j=0}^{\infty} \beta^j L_{t+j}$, with

$$\begin{aligned} L_{t+j} = & \Lambda [c_{t+j}^W - \bar{c}^W]^2 + \Gamma \left[\sum_{i=1}^K n_i (\hat{P}_{i,t}^R - \tilde{P}_{i,t}^R)^2 \right] + \sum_{i=1}^K \varsigma_i (\pi_{t+j}^i)^2 \\ & + t.i.p. + o(\|\xi\|^3), \end{aligned} \quad (13)$$

where *t.i.p.* denotes parameters independent from policy, $o(\|\xi\|^3)$ includes terms of third or higher order, and the coefficients Ω , Λ , Γ , ς_i , and d^i are defined as

$$\begin{aligned} \Omega &\equiv \frac{1}{2} U_C \bar{C} \left(\sum_{i=1}^K n_i d^i \right) \sigma (1 + \sigma \eta), \\ \Lambda &\equiv \frac{1}{\sigma} \left(\sum_{i=1}^K n_i (k_C^i)^{-1} \right)^{-1}, \\ \Gamma &\equiv \frac{1}{\sigma} \left(\sum_{i=1}^K n_i (k_P^i)^{-1} \right)^{-1}, \end{aligned}$$

$$\varsigma_i \equiv \frac{n_i d^i}{\left(\sum_{i=1}^K n_i d^i\right)},$$

$$d^i \equiv \frac{\alpha^i}{(1 - \alpha^i)(1 - \alpha^i \beta)}.$$

The loss function (13) shows that a currency union has three sources of inefficiency: first, an inefficient output level; second, inefficient price dispersion; and third, inefficient response of relative prices to asymmetric shocks due to price stickiness. Equation (13) shows that the first-best option is one in which the central bank offsets the three inefficiencies. However, this outcome is not feasible if the degree of price stickiness differs across regions because of the mismatch between objectives and instruments.

As described in the next section, we use $\mathbf{W}_t$ to derive the optimal monetary policy. However, we use the unconditional expectation of the welfare function (as in Woodford 1999), to compare the welfare loss in alternative monetary policies:

$$W = 100 \cdot \Omega \cdot E(E_0 \mathbf{W}_{t+j})$$

$$W = -100 \cdot \Omega$$

$$\cdot \left[\Lambda \text{var}(\hat{y}_t^w) + \Gamma \sum_{i=0}^K n_i \text{var}(\hat{P}_{i,t}^R - \tilde{P}_{i,t}^R) + \sum_{i=0}^K \varsigma_i \text{var}(\hat{\pi}_{i,t}) \right], \quad (14)$$

where $U_C \bar{C}$ has been normalized to 1. The expectation E_0 is calculated at time zero based on all the information available at that date. Its conditionality is based on the initial conditions of the two state variables $\hat{P}_{i,t-1}^R = 0$ and $\tilde{P}_{i,t-1}^R = 0$. The expectation E is obtained by integrating over the stationary distributions of $\tilde{P}_{i,t,-1}^R$.

4.1 The Optimal Plan

The central bank chooses $\{\hat{y}_t^w, \hat{\pi}_{i,t}, \hat{P}_{i,t}^R\}$ to minimize the welfare function (12) subject to the New Keynesian Phillips curves (9) and the definition of relative prices (10). In this work we let $\varphi_{i,t}$ be the Lagrange multiplier associated with equation (9) and $\psi_{i,t}$ be the

Lagrange multiplier associated with equation (10), and assume the initial conditions $\varphi_{i,-1} = \psi_{i,-1} = \hat{p}_{i,-1} = 0$.

Having solved the optimization problem, we write the equilibrium conditions as a system of first-order stochastic difference equations:

$$A \cdot \hat{x}_{t+1} = B \cdot \hat{x}_t + C \cdot \varepsilon_t,$$

where the column vector $\hat{x}_{t+1}$ contains all the endogenous and exogenous variables of the model $\{\hat{y}_{t+1}^w, \hat{P}_{i,t+1}^R - \tilde{P}_{i,t+1}^R, \hat{\pi}_{i,t+1}, \psi_{i,t}, \tilde{P}_{i,t+1}^R, \hat{P}_{i,t}^R, \varphi_{i,t}\}$, while ε_t is the column vector of regional-specific shocks. The square matrices A and B are functions of the structural parameters of the model. The system is reduced to the following state-space form representation:

$$\begin{aligned}\hat{x}_t &= D \cdot \hat{s}_t \\ \hat{s}_t &= G \cdot \hat{s}_{t-1} + H \cdot \varepsilon_t,\end{aligned}$$

where the column vector $\hat{s}_t$ contains the state variables of the system $\{\tilde{P}_{i,t}^R, \hat{P}_{i,t-1}^R, \varphi_{i,t-1}\}$.

4.2 Inflation Targeting

As mentioned in the previous section, we use the optimal plan as a benchmark to evaluate the performance of alternative inflation-targeting rules. Following Benigno (2004), we focus on two different rules. The first one is a pure inflation-targeting rule where the measure of inflation that the central bank aims to stabilize is the average inflation rate of the K regions, which means

$$\sum_{i=0}^K n_i \hat{\pi}_{i,t} = \hat{\pi}_t^w = 0. \quad (15)$$

This measure of inflation resembles the actual goal of the ECB. Equation (15) can be interpreted as the MUICP, which is a weighted sum of the single region's HICP index weighted by the economic size of each region. We compare the welfare loss entailed by this rule with the one obtained under the optimal inflation targeting defined as

$$\sum_{i=0}^K \gamma_i^{opt} \hat{\pi}_{i,t} = 0,$$

where the weights γ_i^{opt} are not given by the economic size of the regions but chosen optimally in order to minimize the welfare loss (12) with the following constraints:

$$\gamma_i^{opt} \in [0, 1], \quad \text{for } i = 1 \dots K$$

and

$$\sum_{i=0}^K \gamma_i^{opt} = 1.$$

It can be easily shown that if the central bank follows an inflation-targeting rule, the variables $\{\hat{y}_t^w, \hat{\pi}_{i,t}, \hat{P}_{i,t}^R\}$ can be written as linear combinations of two groups of state variables: the relative prices $\hat{P}_{i,t-1}^R$ and the natural level of relative prices $\tilde{P}_{i,t}^R$. Hence the system of equations under the inflation-targeting assumption becomes

$$\hat{z}_t = D \cdot \hat{z}_{t-1} + H \cdot \varepsilon_t,$$

where $\hat{z}_t$ is the column vector of variables $\{\tilde{P}_{i,t+1}^R, \hat{y}_{t+1}^w, \hat{P}_{i,t+1}^R - \tilde{P}_{i,t+1}^R, \hat{\pi}_{i,t+1}, \hat{P}_{i,t}^R\}$. All the entries of the square matrix D are zeros, with the exception of the first and the last K columns corresponding to the state variables.

5. Calibration

To simulate the model, we calibrate the structural parameters. The level of price stickiness (α_c and α_s) and the economic sizes of the regions/sectors (n_c and n_s) are calibrated using micro data on price stickiness in Europe as well as the weights used by Eurostat to create the MUICP for regions and the HICP for sectors, as described in section 2 (table 1).

The structural parameters that are common across sectors and regions are calibrated following Benigno (2004) and Rotemberg and Woodford (1997). The intertemporal discount factor (β) is set equal to 0.99, which approximately corresponds to a gross real rate of

return (β^{-1}) of 1.01 on average and on a quarterly basis. The degree of monopolistic competition (σ) is set equal to 7.66, which corresponds to a markup of prices over marginal cost of around 15 percent.¹⁰ The risk-aversion coefficient (or the inverse of the intertemporal elasticity of substitution of consumption (ρ)), is set equal to 0.16 as in Benigno (2004).¹¹ Assuming that the average real wage with respect to variations in production is 0.5 in the euro area,¹² the value of ρ is compatible with an elasticity of labor supply equal to 0.67, which is in line with the micro and macro evidence, as described in Keane and Rogerson (2012). Assuming labor as the only input factor in the production function, such value implies that in the steady-state workers allocate around 60 percent of their time to working activity.

We set the parameter ϕ , which measures the degree of persistence of the Markovian process for the relative price under flexible prices, equal to 0.95 and the variance of the region-specific white-noise shocks σ_ϵ^2 equal to 0.0086². This is consistent with the international real-business-cycle literature on the calibration of asymmetric productivity shocks.

6. Results

In this section we present the results of the simulations. We start by considering whether our multi-region model is consistent with the two-region model developed in Benigno (2004). In order to replicate the same calibration exercise as in Benigno (2004), the ten regions are split into two macro regions of approximately equal size. For this purpose it is convenient to include Italy, Austria, Belgium, France, and Portugal in the first macro region, whereas we include Spain, Germany, the Netherlands, Finland, and Luxembourg in the second macro region. In this way the shares of aggregate consumption in these two macro regions work out to about 50.1 percent and 49.9 percent of the total. The size of each macro region is computed as

¹⁰We also experimented with values between 4 and 11, as in Carvalho (2006) and Nakamura and Steinsson (2008), and results remain robust.

¹¹We also try a risk-aversion coefficient equal to 1 as a robustness check.

¹²Rotemberg and Woodford (1997) calibrate a value of 0.47 for the United States. We also try this value for a robustness check.

the sum of the economic sizes of the regions belonging to it, and price stickiness is computed as a weighted average of the stickiness of each country within each macro region, where the weights are given by the economic size of each country (n_r).

In a model with two equal-sized regions, implementing an asymmetric shock to flexible relative prices, such as the one described in section 3.2, turns out to be straightforward, since the shock affecting the two macro regions has the same size and opposite sign. Although the two macro regions have different degrees of price stickiness, the changes in relative prices in the first region mimic exactly the changes in the second region. The same reasoning applies to inflation which has the same size and opposite sign in the two macro regions.

Table 2 reports the welfare reduction, expressed in terms of consumption units, for the three different policies derived in section 4: inflation targeting W_{IT} , optimal targeting W_{OT} , and optimal plan W_{OP} . The deadweight loss reduction (DR) represents the percentage reduction in the deadweight loss that society can obtain by using optimal inflation targeting instead of pure inflation targeting. The percentage reduction is calculated as

$$DR \equiv \frac{E[W_{IT}] - E[W_{OT}]}{E[W_{IT}] - E[W_{OP}]} \times 100.$$

Table 2 shows that optimal targeting outperforms inflation targeting. In fact, the implied welfare reduction measured by the unconditional loss function in equation (14) comes very close to that of the optimal plan. As pointed out in Benigno (2004), when the central bank is allowed to optimally choose the weights, it turns out to be welfare improving to assign higher weights (with respect to its economic size) to the region with more sluggish prices. The bottom panel of table 2 shows that the same applies if we consider sectors instead of regions. Given that price stickiness in the two macro sectors is very dispersed compared with the macro regions, the sector optimal weights turn out to be different from the ones imposed by pure inflation targeting.¹³

¹³Note that when we group together different regions, averaging their price stickiness and economic size, we disregard the differences across regions. However, the analysis is focused on evaluating what happens within each macro region

Table 2. A Two-Region/Two-Sector Model

Regions				
	Economic Size (n_r)	Shock Proportion (p_r)	Price Adjustment ($1 - \alpha_r$)	Optimal Weights (γ_r^{opt})
Macro Region 1	50.13	+	15.99	45.03
Macro Region 2	49.87	−	14.02	54.97
	Inflation Targeting	Optimal Targeting	Optimal Plan	DR
Welfare Reduction	−0.1035	−0.1021	−0.1021	97.84
Sectors				
	Economic Size (n_s)	Shock Proportion (p_s)	Price Adjustment ($1 - \alpha_s$)	Optimal Weights (γ_s^{opt})
Macro Sector 1	50.20	+	6.14	91.73
Macro Sector 2	49.80	−	27.74	8.27
	Inflation Targeting	Optimal Targeting	Optimal Plan	DR
Welfare Reduction	−0.1690	−0.0843	−0.0822	97.53
Notes: Macro Region 1: Italy, Austria, Belgium, France, Portugal; Macro Region 2: Spain, Germany, Netherlands, Finland, Luxembourg. Macro Sector 1: restaurants and hotels, housing, furnishing and household equipment, miscellaneous goods and services, processed food. Macro Sector 2: recreation and culture, transport and communications, clothing, unprocessed food, energy. DR: Deadweight loss reduction.				

The interaction among variables becomes more complex in a multi-region model. The central bank itself faces a minimization problem where the welfare loss depends on several variables (i.e., aggregate output gap, relative prices, and inflation rates for each region). Moreover, we need to decide how the different regions are

when we take explicitly into account that regions have a different economic size and a different degree of price stickiness. In particular, we are interested in testing whether the “stickiness principle” holds within each macro region or only between the two macro regions.

affected by asymmetric shocks to flexible relative prices. In fact, it differs from a two-region model because there are several alternative patterns of asymmetric shocks that satisfy the condition imposed by equation (11).

In this analysis we assume that half the regions experience a positive shock to their flexible relative price, which means that their relative prices increase, whereas the other half incurs a negative shock, with an implied relative price decrease. We also assume that the shock is uniformly distributed within each macro region.

As pointed out by Benigno (2004), when all regions have the same degree of price stickiness, the optimal weights coincide with the economic size of the regions, and pure inflation targeting leads to the same welfare loss as the optimal plan.¹⁴ When we relax this assumption, we are able to evaluate how the optimal weights change with the degree of price rigidity and the welfare gain implied by optimal inflation targeting.

In tables 3 and 4 we report the results of our multi-region model. In particular, we look, on the one hand, at different combinations of countries belonging to each of the two macro regions. In the top panel of both tables, regions are split into the same macro regions reported in table 2, whereas in the bottom panel of both tables we group the first five more rigid regions together and then the first five more flexible ones. On the other hand, in order to gain more insight into the results, we compare the case in which all regions have the same economic size (table 3) with that in which the observed size of each region is considered (table 4). Observing regions with the same economic size is interesting because it implies that the two macro regions have the same size and consequently are hit by shocks characterized by the same intensity and opposite sign. In other words, the regions in table 3 differ only in their price stickiness and the sign of the shock that affects their relative prices.

Tables 3 and 4 show that, although optimal inflation targeting clearly outperforms inflation targeting in terms of welfare reduction, results on the optimal weights tend to partially contrast with the “stickiness principle,” since the optimal weights are not strictly allocated according to the degree of rigidity in the frequency of price

¹⁴We confirm this result in a multi-region setting.

Table 3. Optimal Weights with Equal Economic Size (regions)

	Economic Size (n_r)	Shock Proportion (p_r)	Price Adjustment ($1 - \alpha_r$)	Optimal Weights (γ_r^{opt})
Italy	10.00	+	10.00	26.45
Austria	10.00	+	15.40	1.24
Belgium	10.00	+	17.60	3.09
France	10.00	+	20.90	12.23
Portugal	10.00	+	21.10	9.42
Spain	10.00	–	13.30	13.92
Germany	10.00	–	13.50	11.75
Netherlands	10.00	–	16.20	9.77
Finland	10.00	–	20.30	1.11
Luxembourg	10.00	–	23.00	11.03
Macro Region 1a	50.00	+	17.00	50.60
Macro Region 2a	50.00	–	17.26	49.40
	Inflation Targeting	Optimal Targeting	Optimal Plan	DR
Welfare Reduction	–0.0999	–0.0999	–0.0999	97.67
	Economic Size (n_r)	Shock Proportion (p_r)	Price Adjustment ($1 - \alpha_r$)	Optimal Weights (γ_r^{opt})
Italy	10.00	+	10.00	57.89
Spain	10.00	+	13.30	0.02
Germaay	10.00	+	13.50	0.02
Austria	10.00	+	15.40	0.03
Netherlands	10.00	+	16.20	10.34
Belgium	10.00	–	17.60	31.70
Finland	10.00	–	20.30	0.01
France	10.00	–	20.90	0.00
Portugal	10.00	–	21.10	0.00
Luxembourg	10.00	–	23.00	0.00
Macro Region 1b	50.00	+	13.68	65.58
Macro Region 2b	50.00	–	20.58	34.42
	Inflation Targeting	Optimal Targeting	Optimal Plan	DR
Welfare Reduction	–0.1107	–0.0987	–0.0985	98.79
Notes: Macro Region 1a: Italy, Austria, Belgium, France, Portugal; Macro Region 2a: Spain, Germany, Netherlands, Finland, Luxembourg. Macro Region 1b: Italy, Spain, Germany, Austria, Netherlands; Macro Region 2b: Belgium, Finland, France, Portugal, Luxembourg. DR: Deadweight loss reduction.				

Table 4. Optimal Weights with Unequal Economic Size (regions)

	Economic Size (n_r)	Shock Proportion (p_r)	Price Adjustment ($1 - \alpha_r$)	Optimal Weights (γ_r^{opt})
Italy	19.89	+	10.00	24.97
Austria	3.25	+	15.40	0.09
Belgium	3.51	+	17.60	0.18
France	21.19	+	20.90	14.96
Portugal	2.29	+	21.10	8.13
Spain	12.49	–	13.30	13.96
Germany	30.00	–	13.50	29.07
Netherlands	5.44	–	16.20	0.21
Finland	1.65	–	20.30	0.09
Luxembourg	0.29	–	23.00	8.33
Macro Region 1a	50.13	+	16.00	45.01
Macro Region 2a	49.87	–	14.02	54.99
	Inflation Targeting	Optimal Targeting	Optimal Plan	DR
Welfare Reduction	–0.1026	–0.1007	–0.1007	99.17
	Economic Size (n_r)	Shock Proportion (p_r)	Price Adjustment ($1 - \alpha_r$)	Optimal Weights (γ_r^{opt})
Italy	19.89	+	10.00	74.97
Spain	12.49	+	13.30	0.05
Germany	30.00	+	13.50	0.05
Austria	3.25	+	15.40	0.09
Netherlands	5.44	+	16.20	9.48
Belgium	3.51	–	17.60	15.34
Finland	1.65	–	20.30	0.01
France	21.19	–	20.90	0.01
Portugal	2.29	–	21.10	0.01
Luxembourg	0.29	–	23.00	0.00
Macro Region 1b	71.07	+	12.78	83.87
Macro Region 2b	28.93	–	20.50	16.13
	Inflation Targeting	Optimal Targeting	Optimal Plan	DR
Welfare Reduction	–0.0469	–0.0398	–0.0397	99.03
Notes: Macro Region 1a: Italy, Austria, Belgium, France, Portugal; Macro Region 2a: Spain, Germany, Netherlands, Finland, Luxembourg. Macro Region 1b: Italy, Spain, Germany, Austria, Netherlands; Macro Region 2b: Belgium, Finland, France, Portugal, Luxembourg. DR: Deadweight loss reduction.				

adjustment. In the specific examples that we put forward, the region with the higher degree of price adjustment rigidity within macro regions receives the highest weight. Italy, the most rigid region in table 3 (top panel), holds the highest weight (26.45 percent) and Spain, the most rigid region in the second macro group, holds the second highest weight (13.92 percent), although its price adjustment frequency is higher with respect to other regions. The same pattern emerges in the bottom panel, where the stickiest regions in the two macro regions are Italy (57.89 percent) and Belgium (31.70 percent). The optimal weights are not strictly allocated according to the sluggishness of their price adjustment, even though the less/more sticky macro region/sector receives a lower/higher weight with respect to its economic size, within each group.

The exercise shows that in a context of asymmetric shocks to relative prices, the optimal inflation weights are not exclusively related to price stickiness and economic size, but also to how the shocks are distributed across regions. The optimal weights are sensitive to the composition of the macro regions (top panel versus bottom panel) and to the economic size/shock intensity of the two macro regions (table 3 versus table 4), showing that there is no simple rule of thumb to establish the optimal weights.

Table 5 reports simulations on economic sectors and shows that the results are similar to the regional analysis. We still assume that half of the sectors receive a uniformly distributed positive shock to the flexible relative price and the other half a uniformly distributed negative shock. We include in the first group restaurants and hotels, housing, furnishing and household equipment, miscellaneous goods and services, and processed food, while in the second group we include recreation and culture, transport and communications, clothing, unprocessed food, and energy. Table 5 shows that the most sticky sector in each group receives the highest optimal weight. Interestingly, in line with the findings in the literature that proposes the stabilization of a core price index that excludes goods with a high frequency of price change (Bryan and Cecchetti 1994; Aoki 2001; Cogley 2002; Eusepi, Hobijn, and Tambalotti 2011), we observe that food and energy also receive very low weights in this context. Finally, for sectors, the welfare gain due to optimal inflation targeting is also high.

Table 5. Optimal Weights with Unequal Economic Size (sectors)

	Economic Size (n_s)	Shock Proportion (p_s)	Price Adjustment ($1 - \alpha_s$)	Optimal Weights (γ_s^{opt})
Restaurants and Hotels	30.30	+	4.20	63.27
Housing	2.70	+	6.50	0.24
Furnishing and Household Equipment	5.00	+	7.20	0.19
Miscellaneous Goods and Services	4.80	+	7.30	0.19
Processed Food	7.40	+	12.50	9.40
Recreation and Culture	6.50	–	6.60	0.42
Transport and Communications	8.50	–	7.20	1.00
Clothing	16.20	–	8.40	24.70
Unprocessed Food	7.80	–	37.20	0.58
Energy	10.80	–	78.80	0.01
Macro Sector 1a	50.20	+	6.14	91.74
Macro Sector 2a	49.80	–	27.74	8.26
	Inflation Targeting	Optimal Targeting	Optimal Plan	DR
Welfare Reduction	–0.151	–0.0834	–0.0834	99.99
	Economic Size (n_r)	Shock Proportion (p_r)	Price Adjustment ($1 - \alpha_r$)	Optimal Weights (γ_r^{opt})
Restaurants and Hotels	30.30	+	4.20	79.89
Housing	2.70	+	6.50	0.17
Recreation and Culture	6.50	+	6.60	0.17
Furnishing and Household Equipment	5.00	+	7.20	0.73
Transport and Communications	8.50	+	7.20	0.44
Miscellaneous Goods and Services	4.80	–	7.30	3.50
Clothing	16.20	–	8.40	15.01
Processed Food	7.40	–	12.50	0.01
Unprocessed Food	7.80	–	37.20	0.07
Energy	10.80	–	78.80	0.01
Macro Sector 1b	53.00	+	5.38	94.72
Macro Sector 2b	47.00	–	29.89	5.28
	Inflation Targeting	Optimal Targeting	Optimal Plan	DR
Welfare Reduction	–0.1523	–0.0738	–0.0738	99.99
Notes: Macro Sector 1a: restaurants and hotels, housing, furnishing and household equipment, miscellaneous goods and services, processed food; Macro Sector 2a: recreation and culture, transport and communications, clothing, unprocessed food, energy. Macro Sector 1b: restaurants and hotels, housing, recreation and culture, furnishing and household equipment, transport and communications; Macro Sector 2b: miscellaneous goods and services, clothing, processed food, unprocessed food, energy. DR: Deadweight loss reduction.				

7. Concluding Remarks

This paper investigates optimal inflation targeting for the euro area using a multi-region model with asymmetric demand shocks. The analysis shows that in a multi-region context the optimal weights result from complex interactions between the degree of price stickiness, economic size, and the distribution of the shocks within regions. A similar result holds when we use the model to match the different degrees of nominal price rigidities across sectors. Therefore, assigning higher weights to the regions or sectors with a higher degree of nominal rigidities is not necessarily the optimal policy, and there is no simple rule of thumb that the central bank can follow to guide the choice of the optimal weights. Simulations show that the welfare gain from choosing the weights optimally may be substantial compared with a pure inflation-targeting regime that weights each regional inflation rate according to the economic size of the region.

The analysis shows that further progress is needed for a comprehensive assessment on the welfare consequences of heterogeneity in nominal rigidities across regions and sectors. For instance, it would certainly be interesting to extend the model with a segmented labor market, reflecting the limited labor mobility in Europe. In addition, the analysis should also be extended to investigate other sources of heterogeneity such as heterogeneity in the labor shares or in the shocks disturbing each region and sector. Our paper particularly investigated the effect of asymmetric demand shocks that move relative prices across regions; however, more analysis is needed to extend the number of shocks included in the model to study their effect on the optimal weights and enable an empirical evaluation of the structural model. These investigations remain open for future research.

References

- Aoki, K. 2001. "Optimal Monetary Responses to Relative Price Changes." *Journal of Monetary Economics* 48 (1): 55–80.
- Benigno, P. 2004. "Optimal Monetary Policy in a Currency Area." *Journal of International Economics* 63 (2): 293–320.

- Benigno, P., and J. D. Lopez-Salido. 2006. "Inflation Persistence and Optimal Monetary Policy in the Euro Area." *Journal of Money, Credit and Banking* 38 (3): 587–614.
- Bils, M., and P. Klenow. 2004. "Some Evidence on the Importance of Sticky Prices." *Journal of Political Economy* 112 (5): 947–85.
- Bodenstein, M., C. J. Erceg, and L. Guerrieri. 2008. "Optimal Monetary Policy with Distinct Core and Headline Inflation Rates." *Journal of Monetary Economics* 55 (Supplement): S18–S33.
- Bryan, M. F., and S. G. Cecchetti. 1994. "Measuring Core Inflation." In *Monetary Policy*, ed. N. G. Mankiw, 195–219. University of Chicago Press.
- Calvo, G. 1983. "Staggered Prices in a Utility-Maximizing Framework." *Journal of Monetary Economics* 12 (3): 383–98.
- Carvalho, C. 2006. "Heterogeneity in Price Stickiness and the Real Effects of Monetary Shocks." *B.E. Journal of Macroeconomics* 6 (3): 1–58.
- Cogley, T. 2002. "A Simple Adaptive Measure of Core Inflation." *Journal of Money, Credit and Banking* 34 (1): 94–113.
- Dhyne, E., L. J. Alvarez, H. Le Bihan, G. Veronese, D. Dias, J. Hoffmann, N. Jonker, P. Lünemann, F. Rumler, and J. Vilmunen. 2006. "Price Changes in the Euro Area and the United States: Some Facts from Individual Consumer Price Data." *Journal of Economic Perspectives* 20 (2): 171–92.
- Erceg, C. J., D. W. Henderson, and A. T. Levin. 2000. "Optimal Monetary Policy with Staggered Wage and Price Contracts." *Journal of Monetary Economics* 46 (2): 281–313.
- Eusepi, S., B. Hobijn, and A. Tambalotti. 2011. "CONDI: A Cost-of-Nominal-Distortions Index." *American Economic Journal: Macroeconomics* 3 (3): 53–91.
- Galí, J., and T. Monacelli. 2005. "Monetary Policy and Exchange Rate Volatility in a Small Open Economy." *Review of Economic Studies* 72 (3): 707–34.
- Goodfriend, M., and R. King. 1997. "The New Neoclassical Synthesis and the Role of Monetary Policy." In *NBER Macroeconomics Annual 1997*, Vol. 12, ed. B. Bernanke and J. Rotemberg, 231–96. Cambridge, MA: MIT Press.
- Huang, K. X., and Z. Liu. 2005. "Inflation Targeting: What Inflation Rate to Target?" *Journal of Monetary Economics* 52 (8): 1435–62.

- Keane, M., and R. Rogerson. 2012. "Micro and Macro Labor Supply Elasticities: A Reassessment of Conventional Wisdom." *Journal of Economic Literature* 50 (2): 464–76.
- Lombardo, G. 2006. "Inflation Targeting Rules and Welfare in an Asymmetric Currency Area." *Journal of International Economics* 68 (2): 424–42.
- Nakamura, E., and J. Steinsson. 2008. "Five Facts about Prices: A Reevaluation of Menu Cost Models." *Quarterly Journal of Economics* 123 (4): 1415–64.
- Rotemberg, J., and M. Woodford. 1997. "An Optimization-Based Econometric Framework for the Evaluation of Monetary Policy." In *NBER Macroeconomic Annual 1997*, Vol. 12, ed. B. Bernanke and J. Rotemberg, 297–346. Cambridge, MA: MIT Press.
- Soffritti, M., and F. Zanetti. 2008. "The Advantage of Tying One's Hands: Revisited." *International Journal of Finance and Economics* 13 (2): 135–49.
- Woodford, M. 1999. "Optimal Monetary Policy Inertia." NBER Working Paper No. 7261.
- . 2003. *Interest and Prices*. Princeton, NJ: Princeton University Press.

The Effects of Liquidity Regulation on Bank Assets and Liabilities*

Patty Duijm^a and Peter Wierdsma^{a,b}

^aDe Nederlandsche Bank

^bVU University

Under Basel III rules, banks became subject to a liquidity coverage ratio (LCR) from 2015 onward, to promote short-term resilience. Investigating the effects of such liquidity regulation on bank balance sheets, we find (i) cointegration of liquid assets and liabilities, to maintain a minimum short-term liquidity buffer; and (ii) that adjustment in the liquidity ratio is skewed towards the liability side. This finding contrasts with established wisdom that compliance with the LCR is mainly driven by changes in liquid assets. Moreover, microprudential regulation has not prevented a procyclical liquidity cycle in secured financing that is strongly correlated with leverage.

JEL Codes: E44, G21, G28.

1. Introduction

The Basel Committee on Banking Supervision (BCBS) has introduced a liquidity coverage ratio (LCR) from 2015 onward. It requires banks to hold a sufficient level of high-quality liquid assets against expected net liquid outflows over a thirty-day stress period, to promote short-term resilience (BCBS 2009). The introduction of the LCR was motivated by the liquidity crisis of 2007–8, which occurred in combination with a solvency crisis. In this context, our contribution addresses two questions: (i) what is the impact of a liquidity constraint such as the LCR on individual bank behavior? and (ii)

*We thank, without implicating them, Clemens Bonner, Jan Willem van den End, Jon Frost, Leo de Haan, Dirk Schoenmaker, Robert Vermeulen, and John Williams for their helpful comments. The usual disclaimer applies. Author e-mails: p.duijm@dnb.nl and peter.wierdsma@dnb.nl.

what has been the role of liquidity regulation before, during, and after the liquidity and solvency crisis of 2007–8?

We study these questions by using a unique database for Dutch banks, which have been subject to liquidity regulation that is comparable to Basel III's LCR since 2003. We can systematically track liquid assets, liabilities, and their ratio during the upswing and downswing of the financial cycle. Moreover, to investigate the link between liquidity and capital regulation, we collected bank-level information on (core) capital, assets, and risk weights.

On the first question—i.e., the impact of the LCR on bank behavior—several studies assume that the causality runs from liabilities to assets. These studies find that banks adjust their assets in response to a negative funding shock (Berrospide 2012; De Haan and van den End 2013a, 2013b). An innovative element in our study is that we let the data determine the direction of causality. We argue that a constraint on the ratio between liquid assets and required liquidity implies that the two variables should be cointegrated, which is supported by our findings. The error-correction regressions indicate that banks adjust their liabilities—and to a lesser extent their liquid assets—when the LCR is above its equilibrium value, while the adjustment is even more skewed towards the liability side when the LCR is below its equilibrium value. In line with this finding, we find that wholesale funding (with a high run-off rate in the denominator of the LCR) has been replaced by more stable deposits during the aftermath of the crisis.

To address the second question—i.e., the role of liquidity regulation—we take a macroprudential perspective and investigate aggregate patterns in our variables before, during, and after the crisis. Results indicate a strong increase in the levels of available and required liquidity (the constituent parts of the LCR) before the financial crisis and a strong decrease afterwards. This cycle in short-term assets and liabilities occurs mostly through secured financing. It is accompanied by increasing leverage during the upturn and decreasing leverage during the downturn. This is in line with earlier results for the United States on the link between liquidity and leverage (Adrian and Shin 2010). Moreover, the LCR itself is strongly correlated with the leverage ratio and shows a procyclical pattern. During increased risk taking in the upturn of the financial cycle, “cheaper” short-term wholesale funding (with a high run-off rate in

the denominator of the LCR) is used to finance riskier and more profitable liquid assets (with a lower liquidity weight in the numerator), so that the LCR deteriorates. It is followed by de-risking and an increase in the LCR during the subsequent downturn. This finding of procyclicality implies that banks' short-term liquidity buffers are at their lowest point when the crisis starts, exactly when they are needed the most. At the same time, regulatory risk-weighted capital requirements have not been a binding constraint, partly due to the procyclicality of risk weights.

The rest of this paper is organized as follows. Section 2 presents our conceptual framework. Section 3 provides the estimation results on bank behavior under a liquidity constraint. Section 4 investigates aggregate patterns for liquidity and solvency. Section 5 concludes.

2. Conceptual Framework

The LCR is defined as a ratio with the numerator representing the amount of "high-quality liquid assets" (HQLA), i.e., assets that can be easily and immediately converted into cash at little or no loss of value (Bank for International Settlements 2013). Liquid assets primarily consist of cash, central bank reserves, and, to a certain extent, marketable securities, sovereign debt, and central bank debt.¹ The denominator is the net cash outflow within thirty days, which is the difference between outgoing and incoming cash flows.

The LCR is defined as

$$LCR = \frac{\text{High Quality Liquid Assets}}{\text{Cash outflows} - \text{Cash inflows}}, \quad (1)$$

where the cash outflows are subject to prescribed run-off rates and the cash inflows are subject to prescribed haircuts in order to assign

¹There are two categories of assets that can be included in the stock of HQLA: level 1 assets can be included without a limit, while level 2 assets can only comprise up to 40 percent of the stock. Level 1 assets are limited to cash, central bank reserves, and marketable securities representing claims on or guaranteed by, e.g., sovereigns, central banks, and the BIS (with a 0 percent risk weight under the standardized approach for credit risk). Sovereign or central bank debt can, under certain conditions (BIS 2013), also be reported as level 1 assets. Level 2 assets consist of other marketable securities, corporate debt securities, and covered bonds that satisfy certain conditions. See BIS (2013) for a comprehensive definition of HQLA.

these items a liquidity weight. The similarity between Basel III and the existing Dutch supervisory framework makes it possible to construct a comparable measure for the LCR; the Dutch liquidity coverage ratio (DLCR).

In line with previous studies (e.g., Bonner 2012; De Haan and van den End 2013a), the DLCR is defined as

$$DLCR_{i,t} = \frac{AL_{i,t}}{RL_{i,t}} = \frac{\sum_j a_j \cdot Asset_{i,j,t} + \sum_k b_k \cdot Inflow_{i,k,t}}{\sum_l c_l \cdot Liability_{i,l,t} + \sum_m d_m \cdot Outflow_{i,m,t}}, \quad (2)$$

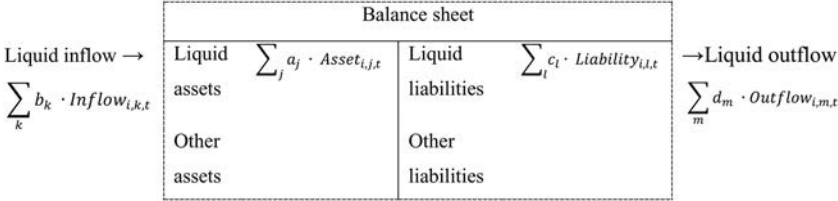
where $AL_{i,t}$ and $RL_{i,t}$ stand for, respectively, available liquidity and required liquidity of bank i at time t . The variables a_j , b_k , c_l , and d_m represent the regulatory weights for the assets j , cash inflows k , liabilities l , and cash outflows m . Hence, available liquidity is defined as the weighted stock of liquid assets plus the weighted cash inflows scheduled within the coming month. The liquidity weight on assets is defined as 100 minus the haircut. These haircuts are determined by the supervisor and aim to reflect the lack of market liquidity in times of stress. Required liquidity is defined as the weighted stock of liquid liabilities plus the weighted cash outflows scheduled within the coming month. The liquidity weight on liabilities is defined as the run-off rate. These run-off rates aim to reflect the probability of withdrawal and hence the funding liquidity risk.

The LCR and the DLCR reflect the same regulatory philosophy and are very similar. The main differences are the regulatory weights. In particular, the stock of HQLA is more narrowly defined for the LCR than for the DLCR. For the latter, the haircuts and run-off rates were determined by the Dutch regulator under the “Liquidity Regulation under the Wft,” for the first time in January 2003.² There has been one structural change during the period under consideration. In May 2011, the Dutch Central Bank supplemented its existing rules with the “Liquidity Regulation under the Wft 2011.”³

²Wft stands for “Wet op het financieel toezicht,” the Dutch Financial Supervision Act.

³The main change is a narrower definition of liquid assets; specifically, the haircuts for debt instruments issued by credit institutions and other institutions (e.g., corporate bonds) have been increased due to the perceived illiquidity of these assets under stressed markets. At the same time, the run-off rate for

Figure 1. Stylized Bank Balance Sheet



In part, the changes anticipated the new international rules, related to the Basel III requirements.

Given the similarity between the Dutch regulatory framework and the Basel III regulation, we will use the DLCR to study the effects of liquidity regulation on bank behavior. To comply with the DLCR, banks manage their balance sheet so that their available liquidity is larger than or equal to their required liquidity. To reduce the probability of non-compliance due to shocks in their liquidity position, banks aim for a positive margin between actual liquidity and required liquidity. However, a high liquidity buffer above the regulatory minimum is costly, as less-liquid assets (e.g., corporate bonds) and less-stable funding (e.g., short-term wholesale funding) might be more profitable. As a result of these two opposing forces, we expect banks to aim for a stable long-term relationship between available and required liquidity.

As both components of the DLCR belong to the same balance sheet (see figure 1), there should be a relation between actual liquidity and required liquidity. This relation defines their co-movement over time, although the causality is unknown *ex ante*. We expect this long-term relationship partly to be determined by bank-specific characteristics, such as its size (e.g., whether it is seen as “too big to fail”) and its business profile. In sum, we hypothesize that the series for available and required liquidity are cointegrated with bank-specific equilibria.

demand deposits has been decreased to reflect their observed stability during the crisis. Overall, the adjustments have led to more stringent liquidity standards.

3. Estimation Results

3.1 *Unit-Root Tests and Cointegration*

To test this hypothesis, we use monthly data from the Dutch supervisory liquidity report over the period July 2003 until April 2013. The report includes detailed information on liquid assets and liquid liabilities at an individual bank level for all banks subject to the liquidity regulation. We use data for fifty-nine banks for which the reported data are complete for the whole period under consideration.⁴ Ideally our data set would have been long enough to cover several financial cycles; however, it gives us some comfort that our data set covers at least the upswing and downswing of one financial cycle.

The long-run relationship between actual liquidity and required liquidity can only be estimated if the series are non-stationary and integrated at the same order. Given the expected heterogeneity in bank behavior, we use a panel unit-root test that allows for different individual fixed effects in the intercepts and slopes of the cointegration equation. Out of the full sample of fifty-nine banks, the series actual liquidity and required liquidity are both integrated at order 1 for forty-one banks (see tables 1 and 2). Hence, we test for cointegration only for those banks. The results in table 3 indeed strongly reject the null hypothesis of no cointegration against the alternative of cointegration for each individual bank.⁵

3.2 *Error-Correction Model*

Given the finding of cointegration at the individual bank level, the long-run equilibrium relationship can be estimated by fully modified ordinary least squares (FMOLS) for heterogeneous cointegrated

⁴The underlying data are confidential. Where we show estimation results for individual banks, we number them randomly so that results cannot be traced back to actual banks. Moreover, we only show aggregate data or estimation results and not the underlying data.

⁵We use Pedroni's (2001) cointegration test, since it allows for cross-sectional interdependence with different individual effects in the intercepts and slopes of the cointegration equation (i.e., a bank-specific long-run equilibrium).

Table 1. Panel Unit-Root Test

This table shows the results of the panel unit-root test based on the Im-Pesaran-Shin (IPS) method, where the null hypothesis is that of a unit root. The appropriate number of lags is selected by Schwarz information criterion (SIC). The p-values are shown in parentheses. *** denotes the 1 percent significance level. Based on the results for the full sample, the data set is limited to banks with time series that are integrated at order 1. The decision for exclusion is made based on the presence of a unit root at the 5 percent significance level (see table 2).

	Actual Liquidity		Required Liquidity	
	Level	First Differences	Level	First Differences
<i>Full Sample (Fifty-Nine Banks)</i>				
# Obs. Test Statistic	6,808 -6.653 (0.000)***	6,766 -88.193 (0.000)***	6,788 -9.522 (0.000)***	6,731 -92.021 (0.000)***
<i>Limited Sample (Forty-One Banks)</i>				
# Obs. Test Statistic	4,722 -0.657 (0.256)	4,710 -72.827 (0.000)***	4,703 1.076 (0.859)	4,691 -77.239 (0.000)***

Table 2. Intermediate Unit-Root Results

This table shows the individual augmented Dickey-Fuller (ADF) test results for all individual time series. The null hypothesis of a unit root (non-stationarity) is tested against the alternative that there is no unit root. The results in table 1 show that the null hypothesis cannot be rejected for all fifty-nine series. However, the intermediate ADF results indicate that most of the series suggest non-stationarity, meaning that the series are integrated at order 1 for forty-one banks. The appropriate number of lags is selected by SIC. *, **, and *** denote 10 percent, 5 percent, and 1 percent significance levels, respectively.

Bank	Actual Liquidity		Required Liquidity		Bank	Available Liquidity		Required Liquidity	
	Probability	Lag	Probability	Lag		Probability	Lag	Probability	Lag
1	0.44	0	0.46	0	16	0.09	0	0.03**	2
2	0.58	0	0.99	2	17	0.54	2	0.99	4
3	0.07	3	0.65	5	18	0.99	9	0.85	2
4	0.79	0	0.81	0	19	0.30	2	0.35	0
5	0.00***	1	0.00***	2	20	0.00***	0	0.02**	1
6	0.19	3	0.33	3	21	0.68	0	0.72	5
7	0.29	1	0.81	7	22	0.00***	0	0.00***	0
8	0.99	0	1.00	2	23	0.16	6	0.05	11
9	0.40	2	0.64	2	24	0.00***	0	0.00***	0
10	0.28	0	0.06*	0	25	0.12	1	0.71	1
11	0.24	2	0.13	2	26	0.30	0	0.30	0
12	0.38	4	0.51	4	27	0.43	4	0.24	2
13	0.61	0	0.55	0	28	0.35	1	0.19	2
14	0.57	3	0.82	3	29	0.76	2	0.00***	6
15	0.00***	0	0.00***	0	30	0.01**	2	0.04**	2

(continued)

Table 2. (Continued)

Bank	Actual Liquidity		Required Liquidity		Bank	Available Liquidity		Required Liquidity	
	Probability	Lag	Probability	Lag		Probability	Lag	Probability	Lag
31	0.62	1	0.00***	0	46	0.01**	0	0.47	2
32	0.85	0	0.33	5	47	0.89	12	0.00***	0
33	0.25	0	0.19	0	48	0.59	2	0.19	1
34	0.36	2	0.58	2	49	0.00***	0	0.00***	0
35	0.33	1	0.51	2	50	0.31	1	0.75	1
36	0.29	2	0.36	2	51	0.46	0	0.03**	2
37	0.00***	0	0.00***	0	52	0.48	2	0.77	2
38	0.27	0	0.39	0	53	0.28	1	0.05**	1
39	0.34	5	0.32	5	54	0.12	0	0.12	1
40	0.07*	1	0.07*	1	55	0.03**	1	0.28	1
41	0.30	1	0.87	1	56	0.00***	0	0.00***	0
42	0.62	1	0.64	1	57	0.34	3	0.48	2
43	0.29	6	0.54	4	58	0.94	2	0.86	3
44	0.34	2	0.39	2	59	0.63	1	0.18	2
45	0.00***	0	0.11	2					

Table 3. Cointegration Test Results

This table shows the results of Pedroni’s cointegration test. The null hypothesis of no cointegration is tested against the alternative that a cointegrating vector exists for each individual bank. The table shows panel statistics (left column) and group statistics (right column). The appropriate number of lags for each individual time series is selected by SIC. p-values are in parentheses. *** denotes the 1 percent significance level.

	Within Dimension		Between Dimension	
Panel v-Statistic	9.764***	(0.000)	Group rho-Statistic	-33.845*** (0.000)
Panel rho-Statistic	-14.877***	(0.000)	Group PP-Statistic	-20.493*** (0.000)
Panel PP-Statistic	-10.809***	(0.000)	Group ADF-Statistic	-11.473*** (0.000)
Panel ADF-Statistic	-10.781***	(0.000)		
Notes: The panel-statistics approach pools over the “within” dimension. It tests the null hypothesis that the first-order autoregressive coefficient on the residuals is the same for each individual bank. The group-statistics approach pools over the “between” dimension. It allows the autoregressive coefficient to differ for each individual.				

panels. The bank-specific long-run equilibrium relationship between actual liquidity and required liquidity is given by

$$AL_{i,t} = \alpha_i^{AL} + \hat{\beta}_{i,FMOLS}^{AL} RL_{i,t} + \varepsilon_{i,t}, \quad (3)$$

where α_i^{AL} represents the individual fixed effects, and $\hat{\beta}_{i,FMOLS}^{AL}$ is the FMOLS estimator correcting for heterogeneity and serial correlation by adjusting the initial OLS estimator.

The lagged residuals from equation (3) define the error-correction terms (*ECT*) in the following vector error-correction model:

$$\Delta AL_{i,t} = \alpha_i^{AL} + \rho^{AL} ECT_{i,t-1}^{AL} + \gamma_i \Delta RL_{i,t-1} + u_{i,t}^{AL}, \quad (4)$$

where α_i^{AL} represents the individual fixed effects, $\Delta AL_{i,t}$ represents the level change of actual liquidity from time $t - 1$ to time t , and ρ^{AL} represents the error-correction speed of adjustment of actual liquidity. $\Delta RL_{i,t-1}$ is included to control for short-term adjustments, and $u_{i,t}^{AL}$ is the error term. The same approach can be applied for required liquidity.⁶ To check for convergence to the long-run equilibrium, the estimated speed-of-adjustment coefficient should show a negative sign. This so-called Engle and Granger (1987) two-step procedure is applied to make inferences about the direction of causality. Under this model, long-run causality is revealed by the statistical significance of the adjustment coefficient ρ^{AL} .

The results are shown in the first row of table 4. These imply that when a bank moves away from its long-run equilibrium, it adjusts both assets and liabilities, and that the adjustment is skewed toward the liability side of the balance sheet. That is, as the liquidity buffer is above (below) equilibrium, banks decrease (increase) their available liquidity and increase (decrease) their required liquidity. The estimated coefficient of -0.098 for available liquidity indicates that, after a shock to the long-run equilibrium, about 10 percent of this disequilibrium is corrected within one month through an adjustment in liquid assets. Likewise, the estimated coefficient of -0.221 for required liquidity indicates that about 22 percent of this disequilibrium is corrected within one month through an adjustment in liabilities. Given that required liquidity is determined by

⁶Then equations (3) and (4) will be replaced by, respectively, $RL_{i,t} = \alpha_i^{RL} + \hat{\beta}_{i,FMOLS}^{RL} AL_{i,t} + \varepsilon_{i,t}$ and $\Delta RL_{i,t} = \alpha_i^{RL} + \rho^{RL} ECT_{i,t-1}^{RL} + \gamma_i \Delta AL_{i,t-1} + u_{i,t}^{RL}$.

Table 4. (Asymmetric) Adjustment Coefficients

This table shows the error-correction terms from the generalized least squares (GLS) results for the (threshold) error-correction model for forty-one banks over the period July 2003–April 2013 (4,749 observations). The heteroskedasticity of the error terms is corrected by using White robust standard errors, and the standard deviations are displayed in parentheses. Cross-section weights are used, and ** and *** denote 5 percent and 1 percent significance levels, respectively.

	Dependent Variable		Dependent Variable	
Symmetric	ΔAL	ρ^{AL}	ΔRL	ρ^{RL}
Asymmetric	ΔAL	ρ_{below}^{AL}	ΔRL	ρ_{below}^{RL}
	ΔAL	ρ_{above}^{AL}	ΔRL	ρ_{above}^{RL}

the weighted liabilities and cash outflows, the results indicate that banks adjust their funding mix—and to a lesser extent their portfolio allocation—when their liquidity position has changed.

A drawback of this first model is that it does not allow for asymmetric adjustment, i.e., it does not distinguish situations in which the liquidity buffer is above and below average. Banks may need to adjust more strongly when their DLCR falls below its long-run equilibrium and approaches the regulatory minimum. To allow for this asymmetry, two dummy variables are introduced:

$$I_{i,t}^{AL} = \begin{cases} 1 & \text{if } ECT_{i,t-1}^{AL} < 0 \\ 0 & \text{if } ECT_{i,t-1}^{AL} \geq 0 \end{cases} \quad I_{i,t}^{RL} = \begin{cases} 1 & \text{if } ECT_{i,t-1}^{RL} \geq 0 \\ 0 & \text{if } ECT_{i,t-1}^{RL} < 0. \end{cases} \quad (5)$$

The asymmetric error-correction model is estimated by

$$\Delta AL_{i,t} = \alpha_i^{AL} + I_{i,t}^{AL} \rho_{below}^{AL} ECT_{i,t-1}^{AL} + (1 - I_{i,t}^{AL}) \rho_{above}^{AL} ECT_{i,t-1}^{AL} + \gamma_i^{AL} \Delta RL_{i,t-1} + v_{i,t}^{AL} \quad (6)$$

$$\Delta RL_{i,t} = \alpha_i^{RL} + I_{i,t}^{RL} \rho_{below}^{RL} ECT_{i,t-1}^{RL} + (1 - I_{i,t}^{RL}) \rho_{above}^{RL} ECT_{i,t-1}^{RL} + \gamma_i^{RL} \Delta AL_{i,t-1} + v_{i,t}^{RL}, \quad (7)$$

where $\rho_{below}^{AL}(\rho_{above}^{AL})$ and $\rho_{below}^{RL}(\rho_{above}^{RL})$ represent the error-correction speed-of-adjustment coefficients given that a bank is below (above) its average liquidity level.

The results in the second row of table 4 suggest that the adjustment on the liability side becomes stronger when the DLCR is below its equilibrium. On average, 31 percent of the deviation from the long-run equilibrium is corrected within one month by a decrease in required liquidity. At the same time, adjustment on the asset side becomes slightly weaker and less significant, with only a 6 percent change in available liquidity. When shocks move the DLCR above its long-run equilibrium, banks decrease liquid assets and increase short-term liabilities. On average, shifts in liquid assets and liabilities both correct approximately 13–14 percent of the deviation from the long-run equilibrium.

3.3 *Robustness Check*

As indicated already, regulatory changes to the DLCR were introduced in May 2011. As this may lead to a structural break, and in order to exclude anticipation effects, we rerun the estimations for the period up to end-2010. Table 5 presents the results. The outcomes indicate an even stronger adjustment toward the liability side of the balance sheet.

3.4 *Discussion of Results*

Our estimations indicate that a regulatory liquidity constraint influences bank behavior, and that Dutch banks primarily adjust their funding mix when their DLCR falls below its long-run equilibrium. This section briefly compares our results with the academic literature on the effects of liquidity regulation on bank behavior.⁷

Several authors investigate the effects of liquidity regulation on banks' liquid assets. De Haan and van den End (2013a) examine the liquidity management of Dutch banks. They model the stock of liquid assets as a function of the stock of liquid liabilities and the future cash inflows and outflows. A key finding is that banks keep liquid assets as a buffer against both the stock of liquid liabilities and net cash outflows. In another study, De Haan and van den End (2013b) find that in response to negative funding liquidity shocks, Dutch banks reduce wholesale lending, hoard liquidity in the form of liquid bonds and central bank reserves, and conduct fire sales of

⁷To save space, we focus only on studies based on econometric evidence, as it is closest to ours. In addition, there is a literature on the wider economic effects of liquidity regulation, which also focuses mainly on the asset side. Examples are King (2010), Perotti and Suarez (2010), and Wagner (2013). Other studies highlight that the LCR may provide incentives for increased reliance on central bank funding; these studies include Ayadi, Arbak, and De Groen (2012), European Banking Authority (2012), and Coeuré (2013). However, the data discussed in section 4 indicate that the reliance on central bank funding is limited for Dutch banks. Toward the end of the observation period, claims on the central bank increase markedly and outweigh reliance on central bank funding. This is consistent with the argument that the Netherlands was seen as a safe haven during the sovereign crisis of 2011–12. A possible effect of liquidity regulation on central bank funding could therefore better be studied in countries where the reliance on central bank funding is higher.

Table 5. Robustness Check

This table shows the generalized least squares (GLS) results for the (threshold) error-correction model for forty-one banks over the period July 2003–December 2010 (3,649 observations). The heteroskedasticity of the error terms is corrected by using White robust standard errors, and the standard deviations are displayed in parentheses. Cross-section weights are used, and ** and *** denote 5 percent and 1 percent significance levels, respectively.

	Dependent Variable		Dependent Variable	
Symmetric	ΔAL	ρ^{AL}	ΔRL	ρ^{RL}
Asymmetric	ΔAL	ρ_{below}^{AL}	ΔRL	ρ_{below}^{RL}
	ΔAL	ρ_{above}^{AL}	ΔRL	ρ_{above}^{RL}

−0.292***
(0.020)
−0.357***
(0.036)
−0.215***
(0.043)

securities, especially equities.⁸ Using data on U.S. commercial banks, Berrospide (2012) studies the behavior of banks' liquid assets as a function of banks' size, their capital ratio, their unused commitment ratio, and their share of core deposits (as a proxy for the role of stable sources of funding). The author finds that stable sources of funding, such as deposits and bank capital, are key determinants of the holdings of liquid assets.

Overall, the econometric approach in the aforementioned studies relies on the assumption that banks adjust liquid assets in response to shifts in their funding profile. Hence, our finding that adjustment can also take place on the liability side of the balance sheet complements the existing literature. More recently, Banerjee and Mio (2014) point to the effects of liquidity regulation on both assets and liabilities. Their study is closest to our approach. They find that banks that became subject to liquidity regulation significantly increased their share of HQLA. At the same time, banks also increased their share of domestic retail deposits, offset by a similar reduction in short-term wholesale funding and non-resident deposits. The main difference with our paper is that we study the adjustment to liquidity shocks after the regulation has been put in place, and we rely on cointegration instead of causal regressions.

4. Aggregate Data

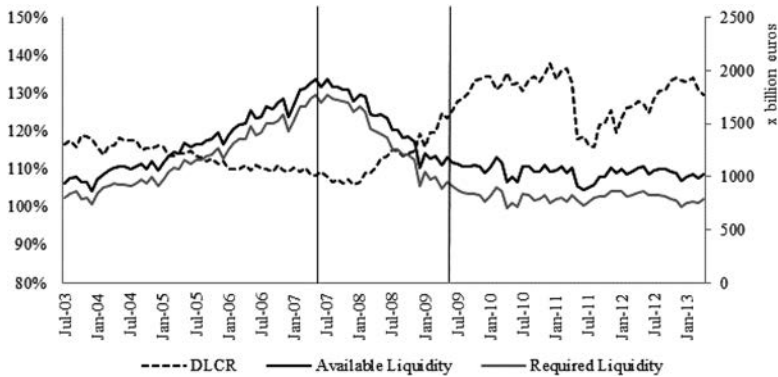
4.1 *Patterns around the Crisis*

We now turn to the second question on the role of liquidity regulation before, during, and after the liquidity and solvency crisis of 2007–8. To do so, we shift focus from bank-level data toward aggregate patterns in the data for the Dutch banking sector as a whole. Figure 2 shows the average level of the DLCR for all banks in the sample and its development over time.

At the aggregate level, available liquidity always lies above required liquidity, so that the DLCR requirement is respected and

⁸The authors suggest that the positive relation between equity holdings and secured funding could also reflect the use of equities in repos and securities lending transactions. When these activities are buoyant, banks' equity holdings are useful as collateral, while these become less useful when the secured funding market collapses.

Figure 2. Dutch Liquidity Coverage Ratio (DLCR) and Its Components



Notes: The graph displays the aggregate level of liquidity of fifty-nine Dutch banks for the period July 2003 until April 2013. The DLCR (left scale) is defined as the ratio of available liquidity over required liquidity. The available and required liquidity are given in billion euros (right scale) on a monthly basis.

minimum short-term liquidity buffers are maintained. As expected, available and required liquidity show strong co-movements, also at the aggregate level. Both series increase strongly in the run-up to the financial crisis, so that the aggregate balance expands strongly, and then decrease during the crisis. These large movements in available and required liquidity mainly cancel out in the ratio, but not fully. In the run-up to the crisis, required liquidity increases somewhat faster than available liquidity. As a result, the DLCR decreases gradually towards the direction of the regulatory minimum ratio of 1. During the crisis, required liquidity decreases more strongly than available liquidity, so that the DLCR shows a substantial increase. This suggests a procyclical pattern of increased risk taking in the upswing of the financial cycle, i.e., a move toward “cheaper” wholesale funding (with a high run-off rate in the denominator of the DLCR). It also suggests de-risking during the crisis, when wholesale funding dries up and needs to be replaced by more stable funding sources.

The aggregate data contradict established wisdom that changes in liquid assets are driving the liquidity ratio. On the contrary, the DLCR decreases in the run-up to the financial crisis, while

the amount of liquid assets increases. The DLCR then strongly increases during the crisis, while liquid assets fall. Finally, the data show that the liquidity crisis of 2007–8, characterized by a strong outflow of both liquid assets (decrease in available liquidity) and liabilities (decrease in required liquidity), is directly visible in the individual series but not in the ratio, as it shows a substantial increase.

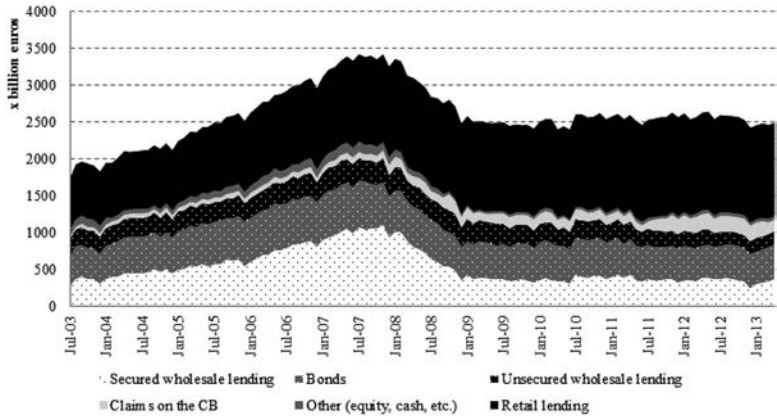
Unfortunately, the data do not include the run-up to the introduction of the liquidity regulation. This is a limitation of our study: we cannot make inferences on a possible level shift in liquid assets and liabilities due to the introduction of a binding liquidity ratio.⁹ However, we do observe data around the regulatory changes of May 2011. Data show a fall in available liquidity, due to an increase in haircuts, that leads to a drop in the DLCR. This is followed by a gradual increase in the DLCR that is mostly driven by available liquidity, toward a similar level to that observed during October 2009–May 2011.

4.2 Balance Sheet Composition

Figures 3–6 provide an overview of the shifts in total assets and liabilities for the Dutch banking sector as a whole, and total assets and liabilities weighted by their liquidity value (i.e., available and required liquidity). On the asset side, secured wholesale lending, consisting of (reverse) repos and securities lending, increases steadily over 2003–7 and then declines strongly during the crisis. As secured wholesale lending is defined as highly liquid, it accounts for most of the dynamics in available liquidity. Likewise, on the liability side, the strongest dynamics are observed in secured wholesale funding, which mainly consists of repos. Moreover, over time, we observe a shift from wholesale funding toward retail demand deposits (with a low run-off rate). Overall, it appears that the liquidity components of the aggregate balance sheet reflect rapid balance sheet expansion and contraction over the financial cycle, driven by both secured funding and lending.

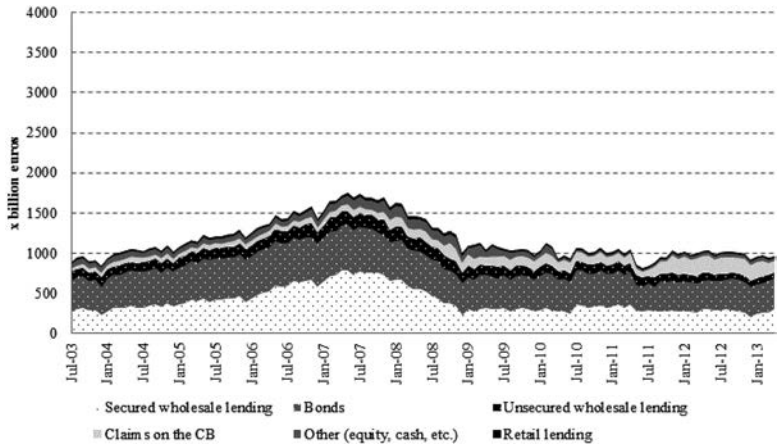
⁹For the United Kingdom, Banerjee and Mio (2014) find that an increase in liquid assets has been one of the effects of the introduction of liquidity regulation.

Figure 3. Breakdown of Total Assets



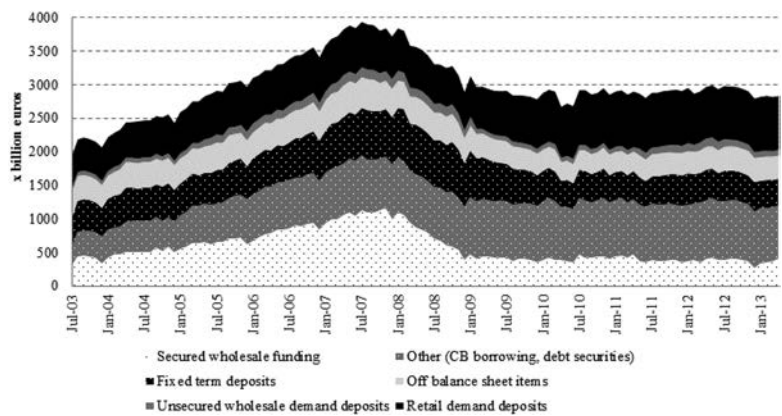
Notes: This figure shows the aggregate asset allocation for the full sample of fifty-nine banks over time, based on consolidated balance sheets. The order of the series is as follows, from bottom to top: secured wholesale lending, bonds, unsecured wholesale lending, claims on the CB, other (equity, cash, etc.), retail lending.

Figure 4. Breakdown of Available Liquidity (liquidity-weighted assets)



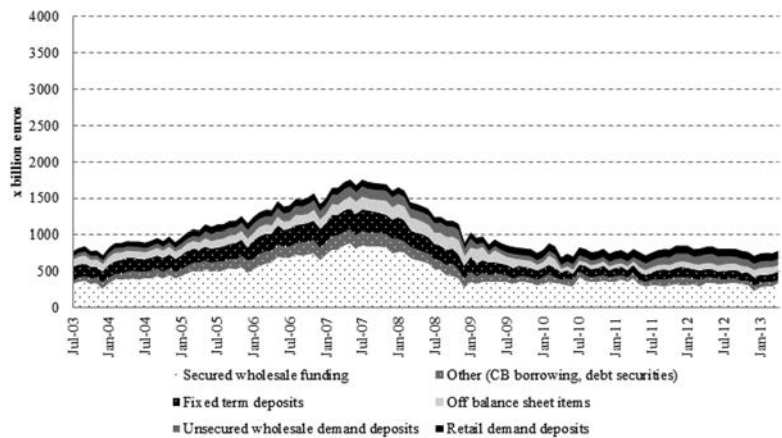
Notes: This figure shows the aggregate asset totals weighted by their liquidity value for the full sample of fifty-nine banks over time, based on consolidated balance sheets. The order of the series is as follows, from bottom to top: secured wholesale lending, bonds, unsecured wholesale lending, claims on the CB, other (equity, cash, etc.), retail lending.

Figure 5. Breakdown of Total Liabilities



Notes: This figure shows the aggregate funding mix for the full sample of fifty-nine banks over time, based on consolidated balance sheets, including off-balance-sheet items (therefore total liabilities exceeds the total assets in figure 1). The order of the series is as follows, from bottom to top: secured wholesale funding, other (CB borrowing, debt securities), fixed term deposits, off-balance-sheet items, unsecured wholesale demand deposits, retail demand deposits.

Figure 6. Breakdown of Required Liquidity (liquidity-weighted liabilities)



Notes: This figure shows the aggregate liabilities weighted by their liquidity value for the full sample of fifty-nine banks over time, based on consolidated balance sheets. The order of the series is as follows, from bottom to top: secured wholesale funding, other (CB borrowing, debt securities), fixed term deposits, off-balance-sheet items, unsecured wholesale demand deposits, retail demand deposits.

4.3 *Discussion of Results*

From a microprudential perspective, the liquidity rules appear to have been effective in the Dutch case, given that a minimum buffer of liquid assets has always been maintained to cover possible outflows, as captured by required liquid assets. At the same time, the liquidity regulation did not prevent a procyclical liquidity cycle driven by secured financing. Our findings therefore provide empirical support to the “consensus view” on systemic liquidity risk (Acharya, Krishnamurthy, and Perotti 2011). According to this view, microprudential measures such as the LCR help support stability but are not sufficient. First, they focus on individual liquidity risk but not on systemic liquidity risk. Second, they do not target liquidity risk in particular in securities financing transactions and derivatives. Third, they are not countercyclical.

Several authors have already pointed to the relevance of secured financing—and repos in particular—in explaining the buildup of risk prior to the financial crisis in the United States, and contagion between institutions when this risk crystallized (e.g., Brunnermeier and Pederson 2009; Gorton and Metrick 2012; Copeland, Martin, and Walker 2014). Our results point to the relevance of secured financing for European countries such as the Netherlands. Future research would be needed to provide further insights, especially on the role played by the type of collateral (such as asset-backed securities versus government bonds) and the pattern of margins and haircuts that may have been driving fire sales during the crisis, which our data set unfortunately does not provide. Such research could inform policy discussions on the use of through-the-cycle or countercyclical margins and haircuts on securities financing transactions, as currently discussed in international forums such as the Financial Stability Board (FSB 2014).

A related approach points to the links between liquidity and leverage in the U.S. context. Adrian and Shin (2010) suggest that financial market liquidity can be understood as the rate of growth of aggregate balance sheets. They argue that during the upswing of the financial cycle, asset prices increase so that capital increases and leverage falls.¹⁰ This provides an incentive to financial institutions

¹⁰Here leverage is defined as the ratio of total assets over capital.

to use this “excess capital” to maximize return on equity. They may therefore extend their balance sheet through borrowing funds to purchase assets, so that capital falls (and leverage increases) back to its previous level. This translates into procyclical patterns in the size of banks’ balance sheets. For U.S. investment banks, Adrian and Shin (2010) present evidence for the expansion and contraction of balance sheets via repos (i.e., using purchased securities as collateral for the cash borrowing).^{11,12}

To investigate such a possible link between liquidity and leverage for Dutch banks, and with risk-weighted capital requirements more generally, we complemented our data set with balance sheet data on risk weights, total assets, and (core) capital.¹³ Based on the possible link between liquidity and leverage, we expect a correlation between the cycle in available and required liquidity and the leverage ratio (defined here as equity over total assets). This occurs given that the series for available and required liquidity reflect debt-financed balance sheet expansion and contraction. All else equal (i.e., if equity would be constant), such a pattern would reflect procyclical leverage. This procyclical pattern of the leverage ratio is confirmed in figure 7, which also highlights the strong correlation of the leverage ratio with the DLCR.

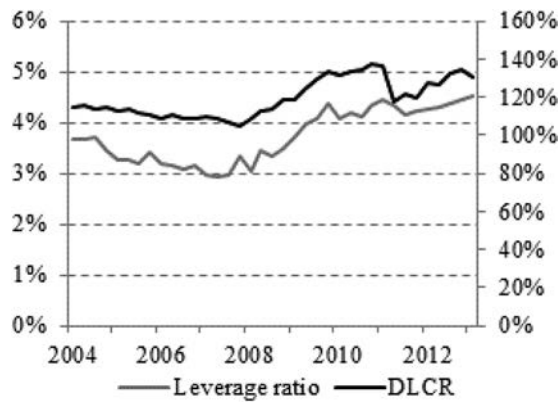
Given that liquidity problems often reflect underlying solvency problems (Admati and Hellwig 2013), a link between liquidity ratios and risk-weighted capital ratios could also be expected. As shown in figure 8, the correlation is indeed positive but not as strong as for the

¹¹The Dutch banking sector is dominated by the largest three banks and is therefore highly concentrated: the largest three banks account for around 75 percent of the total assets. These banks are universal banks: they combine traditional banking with a sizable presence in securities markets. Our aggregate results therefore partly reflect the presence of these large banks in securities markets.

¹²Similarly, Geanakoplos (2010) points to procyclical leverage driven by procyclical margins and haircuts on collateral.

¹³The confidential data originates from the supervisory solvency reporting requirement. In contrast to the monthly reporting of liquidity data, the solvency data is reported quarterly. Besides that, and also in contrast to the liquidity data reporting, foreign branches with a parent company within the European Union are exempted from reporting, since the Dutch regulator plays no role in solvency supervision of these banks. Hence, data on both the solvency and liquidity position are available for thirty banks. However, these thirty banks still represent 90 percent of the total Dutch banking sector, based on 2013:Q1 data and measured by total assets.

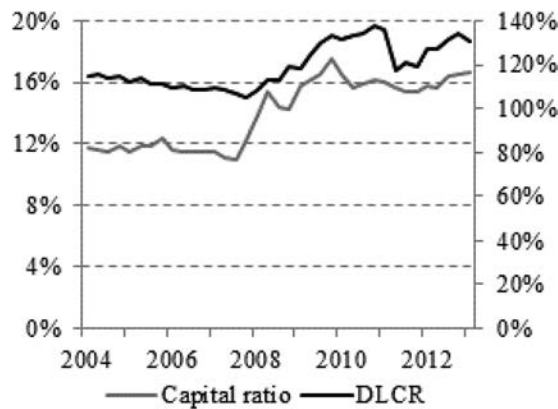
Figure 7. Liquidity and Leverage Ratio^a



Notes: This figure shows the weighted-average leverage ratio (left scale) and DLCR (right scale) for a sample of thirty banks on a quarterly basis for the period 2004:Q1–2013:Q1.

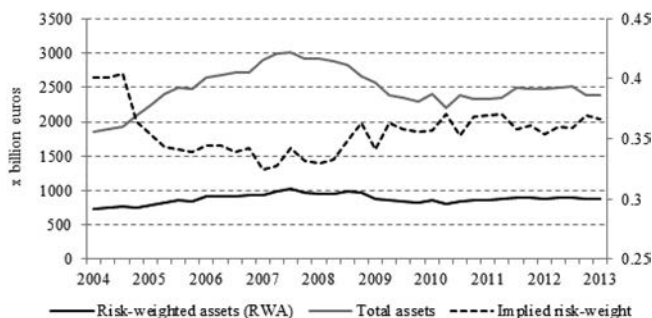
^aThe leverage ratio is defined as total tier 1 capital divided by total assets.

Figure 8. Liquidity and Capital Ratio^a



Notes: This figure shows the weighted-average capital ratio (left scale) and DLCR (right scale) for a sample of thirty banks on a quarterly basis for the period 2004:Q1–2013:Q1.

^aThe capital ratio is defined as the total eligible capital divided by total risk-weighted assets (Basel definition).

Figure 9. Risk Weights

Notes: This figure shows the aggregate asset totals, risk-weighted assets, and the implied average risk weights (right scale) on a quarterly basis for the period 2004:Q1–2013:Q1.

leverage ratio. This difference can be explained by the procyclical change in average risk weights during our sample period (figure 9). As a result, risk-weighted capital requirements remained relatively stable above their regulatory minimum in the run-up to the crisis, despite increasing leverage. Further discussions on the performance of risk weights as ex ante and ex post measures of risk are subject to a separate literature, which is beyond the scope of this paper (see Le Lesle and Avramova 2012).

Finally, our finding of a procyclical pattern in the DLCR is in line with Goodhart et al. (2012). These authors argue that banks naturally have more liquid assets during booms than during busts, and that if a liquidity ratio is binding during a boom, it will be even more restrictive during a bust, making it a procyclical regulatory ratio. Therefore, the authors propose countercyclical haircuts (i.e., liquidity weights), so that the liquidity requirements become time varying and the liquidity buffer can be released during times of financial stress.

5. Conclusion

The main implication of our study is that banks adjust their liquid liabilities, and to a lesser extent their liquid assets, in response to shocks in their liquidity positions. In the Dutch case, liquidity

regulation appears to have been effective from a microprudential perspective but not from a macroprudential perspective. While banks respect the minimum liquidity ratio, liquidity regulation has not prevented a procyclical liquidity cycle in short-term secured financing that is strongly correlated with leverage. At the same time, the increase in leverage was not visible in the regulatory capital ratios. Hence, monitoring the risk-weighted capital requirements, or the LCR as a ratio, does not necessarily signal the buildup or materialization of aggregate risks. It may need to be complemented by monitoring the LCR's constituent parts, both at an institutional level and for the banking sector as a whole, and interpreted against the background of movements in balance sheet size and leverage.

Furthermore, and in line with previous research, our findings point to the significant role of secured financing for explaining the leverage and liquidity cycle. This calls for further research on the role played by the type of collateral, and the pattern of asset prices, margins, and haircuts that may have been driving the liquidity cycle and fire sales during the crisis.

References

- Acharya, V., A. Krishnamurthy, and E. Perotti. 2011. "A Consensus View on Liquidity Risk." VoxEU.org, September 21.
- Admati A., and M. Hellwig. 2013. *The Bankers' New Clothes: What's Wrong with Banking and What to Do about It*. Princeton, NJ: Princeton University Press.
- Adrian, T., and H. S. Shin. 2010. "Liquidity and Leverage." *Journal of Financial Intermediation* 19 (3): 418–37.
- Ayadi, R., E. Arbak, and P. W. De Groen. 2012. "Implementing Basel III in Europe: Diagnosis and Avenues for Improvement." CEPS Policy Brief No. 275.
- Banerjee, R., and H. Mio. 2014. "The Impact of Liquidity Regulation on Banks." BIS Working Paper No. 470.
- Bank for International Settlements. 2013. "Basel III: The Liquidity Coverage Ratio and Liquidity Risk Monitoring Tools." (January).
- Basel Committee on Banking Supervision. 2009. "Strengthening the Resilience of the Banking Sector." Consultative Document.

- Berrospide, J. 2012. "Liquidity Hoarding and the Financial Crisis: An Empirical Evaluation." Manuscript, Board of Governors of the Federal Reserve System.
- Bonner, C. 2012. "Liquidity Regulation, Funding Costs and Corporate Lending." DNB Working Paper No. 361.
- Brunnermeier, M. K., and L. H. Pedersen. 2009. "Market Liquidity and Funding Liquidity." *Review of Financial Studies* 22 (6): 2201–38.
- Coeuré, B. 2013. "Liquidity Regulation and Monetary Policy Implementation: From Theory to Practice." Speech presented at Toulouse School of Economics, Toulouse, October 3.
- Copeland, A., A. Martin, and M. Walker. 2014. "Repo Runs: Evidence from the Tri-Party Repo Market." *Journal of Finance* 69 (6): 2343–80.
- De Haan, L., and J. W. van den End. 2013a. "Bank Liquidity, the Maturity Ladder, and Regulation." *Journal of Banking and Finance* 37 (10): 3930–50.
- . 2013b. "Banks' Responses to Funding Liquidity Shocks: Lending Adjustment, Liquidity Hoarding and Fire Sales." *Journal of International Financial Markets Institutions and Money* 26: 152–74.
- Engle, R., and C. W. J. Granger. 1987. "Forecasting and Testing in Co-Integrated Systems." *Journal of Econometrics* 35 (1): 143–59.
- European Banking Authority Banking Stakeholder Group. 2012. "New Bank Liquidity Rules: Dangers Ahead." EBA Position Paper.
- Financial Stability Board. 2014. "Strengthening Oversight and Regulation of Shadow Banking: Regulatory Framework for Haircuts on Non-Centrally Cleared Securities Financing Transactions." (October).
- Geanakoplos, J. 2010. "The Leverage Cycle." In *NBER Macroeconomics Annual 2009*, Vol. 24, ed. D. Acemoglu, K. Rogoff, and M. Woodford, 1–65. University of Chicago Press.
- Goodhart, C. A., A. K. Kashyap, D. P. Tsomocos, and A. P. Var-doulakis. 2012. "Financial Regulation in General Equilibrium." NBER Working Paper No. 17909.
- Gorton, G. B., and A. Metrick. 2012. "Who Ran on Repo?" NBER Working Paper No. 18455.

- King, M. R. 2010. "Mapping Capital and Liquidity Requirements to Bank Lending Spreads." BIS Policy Paper No. 324.
- Le Lesle, V., and S. Avramova. 2012. "Revisiting Risk-Weighted Assets: Why Do RWAs Differ across Countries and What Can Be Done about It?" IMF Working Paper No. 12/90.
- Pedroni, P. 2001. "Fully Modified OLS for Heterogeneous Cointegrated Panels." In *Nonstationary Panels, Panel Cointegration, and Dynamic Panels*, Vol. 15 of *Advances in Econometrics Series*, ed. B. H. Baltagi, T. B. Fomby, and R. C. Hill, 99–130. Emerald Group Publishing, Ltd.
- Perotti, E., and J. Suarez. 2010. "Liquidity Risk Charges as a Primary Macroprudential Tool." Policy Paper No. 1, Duisenberg School of Finance.
- Wagner, W. 2013. "Regulation Has to Come to Terms with the Endogenous Nature of Liquidity." Policy Brief No. 24, Duisenberg School of Finance.