Does the Law of One Price Hold in Euro-Area Retail Banking? An Empirical Analysis of Interest Rate Differentials across the Monetary Union*

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To measure integration, economic theory provides a clear background regarding price convergence: the law of one price. This paper is the first test of this law in euro-area retail banking. Since the law can be verified only on similar assets, we use recent harmonized data and a methodology that renders banking products homogeneous across countries, controlling for national factors. Econometric results signal that rates differ, and that markets are still segmented, because banking services are differentiated. Since supply factors play a driving role, there is room for improved integration. Moreover, where bank customers are stronger, rates are more homogeneous.

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1. Introduction

Euro-area financial integration is an important issue, since both economic theory and empirical findings suggest that the integration of financial markets contributes to the smooth functioning of the single monetary policy, to financial stability, and to economic growth (e.g., Artis, Weber, and Hennessy 2000; Danthine, Giavazzi, and von Thadden 2001; Gaspar, Hartmann, and Sleijpen 2003; Guiso et al. 2004; and European Central Bank 2007). To date, some segments of euro-area financial markets have made great progress in terms of integration, while there is little evidence of similar integration having taken place in retail banking. However, the general process of European integration is expected to bring more homogeneous banking systems as well. In fact, euro-area banking convergence is pursued as a goal by European supranational organizations, since the euro-zone countries are banking oriented and the common monetary policy is implemented mainly through the banks.

In relation to this process, a large stream of literature is monitoring the convergence of European credit markets and measuring banking integration with several indicators: the number and value of cross-border transactions and mergers and acquisitions (M&As), the number of foreign banks, and the share of assets held by foreign banks.[1] This literature regards financial convergence primarily as a purely empirical question. From this standpoint, our paper joins in the current debate by analyzing the convergence of an important indicator: banking interest rates.

On the other hand, just regarding price convergence, a theoretical background seems to exist—the law of one price—and a clear benchmark—full convergence—once returns and risks are taken into account. On the basis of the law of one price (hereinafter simply the Law), in a single market, prices should converge thanks to arbitrage.

[1]See, e.g., Centeno and Mello (1999); European Central Bank (1999); Kleimeier and Sander (2000); Byrne and Davis (2002); Cabral, Dierick, and Vesala (2002); Hartmann, Maddaloni, and Manganelli (2003); European Banking Federation (2004); European Central Bank–Center for Financial Studies (2004); Gual (2004); Manna (2004); Murinde, Agung, and Mullineux (2004); Barros et al. (2005); European Commission (2005); European Parliament (2005); Walkner and Raes (2005); European Central Bank (2007).

If the Law holds, there should be no market segmentation, while persistent differences in price levels may signal that barriers remain. As far as we know, after a partial test pioneered by Adam et al. (2002), this paper is the first empirical attempt to verify the validity of the Law in all the main euro-area retail banking activities.

In reality, the Law has been criticized on various grounds, and the test of its validity is particularly complex in banking markets. One the one hand, arbitrage is generally easier in financial markets than in goods markets, since there are no transportation costs and the Law can be expected to hold almost instantaneously.[2] On the other hand, several banking products are not fungible, in the sense that they cannot be substituted either by other products or by the same services provided by other banks; accordingly, they cannot have the same price. Hence the Law may not hold within countries, even if the market is integrated.

Nonetheless, we refer to the law of one price because it remains a useful theoretical reference when one analyzes price convergence. First, financial theorists have used the Law as an uncontroversial minimal condition, and upon it they have built the edifice of modern financial theory, including the Modigliani-Miller capital structure propositions and the Black-Scholes option-pricing formula (e.g., Lamont and Thaler 2003). Second, the European Central Bank (ECB) considers the Law a natural way to assess the state of European financial integration (e.g., Trichet 2006). Third, several scholars indicate that, even with its imperfections, the Law is the sole theory for measuring integration (Adam et al. 2002; Adjaouté and Danthine 2003; Baele et al. 2004; Dermine 2006; Sørensen and Lichtenberger 2007; Gropp and Kashyap 2008).

In any case, when we refer to the Law, we use it not as a dogma, but as a methodological expedient. For us, the Law is a theoretical benchmark that guides the reading of the progressive steps of our analysis. In particular, we propose a specific interpretation of the Law, which seems the only one feasible to us and makes it possible to handle the nonfungibility of banking products. In fact, since the Law calls for "identical prices for identical goods," we stress the fact that goods must be identical and, since banking services are often

[2] Analyses of the Law in the European goods markets are, for example, in European Commission (2001) and De Grauwe (2003).

not uniform, that we can correctly verify the validity of the Law only if we somehow render them homogeneous. In an econometric exercise, it is possible to homogenize national banking services by controlling for the factors differentiating them across countries. Our idea is that, once controlled for both the demand and supply determinants of their differences, the products become homogeneous, so that, if the price is no longer dispersed, the Law holds. Needless to say, as long as national peculiarities continue to prevail, the Law remains only a theoretical benchmark.

This manner of proceeding acknowledges the criticism of the Law suggested by part of the industrial organization theory (e.g., Salop and Stiglitz 1982). According to this line of research, market equilibrium may be characterized by price dispersion for seemingly homogeneous commodities owing to consumer or producer heterogeneity.[3] Our interpretation is precisely that the Law can be verified only if these heterogeneities are taken into account. In the banking case, for example, if loan applicants are different because they do not belong to the same credit-risk class, the underlying loans are not identical; consequently, the corresponding prices are not identical and the Law does not hold. On the contrary, once the risk profile of borrowers has been controlled for, if the interest rates are similar, we can say the Law holds.

Even recent literature, although it admits the Law as the sole theory for measuring integration, emphasizes that it can be verified only on similar assets. Adjaouté and Danthine (2003) and Baele et al. (2004) grant that in order to verify the Law, if assets are not sufficiently homogeneous, which is relatively easy for bonds or in the money market but difficult in retail banking, differences in systematic risk factors and other important characteristics must be taken into account. Likewise, Gropp and Kashyap (2008) argue that the Law will not send a clear message regarding the state of integration "unless one accurately controls for those factors, which may

[3]This large body of research dating back to the 1970s studied price dispersion in contrast with Walrasian theory. Price dispersion can result, for instance, when consumers have different search costs (e.g., Salop 1977; Stiglitz 1987); if consumers receive a different number of price offers (e.g., Butters 1977); if consumers have different valuations for the good (e.g., Shilony 1977; Varian 1985); or if the environment is inflationary and price adjustments are costly (e.g., Bénabou 1992) and so on.

very likely systematically differ across countries." They highlight that if the observed violation of the Law is due to unobserved heterogeneity in demand, which may be a function of "differences in preferences, risk characteristics, or other demand characteristics" in different markets and countries, the price differences would have nothing to do with the failure of integration. We therefore control for differences in preferences, risk characteristics, and other demand characteristics.

We deal with other problems raised by the previous literature. Dermine (2006) signals that empirical tests of the Law could be misleading because if customers buy a bundle of financial services from their bank, the Law should hold for the entire package. We tackle this argument by analyzing not a single or a few banking products, but fourteen different interest rate categories representative of all the main retail banking activities. Adam et al. (2002) highlight that in order to assess the extent to which the Law holds in euro-area banking markets, new and more accurate data were required. We have the advantage of being able to exploit recent harmonized data on euro-area bank interest rates, making a consistent cross-country comparison possible for the first time.

Since integration is not an absolute concept, another element of our analysis is the use of a single country, Italy, as the empirical benchmark for assessing the level of euro-area integration. The idea is that the level of integration reached within a country represents an upper bound to the level euro-area banking markets can reach (Guiso, Sapienza, and Zingales 2004).

Our paper finds three main results: First, the law of one price does not hold for the raw interest rate data, and the euro-area retail banking markets appear still segmented. Second, euro-area bank interest rates differ because national products are differentiated by national factors; once these have been controlled for, many differences disappear and the Law starts to hold. Moreover, since supply factors play an important role in rate heterogeneity, there is scope for further interest rate convergence. And third, when instruments are sophisticated or the market power of bank customers counts, prices are more homogeneous.

The rest of the paper is organized as follows. The next section presents our methodology, based on two econometric approaches and three steps of analysis. The third section introduces the new

euro-area harmonized data on bank interest rates and our data set. The fourth section presents the results of the unconditional tests (the first step of our analysis). The fifth section provides regressions carried out using national determinants of bank interest rates (our second step). The sixth section describes the final outcomes of the conditional tests, i.e., controlling for national peculiarities (our third step). The final section summarizes our findings.

2. Methodology

Our purpose is to assess whether, in the sense argued in the previous section, the law of one price holds in the euro-area credit market. Our focus is twofold, on interest rate categories and on countries. In other words, we want to find out which interest rate categories are more uniform across Europe and which countries are more "similar" in a pairwise and/or multicountry sense.

The new harmonized and still relatively short data series, which we have the advantage of using, do not make it possible to assess the long-run process of convergence. However, since European banking markets have undergone a significant process of integration in the last few decades, the current level of bank interest rates should reflect this convergence. We therefore verify the degree of similarity reached between national rates, the so-called convergence hypothesis (e.g., Harvey and Carvalho 2002; Busetti and Harvey 2003).

In the first step of our analysis, we use two methodological approaches: stationarity tests and statistical tests of equality of country coefficients.

According to the strategy proposed by Harvey and Carvalho (2002, 2005), our first methodological approach is based both on the ADF (augmented Dickey-Fuller) test and on the KPSS (Kwiatkowski-Phillips-Schmidt-Shin) test.[4] These stationarity tests are standard methods used in the empirical literature to evaluate convergence processes—with reference, for instance, to interest rates, as in our case (e.g., Siklos and Wohar 1997), real GDP growth rates (e.g., Bernard and Durlauf 1996), and inflation rates (e.g., Busetti

[4]See, e.g., Dickey and Fuller (1981); Bell, Dickey, and Miller (1985); Hall, Robertson, and Wickens (1992); Kwiatkowski et al. (1992); and Hobjin and Franses (2000).

et al. 2007). We apply the two tests to the bilateral differentials δ_t^{ij} between the bank interest rates of each pair of countries:

$$\delta_t^{ij} = r_{i,t} - r_{j,t}, \tag{1a}$$

where $r_{i,t}$ and $r_{j,t}$ are the fourteen different types of interest rates, specific to each test, for countries i and j ($i \neq j$; $i, j = 1, 2, \ldots, n$ countries) in month $t = 1, 2, \ldots, T$ months.

Two countries can be said to have homogeneous interest rates (occurred convergence) when the interest differential δ_t^{ij} between them is a zero-mean stationary process. The ADF test preliminarily verifies whether the differentials δ_t^{ij} are nonstationary processes. Then the KPSS test verifies the zero-mean stationarity of stationary δ_t^{ij}, rejecting the null hypothesis (zero-mean stationarity) for a large value of ζ statistic:

$$\zeta = \frac{\sum_1^{27} \left(\sum_1^t \delta^{ij} \right)^2}{27^2 \, \widehat{\sigma}_{LR}^2}, \tag{1b}$$

where $\widehat{\sigma}_{LR}^2$ is a nonparametric estimator, robust to autocorrelation and to heteroskedasticity, of the long-run variance of δ_t^{ij}. The two tests are repeated for the fourteen types of bank interest rates and for all pairwise differentials among the euro-area countries, at the 5 percent level of statistical significance.

Our second methodological approach uses the same fourteen bank interest rates as dependent variables in as many regressions. We carry out statistical tests of equality of the country coefficients estimated in the regressions (e.g., Jackson 1992; Levy and Panetta 1993). In formal terms, we adopt the following general specification:

$$r_{i,t} = \alpha_t' \, T_{i,t} + \beta_i' \, C_{i,t} + \gamma' \, D_{i,t} + \delta' \, S_{i,t} + \varepsilon_{i,t}, \tag{2a}$$

where $r_{i,t}$ is defined as in equation (1a); $T_{i,t}$ is a matrix ($nt \times t$) of time (monthly) dummies; $C_{i,t}$ is a matrix ($nt \times i$) of country dummies; α, β, γ, and δ are vectors ($nt \times 1$) of coefficients; $D_{i,t}$ is a matrix ($nt \times g$) of demand-side regressors; $S_{i,t}$ is a matrix ($nt \times h$) of supply-side regressors; g and h indicate the number of regressors, different in each regression in, respectively, matrix $D_{i,t}$ and matrix $S_{i,t}$; and $\varepsilon_{i,t}$ is the idiosyncratic error $\sim$ i.i.d. $(0, \sigma_\varepsilon^2)$.

The estimated coefficients β_i are used in each interest rate category for Wald tests on the statistical significance of bilateral differences for $i \neq j$:

$$H_0\text{: } \beta_i = \beta_j. \tag{2b}$$

When the data do not reject the equality of coefficients, on the basis of the $F[1, Tn - (i + g + h)]$ statistic at the 5 percent significance level, we say that the bilateral interest rate differentials are not significant and therefore the interest rates for the pair of countries are similar or homogeneous. In the first step we use only time $T_{i,t}$ and binary country $C_{i,t}$ dummies as independent variables; in the second step we first add the matrix $D_{i,t}$, which contains factors influencing interest rates on the basis of the characteristics of bank depositors and borrowers, and then the matrix $S_{i,t}$, which contains the determinants of rates that depend on banking-system characteristics.

In the second and third steps of our analysis, we use only our second approach. The reason is that the first approach can only be used on the raw data (unconditional test). On the contrary, our second approach allows us to "clean up" the data using the matrices $D_{i,t}$ and $S_{i,t}$ in sequence (second step) and then to repeat the initial test of homogeneity on the cleaned-up data (conditional test—third step). This data cleaning renders homogeneous euro-area banking services and allows us to really verify the validity of the Law.

There are at least two reasons to distinguish the demand regressors' effect from the overall effect. First, since our aim is to homogenize banking services, and economic theory does not specify what defines a product, it is disputable whether all regressors in matrices $D_{i,t}$ and $S_{i,t}$ contribute to defining banking products. Following the example of credit-risk classes, only if we take into account the riskiness of borrowers (a demand-side characteristic) can we consider the underlying loans as similar goods and expect their prices to be similar. Likewise, market power (a supply-side characteristic) differentiates the perception of goods and therefore might be taken into account as well. Second, the ongoing euro-area process of integration could reduce the differences in the supply factors, but it would be difficult for it to render bank customers more similar. The point stressed by Gropp and Kashyap (2008) is that even in a perfectly integrated (national) market, we should find dispersion due to

demand factors. If this is true, one could view demand-side characteristics as "good" reasons for dispersion and supply-side factors as "bad" reasons. In any case, it is appropriate to keep the two effects distinct.

3. Data

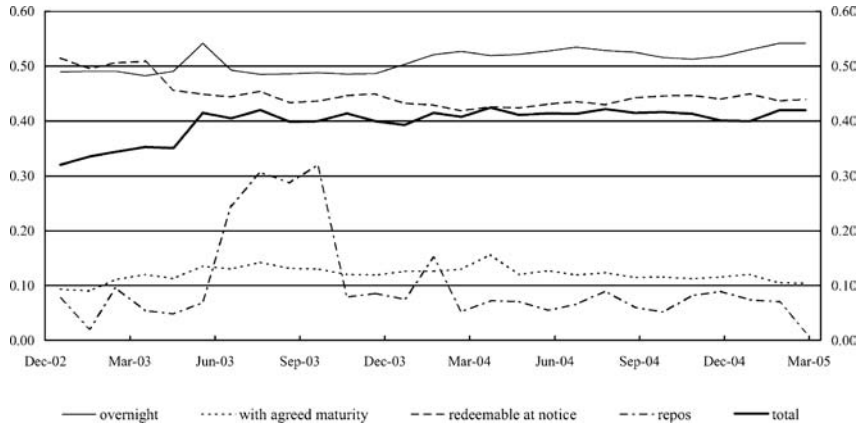
Five out of the fourteen bank interest rate categories regard deposits: interest rates on total deposits, on overnight deposits, on deposits with agreed maturity, on deposits redeemable at notice, and on repos. Five categories regard lending interest rates to households: interest rates on total loans to households, on bank overdrafts, on loans for house purchase, on consumer credit, and on loans for other purposes. Four categories regard lending interest rates to nonfinancial corporations: interest rates on total loans to firms, on bank overdrafts, on loans up to €1 million (loans to small firms), and on loans over €1 million (loans to large firms).[5]

We have the advantage of using recent harmonized monthly data on the bank interest rates in the euro-area countries, collected by the Eurosystem since January 2003 (see European Central Bank 2003). All the fourteen interest rates selected refer to new business for the period January 2003–March 2005 ($T = 27$). The number of observations is 324 (twelve countries and twenty-seven periods) when the interest rate exists in each euro-area country in our sample, and smaller otherwise.[6] We excluded interest rates on outstanding amounts because these suffer from national pre-euro effects, while those on new business reflect the current post-euro situation.

[5] We chose to carry out our analysis on product-specific rate levels. The empirical literature highlights that the analyses of margin and level differences provide similar indications. Moreover, the analysis of product-specific rates may show different degrees of homogeneity in some markets, which could pass unnoticed in the margin analysis. In any case, for the sake of completeness, we extended the analysis to two spreads: the first between the average rate on total loans to households and that on total deposits, and the second between the average rate on total loans to firms and that on total deposits.

[6] In our sample period, twelve European countries adopted the euro: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. The observations are 297 for deposits redeemable at notice (excluding Greece) and 162 for repos (the instrument is not used in Finland, Germany, Ireland, Luxembourg, the Netherlands, or Portugal).

Figure 1. Dispersion of Interest Rates on Deposits of Households



Figures 1–3 list the fourteen interest rate categories and provide the cross-country dispersion of each category in our sample period.

As explained in the previous section, in the second and third steps of our exercise, we add in the estimations of equation (2a) the matrices $D_{i,t}$ and then $S_{i,t}$. The two matrices include a different set of regressors for deposit rates, for lending rates to households,

Figure 2. Dispersion of Interest Rates on Loans to Households

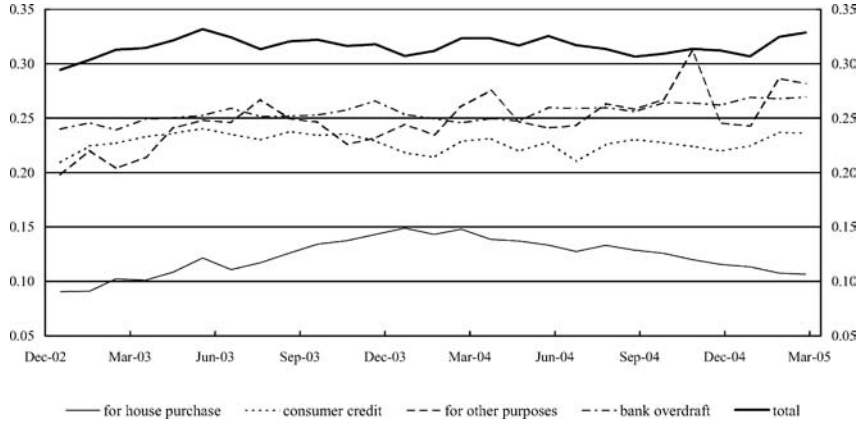
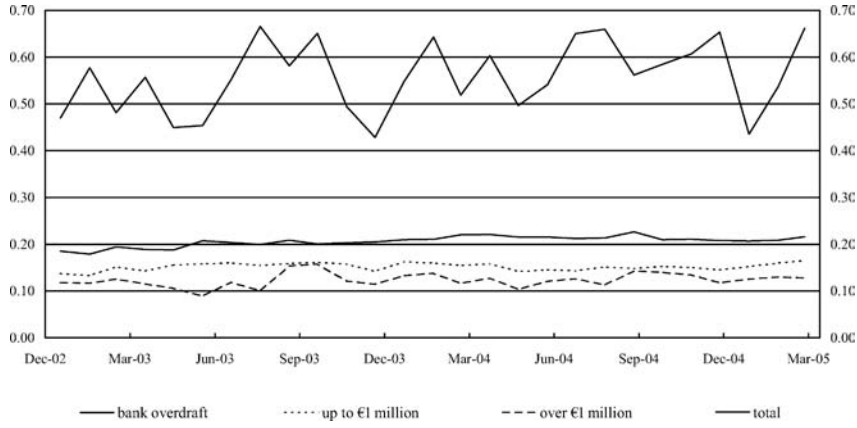


Figure 3. Dispersion of Interest Rates on Loans to Nonfinancial Corporations



and for lending rates to nonfinancial corporations. The regressors are rates of change or ratios between variables. Table 1 contains the complete list of covariates, their description and the effect they proxy, their division between demand and supply factors, the indication of the interest rate equations in which they are included, data sources, and summary statistics. An element of the paper worthy of mention is the large use of European harmonized data collected by the European System of Central Banks (ESCB).

4. First Step: Unconditional Test of Cross-Country Interest Rate Homogeneity

The results of the first step of our analysis are reported in table 2 (instrument-by-instrument analysis) and in table 3 (country-by-country analysis).

The first column of table 2 reports the fourteen categories of bank interest rates. The second column counts the total number of cross-country bilateral differentials for each type of interest rate: $n(n-1)/2$. It is equal to 66 when the interest rate category exists in all the countries; it is equal to 55 for deposits redeemable at notice and to 15 for repos. The third column shows the results of our first methodological approach: the number of stationary bilateral

Table 1. Description of Variables

Type	Covariates	Description	In Equation of	Data Sources	Mean	Std. Dev.	Min.	Max.
Demand-Side Regressors $D_{i,t}$	Real GDP growth	Real GDP growth rate	All rate categories	Eurostat	0.194	0.681	−1.84	3.04
	Disposable income	Total disposable income on number of households	Deposit and lending rates to households	Eurostat	28.442	7.539	10.504	38.706
	Alternative forms of saving	Government bonds as a ratio of GDP	Deposit rates	ESCB–Eurostat	2.55	1.43	0.07	5.87
	Alternative financial sources	Firms' market capitalization on bank loans	Lending rates to nonfinancial corporations	ESCB–Eurostat	1.348	1.194	0.243	5.382
	Risk exposure	Ratio between bank loss provisions and total loans	Lending rates	ESCB–Banksk.	0.442	0.330	0.0	1.13
	Firms' average size	Firms' value added on number of firms	Lending rates to nonfinancial corporations	Eurostat	1.611	0.35	0.734	2.395
Supply-Side Regressors $S_{i,t}$	Bank operating costs	Operating expenses/average balance-sheet total	All rate categories	OECD	1.648	0.490	0.54	2.68
	Bank non-interest income	Non-interest income/average balance-sheet total	All rate categories	OECD	1.204	0.578	0.54	3.74
	Bank liquidity	(Cash + holdings of gov. bonds)/total assets	All rate categories	ESCB	0.043	0.041	0.0	0.191
	Bank capitalization	Capital and reserves as a ratio of total assets	All rate categories	ESCB	0.063	0.017	0.035	0.104
	Bank liability structure	Total deposits as a ratio of total liabilities	Deposit rates	ESCB	0.286	0.103	0.063	0.491
	Bank asset structure	Long-term loans on total loans	Lending rates	ESCB	1.854	0.495	0.965	2.746
	Banks' international presence	Market share of branches and subsidiaries of nondomestic banks as a percentage of the total assets	All rate categories	ECB	23.730	24.767	4.74	94.56
	Banking market concentration	Five largest credit institutions' share of total assets	All rate categories	ECB	52.99	20.891	20.454	84.261
	Bank average size	Total assets on number of banks	All rate categories	ESCB–ECB	3,905	2,586	502.8	12,007
	Bank M&As	Number of domestic bank mergers and acquisitions on total number of domestic banks	All rate categories	ECB	0.022	0.02	0.0	0.09

Table 2. Statistical Tests of the Significance of Bilateral Differentials between National Bank Interest Rates: Outline by Type of Instrument

Interest Rate Categories	Total Number of Bilateral Differentials	Total Number of Statistically Similar Bilateral Differentials			
		First Step		Third Step	
		First Approach: ADF and KPSS Test	Second Approach: With Only Time and Country Dummies (a)	Second Approach: (a) + Demand-Side Regressors (b)	Second Approach: (b) + Supply-Side Regressors (c)
Deposits	**66**	**1**	**2**	**15**	**34**
of which: overnight	66	0	4	19	31
with agreed maturity	66	7	3	27	35
redeemable at notice	55	2	5	11	27
repos	15	0	11	4	8
Loans—Households	**66**	**4**	**1**	**12**	**23**
of which: bank overdrafts	66	3	1	12	22
for house purchase	66	4	3	7	31
consumer credit	66	6	4	13	32
for other purposes	66	6	5	22	45
Loans—Nonfinancial Corps.	**66**	**3**	**4**	**7**	**16**
of which: bank overdrafts	66	2	8	26	42
up to €1 million	66	5	7	14	33
over €1 million	66	21	8	23	47

combinations resulting from the ADF and KPSS tests. The fourth column reports the results of our second methodological approach: the number of cases in which the bilateral differentials are not significant and the interest rates are subsequently similar. The results are partially different under the two approaches only for repos and loans to firms over €1 million. However, both approaches clearly suggest that the data do not appear to fit with the idea of the law of one price holding in the European banking industry.

Table 3 summarizes the main results concerning the bilateral equality of coefficients for each pair of countries.[7] Panel A reports the total number of bilateral differentials, equal to 11 when all rate categories exist for that pair of countries.[8] Panel B shows the number of cases in which the bilateral differentials are nonsignificant in the first step of our analysis. Symmetrically with respect to the instrument-by-instrument analysis, the number of similar interest rates is low for all pairs of countries. Panel C shows the number of nonsignificant bilateral differentials in the third step of our analysis, after controlling both for demand-side and supply-side regressors. We return to it later on (section 6).

As highlighted, a further element of our analysis is the comparison between the degree of integration in the euro area and in a single country. To this purpose, we adopted the same econometric specification of equation (2a) for bank interest rates within Italian regions. We used twenty region dummies (one for each Italian administrative region instead of for the twelve euro-area countries) and ten quarterly time dummies (instead of the twenty-seven monthly dummies of the euro-area equation).[9] Figure 4 shows that the percentage

[7]To improve the fluency of the paper, we report the country-by-country analysis only for the second approach, because the outcomes of the two approaches are substantially similar and the second approach is used in the rest of the paper.

[8]The three aggregate rates (total deposits of households, total loans to households, and total loans to nonfinancial corporations) are excluded from this exercise.

[9]The test was carried out using quarterly data on six interest rates from the Italian Central Credit Register. To enhance the comparison between the data for Italian regions and euro-area countries, we selected six aggregate rates (three for lending and three for borrowing) that are defined similarly in the national Central Credit Register and in Eurosystem statistics. The data from the Italian Central Credit Register are only available on a quarterly basis. The Italian time series are longer than the euro-area ones, but we selected ten quarters (from September

(Continued on page 21)

Table 3. Significance of Bilateral Differentials between National Bank Interest Rates: Cross-Country Analysis

A. Total Number of Bilateral Differentials

	AUS	BEL	FIN	FRA	GER	GRE	IRL	ITA	LUX	NET	POR	SPA
AUS	—											
BEL	11	—										
FIN	10	10	—									
FRA	11	11	10	—								
GER	10	10	10	10	—							
GRE	10	10	9	10	9	—						
IRL	10	10	10	10	10	9	—					
ITA	11	11	10	11	10	10	10	—				
LUX	10	10	10	10	10	9	10	10	—			
NET	10	10	10	10	10	9	10	10	10	—		
POR	10	10	10	10	10	9	10	10	10	9	—	
SPA	11	11	10	11	10	10	10	11	10	9	10	—
Total	114	114	109	114	109	104	109	114	109	109	109	114

B. Number of Similar Interest Rates: Second Approach with Only Time and Country Dummies (a)

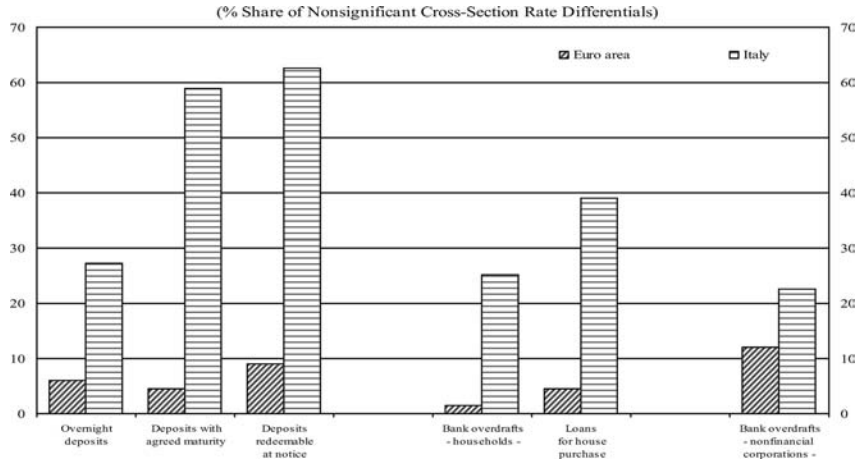
	AUS	BEL	FIN	FRA	GER	GRE	IRL	ITA	LUX	NET	POR	SPA
AUS	—											
BEL	4	—										
FIN	1	0	—									
FRA	0	3	1	—								
GER	2	2	0	0	—							
GRE	2	2	0	0	0	—						
IRL	0	1	0	2	1	1	—					
ITA	2	1	1	0	0	1	0	—				
LUX	2	1	3	0	0	0	2	0	—			
NET	2	2	0	1	0	0	1	1	1	—		
POR	1	0	2	1	0	0	0	1	2	0	—	
SPA	1	3	1	1	0	1	0	1	0	1	0	—
Total	17	19	9	9	5	7	8	8	11	9	7	9

(continued)

Table 3. (Continued)

C. Number of Similar Interest Rates: Second Approach with (a) + Demand- and Supply-Side Regressors												
	AUS	**BEL**	**FIN**	**FRA**	**GER**	**GRE**	**IRL**	**ITA**	**LUX**	**NET**	**POR**	**SPA**
AUS	—											
BEL	6	—										
FIN	7	6	—									
FRA	4	6	7	—								
GER	2	5	5	3	—							
GRE	4	6	4	5	5	—						
IRL	7	6	8	6	7	4	—					
ITA	4	9	5	6	4	7	7	—				
LUX	9	8	6	8	8	5	4	8	—			
NET	6	7	4	6	4	4	6	7	8	—		
POR	2	3	4	3	7	5	6	4	5	1	—	
SPA	5	4	5	3	5	4	7	5	7	2	3	—
Total	56	66	61	57	55	53	68	66	76	55	43	50

Figure 4. Percentage Shares of Statistically Similar Bank Interest Rates: Euro-Area Countries versus Italian Regions (first step of our analysis)



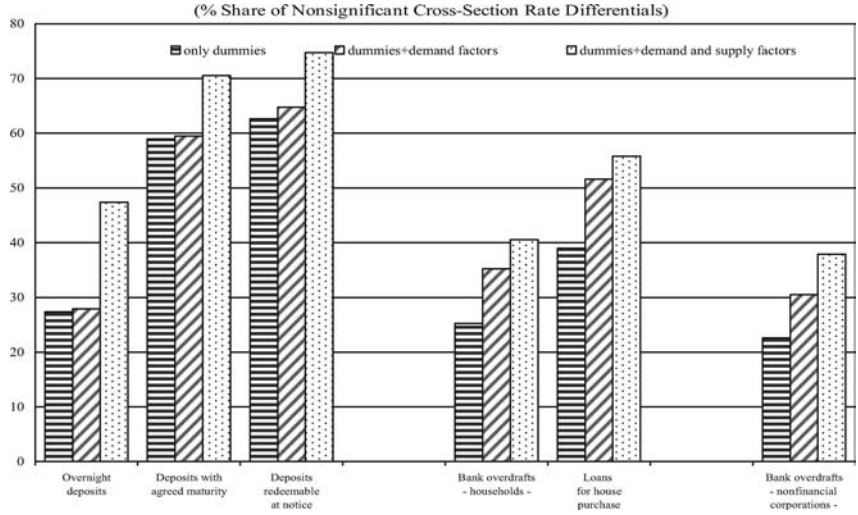
share of similar interest rates—namely, the number of similar interest rates on the total number of bilateral combinations—is much larger for Italian regions than for euro-area countries.[10] In any case, it is worth noting that the homogeneity of interest rates is not full even at the national level, and that the homogeneity of deposits, consistently with other analyses, is higher than that of loans.

Since this heterogeneity may be due to cross-region differences, we repeated the same test after adding three regressors influencing bank rates. The regressors are defined at the regional level as well. Two regressors capture the effect on interest rates of demand factors: regional borrowers' riskiness (the ratio between bad loans and total loans, only in the lending rate regressions) and the growth rate of regional GDP. The third regressor captures the effect of supply

(Continued from page 18)
2001 to December 2003) in order to compare samples of similar length. To check the robustness of the results, we repeated the exercise for Italian regions over a long-period horizon (twenty quarters, from January 1999 to December 2003), and the results remained substantially stable.

[10]Symmetrically, we used the first approach based on the ADF and KPSS tests for the Italian regions as well. The comparison of the outcomes for the Italian regions and the euro-area countries produced similar differences under both approaches.

Figure 5. Percentage Shares of Statistically Similar Bank Interest Rates across the Twenty Italian Administrative Regions (with and without control variables)



factors: regional banking market concentration (Herfindahl indexes of loans and deposits, alternatively).

Figure 5 shows that these determinants explain the rate differences among Italian regions, and once they have been allowed for, the percentage share of similar interest rates increases significantly. This result corroborates what we argued from the beginning. When we control for the factors affecting bank interest rates, we make banking products uniform, and the degree of cross-section homogeneity improves. At the same time, figure 5 shows that even within a country, though integration is higher than across countries, both demand and supply factors matter. Therefore, even in an integrated market, banking characteristics may continue to constitute a bad factor hampering further integration. This is the argument of the second and third steps of our analysis.

5. Second Step: The Determinants of Differences in Bank Interest Rates

Once we have empirically tested that the Law does not hold in the euro area on the raw data and that the intercountry dispersion is

greater than the intracountry dispersion, in this section we pick out the determinants of national differences. Since many channels may influence banks' pricing behavior, we use an eclectic approach, by including regressors representative of the main effects proposed in the literature.[11]

We carried out fourteen regressions, i.e., as many as the interest rate categories subjected to our analysis. For the sake of brevity, the main econometric outcomes are summarized in table 4, where the signs of the coefficients are reported when they are uniform for all the categories belonging to the same class of bank rate: deposits, loans to households, and loans to nonfinancial corporations.[12] Subsections 5.1 (demand-side explanatory variables) and 5.2 (supply-side explanatory variables) examine the correspondences between our results and the effects proposed in the literature; subsection 5.3 summarizes some robustness checks.

5.1 Demand-Side Explanatory Variables

Real GDP Growth. Economic theory suggests that interest rates on loans are positively influenced by real GDP growth, because better economic conditions improve the number of projects becoming profitable, thus increasing credit demand (e.g., Melitz and Pardue 1973; Kashyap and Stein 1995). But the effect is partially ambiguous since only increases in permanent income have a positive influence on credit demand, while the transitory component of GDP is associated with a self-financing effect that reduces recourse to bank loans (Friedman and Kuttner 1993). Symmetrically, the interest rates on deposits are negatively influenced by increases in the transitory component of real GDP. In our estimates, the real GDP growth rate is not significant for interest rates on deposits or on loans

[11] On the other hand, we do not allow for the decreasing official rates set by the Eurosystem in our sample time. First, official rates are country invariant in the euro area and thus not able to add clear explanations for national differences. Second, although the official rates are time variant, the adjustment of national banking rates to monetary policy inputs occurs in the same months, and therefore the effect is captured by the time dummies included in our regressions.

[12] Our results on bank interest-rate-setting behavior can be viewed as an independent part of the analysis, but they are mainly used to verify the validity of the Law in a stricter way.

Table 4. The Determinants of National Differences in Euro-Area Bank Interest Rates: Summary Econometric Results (second step of our analysis)

Explanatory Variables		Effect on Interest Rates on		
		Deposits	Loans to Households	Loans to Nonfinancial Corporations
Demand-Side Explanatory Variables $D_{i,t}$	GDP growth rate	n.s.	+	n.s.
	Disposable income	+	–	n.a.
	Risk exposure	n.a.	n.u.	+
	Alternative financing sources	n.a.	n.a.	+
	Alternative forms of saving	+	n.a.	n.a.
	Firms' average size	n.a.	n.a.	–
Bank Balance-Sheet Characteristics $S_{i,t}$	Bank operating costs	n.u.	n.u.	+
	Bank non-interest income	+	–	n.s.
	Bank liquidity	n.u.	+	–
	Bank capitalization	+	–	–
	Bank liability structure	n.u.	n.a.	n.a.
	Bank asset structure	n.a.	–	–
Banking System Structural Characteristics $S_{i,t}$	Banks' international presence	+	–	+
	Banking market concentration	n.s.	+	+
	Bank average size	–	n.u.	–
	Bank M&As	–	+	n.s.

Note: For the sake of brevity, we do not report the analytical results of all fourteen regressions and their different specifications; they are available from the authors upon request. The symbols ± indicate the signs of the coefficients when the effect of regressors on the dependent variable is significant at the 5 percent level and uniform across interest rate categories, respectively for all kinds of deposit rates, and for all kinds of interest rates on loans to households and to nonfinancial corporations; n.s. means nonsignificant coefficient; n.u. means non-uniform effect of variable, for each instrument category; n.a. means non-applicable variable.

to nonfinancial corporations, while it is positive and significant for interest rates on loans to households.

Disposable Income. While the GDP growth rate is an indicator of general macroeconomic conditions, household disposable income (total disposable income divided by the number of households) is an indicator of households' spending (saving) capacity.

Therefore, there are no problems of collinearity.[13] The effect of disposable income on deposit interest rates is likely to be negative if it implies an increasing supply of deposits, or positive, as in our results, if it implies a decreasing supply of deposits or a stronger bargaining power of savers. Its expected effect on interest rates on loans to households is negative, as we find, because it both decreases the demand for credit and increases households' bargaining power (de Bondt 2002; Gambacorta 2008).

Risk Exposure. Banks investing in riskier projects ask for a higher interest rate return because lending rates include a risk component (the risk of default).[14] We used, as a standard proxy of the riskiness of loan applicants, the ratio between banks' total loss provisions and total loans. The idea is that where banks have larger loss provisions, the borrowers are riskier.[15] Our results show a positive effect on the interest rates of nonfinancial corporations.

Alternative Financing Sources. Where borrowers have direct financing at their disposal, since this is less expensive than intermediated financing, bank loan applicants are only agents unable to

[13]According to standard consumer theory, spending (and saving) decisions depend on households' income and wealth. The measures of households' financial wealth in the national financial accounts are not available for all the euro-area countries.

[14]Economic theory suggests contrasting views about the link between interest rates, risk, collateral, and relationship banking. Credit institutions do not necessarily adjust the interest rate with rising risk, if they choose to ration the credit supply in order to avoid adverse selection and moral hazard (Stiglitz and Weiss 1981). Moreover, the provision of collateral or relationship banking might decrease lending rates by reducing the problem of asymmetric information (e.g., Petersen and Rajan 1994). On the other hand, some authors (Manove, Padilla, and Pagano 2000) have argued that collateral may have a perverse effect on banks' risk because it may reduce the screening and monitoring of debtors. Similarly, relationship banking may result in higher interest rates (Angelini, Di Salvio, and Ferri 1998), which can be attributed to a lock-in effect on borrowers and banks' stronger bargaining power.

[15]The ratio of loss provisions to total loans could also act as a proxy for the ability of the legal system to safeguard lenders' rights. When banks are forced to make larger loss provisions, it is because the legal system is less efficient. Actually, in some specifications we used another variable, the usual duration of enforcement proceedings for mortgage loans, as a proxy of the (in)efficiency of the legal and judiciary system. The results confirm that lending rates tend to increase where the time taken for proceedings is longer. The inclusion of this regressor did not distort the other results of the estimates, but we eliminated it because the available data are time invariant.

obtain direct debt and thus forced to pay higher interest rates (e.g., Diamond 1991; Holmström and Tirole 1997). As a proxy of direct finance, we used the ratio of firms' market capitalization to their bank loans. As expected, the effect of the variable is significantly positive.

Alternative Forms of Saving. Likewise, where savers have more financial instruments at their disposal, the supply of deposits decreases, and therefore banks are likely to set higher deposit rates (e.g., Green 1998). We used the ratio between government bonds and GDP as a proxy of an alternative financial investment. As expected, the effect on deposit interest rates is positive.

Firms' Average Size. Larger firms, where size is measured by nonfinancial corporations' value added divided by the number of firms, are usually less opaque and have a greater bargaining power, so that banks quote lower lending interest rates (e.g., Berger and Udell 2006). Our econometric exercises corroborate this idea.

5.2 Supply-Side Explanatory Variables

Bank Operating Costs. Since banks apply a mark-up and a mark-down on a refinancing rate and on management costs, operating costs have a positive effect on lending rates and a negative effect on deposit rates (e.g., Klein 1971; Monti 1972). Our estimates confirm the expected signs for all interest rate categories on loans to nonfinancial corporations, for total deposits, and for total loans to households.

Bank Non-Interest Income. In the past few decades, because of falling net interest spreads, banks have been shifting their focus away from interest-generating activities, such as deposit taking and lending, toward more profitable fee-generating services (e.g., DeYoung and Roland 2001). Our results show that in countries where the share of non-interest income in bank income statements is higher, banks set higher interest rates on deposits and lower interest rates on loans to households.

Bank Liquidity and Capitalization. According to bank lending channel theory, when policy rates decrease or in any case are low (as in our sample period), well-capitalized and liquid banks let interest rates on loans fall and those on deposits increase (Bernanke and Blinder 1988; Bernanke and Gertler 1995; Kashyap and Stein 1995,

2000). These predictions are confirmed in our estimates: highly capitalized banking systems (capital and reserves as a share of total assets) have lower lending rates and higher deposit rates; highly liquid banking systems (cash plus holdings of government bonds as a share of total assets) have lower lending rates to nonfinancial corporations, but higher rates to households.

Bank Liability Structure. Banks that finance themselves mainly through bonds, rather than deposits, should set higher deposit rates because their liabilities are more affected by market movements (Berlin and Mester 1999). Accordingly, in our estimates, banking systems in which deposits account for a larger share of liabilities set lower rates on all deposit categories but repos.

Bank Asset Structure. Banks that have a higher proportion of long-term loans should set lower lending rates—first, because they are expected to care more for credit relationships (Berger and Udell 1992), and second, as part of an implicit risk-sharing agreement, based on the risk aversion of their better borrowers (Fried and Howitt 1980). Consistently, in our estimates, the asset structure indicator (the ratio of long-term loans to total loans) is inversely correlated with lending rates.

Banks' International Presence. The share of foreign banks in a market is an indicator of competitive pressure, and, according to theory, increasing competition leads to lower lending rates and higher deposit rates (e.g., Guiso et al. 2004). Moreover, a larger international presence is accompanied by an increase in cross-border activity, which might homogenize banking behavior. In our exercises, a larger presence of foreign banks, measured by market share as a percentage of total assets, affects the level of interest rates on deposits positively, the lending rates to households negatively, and the lending rates to nonfinancial corporations positively.

Banking Market Concentration, Bank Average Size, and Bank M&As. Banking literature underlines two possible impacts of concentration on the pricing behavior of banks. Following the class of models applying the structure-conduct-performance approach to banking activity (e.g., Berger and Hannan 1989), as market power increases, banks set lower deposit rates and higher lending rates. By contrast, the so-called efficient-structure approach (e.g., Demsetz 1973) suggests that concentration is due to more-efficient banks

taking over less-efficient counterparts; therefore, more-concentrated markets are associated with increased efficiency, lower management costs, and hence lower spreads. We tested three kinds of variables concerning the banking system structure: market concentration (the five largest credit institutions' share of total assets), bank average size (the ratio of total assets to number of banks), and banking M&As (the ratio of the number of domestic bank mergers and acquisitions to the total number of domestic banks). Our results provide evidence in favor of the structure-conduct-performance hypothesis. At the same time, it is interesting that banking systems with larger banks on average set lower lending rates to firms.

5.3 Robustness Checks

Although bank interest rate setting is not the first topic of our paper, we made some checks to evaluate the robustness of previous results. The first robustness check lies in the fact that we conducted regressions on fourteen interest rate categories.

A way to check the robustness of our results was to introduce the additional explanatory variables progressively in order to control for the possible presence of endogeneity. In the first specification, we used only demand-side factors in each equation; then we introduced bank balance-sheet characteristics and finally banking-system structural characteristics as well. The explanatory power of the estimations remained noteworthy. The signs of the significant coefficients always remained the same, although the significance level changed.

The further robustness check was to modify the whole specification by introducing interaction terms instead of using the single variables. There was no change in the sense of all the results.

Another way to check the robustness of results involved substituting the single regressors with similar variables. As a proxy of the riskiness of loan applicants, we replaced the figures on bank loss provisions with the statistics on write-offs/write-downs of loans collected by the ECB. These series, while harmonized and relative to the entire population of banks, are less long and not available for all countries. In any case, the use of these data confirmed that risk exposure affects lending rates positively. In a similar way, we used the Herfindahl indexes instead of the share of the five largest credit institutions. In the indicator of alternative financing sources,

we added the securities issued by nonfinancial firms to market capitalization. The results remained stable, but the data on securities issued are not available for all countries. Finally, we substituted the denominator of some regressors represented by ratios: the number of households with GDP in the indicator of disposable income, and bank loans both with GDP and with the number of firms in the indicator of alternative financing sources. The results remained stable every time.

6. Third Step: Conditional Test of Cross-Country Interest Rate Homogeneity

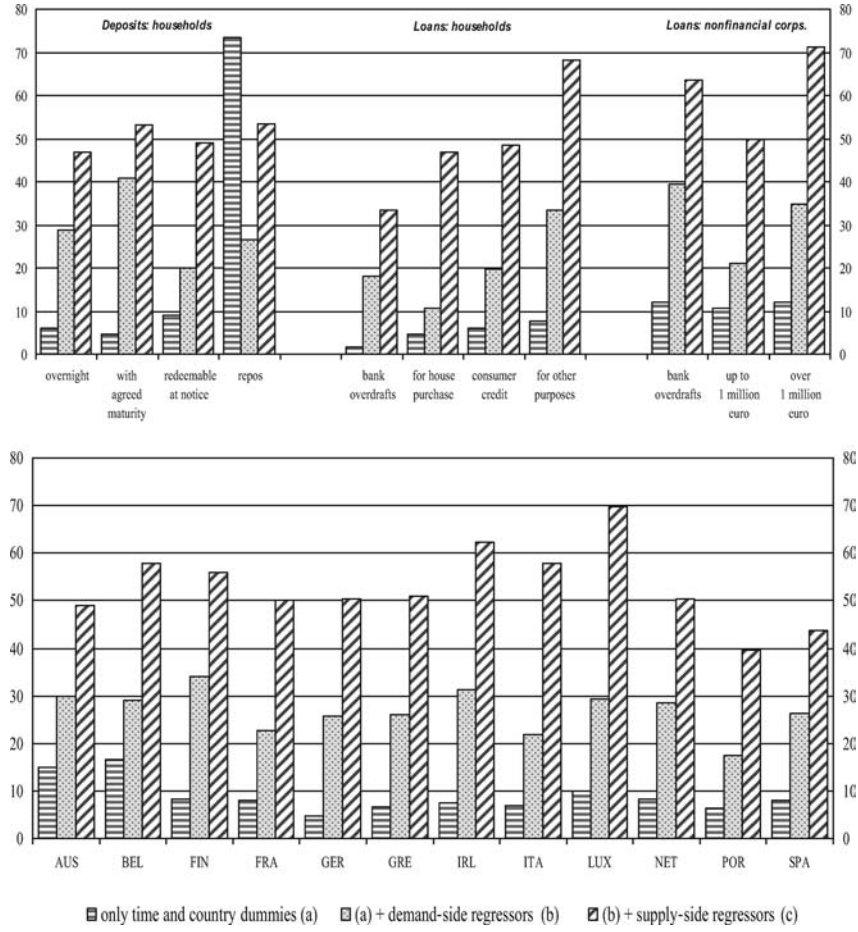
The last two columns of table 2 report the results of Wald tests on the significance of bilateral differentials after controlling for, respectively, the demand-side regressors and the overall effect of both demand and supply factors. Figure 6 shows the percentage shares of statistically similar interest rates. As expected, the similarities progressively increase, moving from the tests based on only time and country dummies to those based on demand regressors up to those based on all the covariates.[16]

Looking at the instrument-by-instrument results (figure 6, upper panel), after allowing for all the consumer and producer heterogeneities, the share of nonsignificant differentials is over 60 percent for four instruments and over or close to 50 percent for six instruments. In one case the homogeneity remains quite low (bank overdrafts granted to households).[17] The results suggest that the more sophisticated instruments, and those where the market power of bank customers counts, are characterized by more homogeneous

[16] In one case only (repos) did the regressors not have any explanatory power and was the level of homogeneity higher before controlling for national characteristics. However, it should be noted that, compared with other deposit products, repos are more sophisticated and less widespread in euro-area countries. This may have influenced their atypical result.

[17] The improvement in the results is confirmed for the two spreads to which we extended the analysis (see footnote 5). For the spread between the average rate on total loans to households and that on total deposits, the number of similarities progressively grows from one out of sixty-six in the first step, to thirteen in the second, and to thirty in the third; for the spread between the average rate on total loans to firms and that on total deposits, it grows from two out of sixty-six, to seven, and then to seventeen.

Figure 6. Percentage Shares of Statistically Similar Bank Interest Rates across Euro-Area Countries (first and third step of our analysis)



prices: repos versus overnight deposits, interest rates for enterprises versus those for households, and interest rates for large corporations (i.e., loans over €1 million) versus those for small firms (i.e., loans up to €1 million).[18]

[18]Our exercise does not consider the effect of fiscal framework. The taxation on bank products can influence the behavior of both banks and their customers

Turning to the country-by-country results (figure 6, lower panel), the percentage share of nonsignificant differentials progressively grows for all countries. After controlling for the overall effect of the regressors, the percentage share is close to or exceeds 50 percent in ten out of twelve countries. On the other hand, geographical proximity and similar cultural characteristics do not seem to explain the statistical similarity between interest rates: the number of nonsignificant differentials grows between the Benelux countries but remains low between Spain and Portugal and between Germany and Austria (table 3, panel C).

Both instrument and country analyses show that supply factors play a driving role in generating rate heterogeneity. Ceteris paribus, their effect is much more important across countries than within Italy. Empirically, this shows that if supply factors ease, there will be considerable room for an improvement in integration.

7. Concluding Remarks

Prima facie, the law of one price does not hold in the euro-area retail banking markets. The econometric analysis, comparing the bank rate differentials in the twenty Italian regions with those of twelve euro-area countries, shows that the degree of integration in a national banking market is much higher than in the euro area.

However, if we take into account demand-side regressors and supply-side regressors, many differences disappear and the Law starts to hold. In particular, econometric results suggest that where the bank customer is likely to be stronger, because of greater market power or better information, interest rates tend to be more homogeneous across Europe. This is the case of corporations compared with households, and large corporations compared with small firms. By contrast, geographical proximity does not influence the similarity of interest rates as much as one might have expected.

Our methodology and empirical findings show that, on the basis of our interpretation, the Law is an empirically testable theory. We show that the euro-area prices appear different, because national

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and hence interest rates. The lack of harmonized data as well as the difficulty of finding good information or building a good proxy put us off including this effect in the exercise. However, its inclusion would probably strengthen our results.

bank products appear different or because they are differentiated by national factors. In particular, since great dispersion is due to supply factors, the degree of integration will improve if the ongoing euro-area process of convergence makes European banks more similar.

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