Deposit Insurance and Banks' Deposit Rates: Evidence from the 2009 EU Policy*

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Deposit insurance is one of the main pillars of banking regulation meant to safeguard financial stability. In early 2009, the EU increased the minimum deposit insurance limit from €20,000 to €100,000 per bank account with the goal of achieving greater stability in the financial markets. Italy had already set a limit of €103,291 in 1994. We evaluate the impact of the new directive on the banks' average interest rate on customer deposits by comparing banks in the euro-zone countries to those in Italy, before and after the policy change. The comparability between the two groups of banks is improved by means of a propensity score matching. We find that the increase in the deposit insurance limit led to a significant decrease in the cost of funding per unit of customer deposit and that the effect is stronger for riskier banks, suggesting that the policy reduced the risk premium demanded by depositors.

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1. Introduction

Deposit insurance is a widely employed measure intended to protect depositors, in part or in full, against the risk of insolvency. In the aftermath of the financial crisis and in order to protect

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the stability of their national banking systems, governments either adopted a deposit insurance scheme or redesigned the existing one by extending its scope and coverage (Demirgüç-Kunt, Kane, and Laeven 2015). Thus, the World Bank reported an increase in the number of countries that have some form of explicit deposit insurance scheme from 93 in 2013 to more than 107 in 2016 (Anginer and Bertay 2019). For example, the U.S. government temporarily increased its deposit insurance coverage from $100,000 to $250,000 in October 2008 and then made the change permanent in July 2010. Similarly, the European Union raised its deposit insurance limit from €20,000 to €100,000 in March 2009 as a first step toward the creation of a common regulatory environment within the European Banking Union.

The increases in deposit insurance limits are consistent with the theoretical foundation of an explicit deposit insurance as a bound on financial instability and, in particular, as a measure to avoid bank runs (Diamond and Dybvig 1983). In view of the fact that banks are mainly financed by deposits—they constitute about 60 percent of total bank assets in Europe and the United States—and that they play a vital role in the real economy, increasing deposit safety was crucial in reducing liquidity risk in distressed financial markets.

Beyond the short-run impact on financial stability, regulators have sought a more comprehensive understanding of the potential benefits and costs associated with increasing deposit insurance limits. The increase in the coverage limit affects not only financial stability but also the demand and supply of deposits. An increase in coverage may therefore affect the equilibrium interest rate on deposits and consequently banks' cost of funding (Cooper and Ross 2002; Davila and Goldstein 2015). While there is a long-standing debate in the literature regarding the impact of deposit insurance on the banks' cost of deposit funding, there are few attempts in the related empirical literature that use a quasi-experimental setting to examine the issue. This paper attempts to fill the gap.

We empirically evaluate the effect of the aforementioned March 2009 raising of EU deposit insurance coverage on banks' average deposit interest rates. In particular, we exploit a unique feature of the European change in policy, namely that Italian banks were already subject to a national deposit insurance limit of €103,291 which had been in place since 1994, well before the new European regime. Italian banks were therefore unaffected by the new EU policy. This allows us to employ a difference-in-differences (diff-in-diff) strategy by comparing Italian banks to those operating in the rest of the euro zone. We argue that the empirical results offer a reliable estimate of the causal effect of the increase in deposit insurance on banks' average deposit rates and deposit amounts. We find that the increase in the deposit insurance limit led to a decrease in the cost of funding per unit of deposits for euro-zone banks relative to banks in Italy of between 0.3 and 0.7 percentage point. This effect is sizable in terms of its macroeconomic implications. Indeed, Gambacorta and Shin (2018) recently showed that a lower cost of debt financing for banks implies a lower cost of equity and ultimately translates into large increases in bank lending.

We consider bank-level data provided by Bankscope (Bureau Van Dijk). In the treatment group, we consider banks operating in the European countries that jointly satisfy the following criteria: (i) they were part of the euro zone since the introduction of the euro as the single currency in January 2002; (ii) they were subject to an increase in deposit insurance limits between September 30, 2008 and June 30, 2009, and no further increase subsequently. The rationale for criterion (i) is that, given time fixed effects in all the regressions, we choose to select all countries that are subject to the same monetary authority. The rationale for criterion (ii) relates to our decision to limit the analysis to the two years subsequent to the policy (2009 and 2010) in order to reduce the risk of confounding policy changes or other exogenous events at the country level in the post-treatment years. The banks that operate in Italy were chosen for the control group not only because they were unaffected by the 2009/14/EC directive, but also because, as documented in Laeven and Valencia (2010), the Italian government did not adopt any specific policy response to the 2008 financial crisis. Furthermore, up until the 2011 sovereign debt crisis,[1] the Italian government did not intervene with any kind of extraordinary measure in order to directly assist its banks, such as capital injections or asset guarantees.

[1] For all practical purposes, the 2011 sovereign debt crisis was unexpected at the end of 2010, which is clearly demonstrated by the yield on Italian government bonds. To avoid the confounding effects of the sovereign debt crisis in our setting, we decided not to continue our empirical investigation beyond 2010.

We first estimate the impact of an increase in the deposit insurance limit using a diff-in-diff model, in which observations are weighted by individual bank size (measured by total assets). We consider for the dependent variable both interest rate expenses divided by total deposits, as a measure of average deposit interest rate, and the logarithm of total customers' deposits. By weighting each observation by the bank's total assets and including time and country fixed effects, the results can be interpreted as the macroeconomic impact of the policy. We find that there is a decrease in banks' average deposit interest rates of about 0.3 percentage point in treated countries relative to Italy and a relative increase in the total amount of bank deposits.

To extend the findings, we also estimate an unweighted diff-in-diff regression in which the unit of observation is at the bank level. This strategy allows us to include bank fixed effects in the regression analysis together with time fixed effects. Given that the sample of banks in the treatment and control groups is heterogenous along various dimensions, we strove for a sample of banks operating in the treated countries that is directly comparable to banks operating in Italy. To this end, we use a propensity score matching to identify banks within the treated countries that are comparable in terms of ex ante observable characteristics to banks operating in Italy. The results from the diff-in-diff estimation performed on the matched sample confirm that the policy had a negative and sizable impact on the average interest rates paid by banks on customer deposits (about 0.7 percentage point).

To further investigate the economic mechanism behind this finding, we exploit heterogeneities at the bank level. In particular, we find that the results for deposit rates are primarily driven by the riskier financial institutions. The empirical results suggest that an increase in deposit insurance coverage negatively affects per-unit cost of deposit funding and has either a positive or zero impact on the amount of deposits. Given that equilibrium movements are the results of changes in both the demand and supply of deposits, we conclude that the dominant effect is an increase in the supply of deposits and a reduction in the demand for deposits among the riskier banks. This conclusion is consistent with the predictions of the related theoretical literature.

On the supply side, depositors increase their supply of deposits following an increase in the deposit insurance limit, since they are willing to accept a lower interest rate for a given amount of deposits. In the absence of a direct impact of deposit insurance on banks' risk-taking due to moral hazard incentives, the increase in the deposit insurance limit should result in a lower deposit risk premium demanded by depositors (Bartholdy, Boyle, and Stover 2003). On the demand side, banks may either reduce or increase the deposit interest rate for a given level of deposits, depending on the set of assumptions regarding their incentives to take on risk. We distinguish between two groups of predictions in the literature. In the first, and in the wake of the seminal paper by Diamond and Dybvig (1983), Cooper and Ross (2002) study optimal deposit insurance limits in a setting where banks provide insurance to depositors in the form of deposit contracts. Since liquidity shocks faced by depositors constitute private information, late depositors can mimic the earlier ones and trigger a bank run. Cooper and Ross (2002) find that as the deposit insurance limit increases, depositors invest less in monitoring banks. As a consequence, and in the presence of moral hazard, banks increase the riskiness of their investments and their demand for deposits. Moreover, Matutes and Vives (2000) develop a model of banking competition based on Diamond (1984)'s delegated monitoring model and find that an increase in deposit insurance limits leads to an increase in the elasticity of the supply of deposits, thus increasing competition among the banks in the deposit market, which leads banks to pay a higher deposit rate for a given amount of deposits. In the second group, and if ex ante deposit insurance premiums are taken into account, larger deposit insurance coverage should decrease the banks' returns since less funds can be profitably invested. Since premiums increase with the level of deposit insurance, banks can pass these costs through to depositors and offer lower deposit rates per unit of deposits. As highlighted by Cooper and Ross (2002), the overall effect of the increase in the deposit insurance limit on banks' demand for deposits crucially depends on how it affects banks' risk-taking. Using our selected matched sample, we are able to study how a bank's realized risk responded to the increase in the deposit insurance limit in 2009. We find that treated banks did not show a significant difference in the Z-score relative to control banks, although we observe an increase in the ratio of nonperforming loans to total assets after 2009. At the same time, we find an increase, though not significant, in bank equity capitalization. Taken together, these results suggest that there is no substantial change in individual bank risk in response to the increase in the deposit insurance limit. This result is consistent with the recent evidence provided by Anginer, Demirgüç-Kunt, and Zhu (2014), who find that the effect of deposit insurance on risk-taking is dominated by its stabilization effect in turbulent times.

In addition to contributing to the debate regarding the impact of deposit insurance on banks' cost of deposit funding due to the resulting movements in the demand and supply of deposits, the findings also complement the recent empirical literature that focuses on the impact of deposit insurance on financial stability. Demirgüç-Kunt and Detragiache (2002) show that countries with an explicit deposit insurance system are associated with greater likelihood of a financial crisis, particularly when bank interest rates have been deregulated. In contrast, Dewenter, Hess, and Brogaard (2018) show that even in the presence of relatively homogenous banks, increases in deposit insurance limits have large effects on bank risk-taking in countries with weaker legal institutions. Our focus on the euro zone naturally means that we are analyzing a set of countries with relatively strong institutions and as a consequence we expect there to be less effect on risk. More recently, within-country studies have found a positive impact of deposit insurance on banks' risk-taking (see Lambert, Noth, and Schüwer 2017 for the United States and Chernykh and Cole 2011 for Russia). Finally, the paper contributes to the recent empirical evidence that depositors do indeed react to changes in deposit insurance limits (Iyer et al. 2017) and to changes in deposit insurance credibility (Bonfim and Santos 2018; Peia and Vranceanu 2017).

The rest of the paper is organized as follows: section 2 provides a description of the empirical setting and of the data; section 3 reports the results of the cross-country level analysis; and section 4 reports the results of the bank-level analysis. Section 5 concludes.

2. Institutional Setting and Data

2.1 The 2009/14/EC Directive

Directive 94/19/EC, which was signed on May 30, 1994, instituted a harmonized minimum level of deposit insurance on all deposits in the EU. Article 7 of the directive required all member states to put in place a deposit guarantee scheme that would cover up to at least €20,000 per depositor in the case that an insured bank could not redeem his deposit.[2] The €20,000 limit introduced by the 94/19/EC directive represented a first step toward the integration of European financial regulation, while at the same time leaving member countries with some level of discretion. Thus member countries could and did impose higher deposit insurance limits as they saw fit.

In response to the instability in the wake of the financial crisis, the floor was then raised on March 11, 2009 to €100,000 by the 2009/14/EC directive, whose goal was to enhance deposit protection and prevent liquidity issues from exacerbating banking instability. At the same time, the new directive supported the harmonization of the deposit insurance limits across Europe, a step toward the creation of the upcoming European banking union and of a European common deposit insurance scheme.

The actual convergence toward the €100,000 limit started a couple of months before the implementation of the 2009/14/EC directive. During the fourth quarter of 2008 and the first quarter of 2011, most European governments had already raised the limit of their deposit insurance coverage to €100,000. This increase was not, however, uniform across countries, ranging from no increase in Italy to an increase of €100,000 in Luxembourg and differing in the timing of the increase.

The uniqueness of the European case lies in the heterogeneity of the increase in deposit insurance limits among otherwise similar European countries. Thus, euro-zone countries shared a common currency and integrated markets for goods and services, but not a common banking union. Since the deposit insurance limit was not raised in all European countries, and since not all European countries were part of the euro zone, we restricted the sample to a subset of the most homogeneous countries. We selected European countries that satisfied both of the following criteria: (i) membership in the euro area since the introduction of the euro as the single currency in January 2002; (ii) their deposit insurance limit was raised between September 30, 2008 and June 30, 2009, with no additional

[2] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31994L0019:EN:HTML.

Table 1. Deposit Insurance Limit by Country in September 2008

Country	DI Limit (€)
Austria	20,000
Belgium	20,000
France	70,000
Germany	20,000
Greece	20,000
Ireland	20,000
Italy	103,291
Netherlands	20,000
Portugal	25,000
Spain	20,000

Note: The source of data is Demirgüç-Kunt, Kane, and Laeven et al. (2015) and data available online from various national deposit insurers.

increase in subsequent years. This selection strategy made it possible to compare banks in countries that were ex ante very similar to one another before the increase in the deposit insurance limit. Table 1 shows those countries that satisfy both of the conditions and their deposit insurance limits in 2008.[3]

Data on deposit insurance limits and their evolution through time have been collected from different sources. The main source of this data was a database assembled by Demirgüç-Kunt, Kane, and Laeven (2015). However, the database did not provide the exact date of when the deposit insurance limit was changed, so we supplemented the information using data available from various national deposit insurers in order to obtain the exact date and amount of the change.

2.2 Data Sources

Data were obtained from Bankscope, a Bureau Van Dijk (BVD) data set that contains yearly bank-level information with a global

[3]We do not have information on the main dependent variable, namely interest expenses per unit of customer deposits, for banks operating in Finland and Luxembourg, although they were part of the euro zone since the introduction of the euro as a single currency. Banks in those countries are not part of the sample.

coverage. Bankscope obtains balance sheet information from Fitch Solutions, the primary distributor of Fitch Rating content, and it also provides summary reports, peer analysis, and aggregated data reports. We focus on bank-level data for all banks that were active between 2006 and 2010 in the EU countries listed in table 1. We downloaded annual rather than quarterly data, since far fewer banks report quarterly data and they are less representative of the banking system in the respective country. The sample was restricted to banks with a consolidation code of C1, U1, or C2 and does not include banks with a consolidation code of U2. Codes C1 and C2 identify banks that report a consolidated financial statement that includes its controlled subsidiaries or branches, either with no unconsolidated companion (C1) or with an unconsolidated companion (C2). The financial statements of banks with code U1 include subsidiaries or branches with no consolidated companion.[4]

We further restrict the sample by considering only banks whose core business is credit intermediation, i.e., raising funds through deposits and lending them out as credit. We proceed in two steps, by first restricting the sample to banks labeled either as bank holding companies, commercial banks, cooperative banks, or saving banks as the peer group classification and then screening manually those banks according to their primary business line. Financial institutions whose main focus is on other activities, such as credit factoring and leasing, were dropped.[5]

We complemented the bank-level information from Bankscope with some country-level data publicly available from the OECD

[4]This selection criterion was used in order to maximize the data coverage of the main dependent variable (the ratio of interest expenses on customer deposits to total deposits) in our final data set. Indeed, if we had initially selected financial statements with the code U2 rather than C2, we would have lost observations for all major banks operating in Austria, Belgium, Germany, and Ireland and some of the major banks in the other euro-zone countries. We checked the robustness of the baseline results to our selection criterion by repeating the main regression analyses after imputing to the final sample of banks the unconsolidated balance sheet items (U2) of total customer deposits, total assets, and average interest rates (when available) for banks with consolidation code C2. The results are available on request.

[5]The initial sample consists of 200 banks operating in Austria, 30 banks in Belgium, 160 in France, 657 in Germany, 10 in Greece, 9 in Ireland, 451 in Italy, 22 in the Netherlands, 21 in Portugal, and 100 in Spain.

database, such as gross domestic product (GDP) growth, unemployment rate, and ratio of public debt to GDP. Finally, we added information on the level of covered deposits as a proportion of those deposits that are eligible for deposit insurance. We refer to this ratio as the covered-to-eligible (CtE) ratio, which is defined as the ratio of covered deposits in a particular country to the total amount of eligible deposits: $CtE = \frac{\text{Covered Deposits}}{\text{Eligible Deposits}}$. The greater its value, the higher is the proportion of deposits covered by national deposit insurance. The CtE ratio provides information on the potential effect on a country's banking system of a change in the deposit insurance limit: a low CtE ratio means that the amount of uncovered deposits is high and that a small change in the deposit insurance limit could turn uncovered deposits into covered ones. In other words, the lower is the CtE ratio, the greater is the amount of deposits that becomes covered after the change. Since European banks are not obligated to provide this information, we were forced to use estimates from a European Commission report by Cariboni and Uboldi (2008) on a country-level basis. These estimates are based on a survey of all EU member states in 2005.

Table 2 presents country-level summary statistics on some key variables for the European countries (treatment), in which the deposit insurance limit was increased following the 2009/14/EC directive and for Italy (control).

The statistics are computed as the mean for the pre-treatment years, i.e., 2006–08. The control group's statistics include only Italy. Column 3 in table 2 displays the mean difference between the average values in columns 2 and 1. The average deposit rate is measured by the interest expenses per unit of customer deposit of each bank weighted by each bank's total assets within each country-year. The cost of deposit funding (per unit of deposit) is an implicit measure of the average interest rate on deposits.[6] The weighted average deposit rate in Italy is significantly lower than in the European countries,

[6]A similar approximation was used recently by Gambacorta and Shin (2018), who measure the average cost of funds for a sample of banks by using the ratio between interest expenses and total interest-bearing liabilities (source: Bankscope). In line with our definition, differences in the cost of funds are captured by the average rate of interest the bank pays on its deposits and other interest-bearing liabilities. Demirgüç-Kunt and Huizinga (2004) also use this variable as an implicit measure of bank interest rates.

Table 2. Summary Statistics: Country Level 2006–08

	(1) Treatment	(2) Control	(3) Difference
Weighted Average Deposit Interest Rates	3.9456	2.7555	−1.1901**
Growth Rate of Total Deposits	0.0882	0.0927	0.0045
Growth Rate of Real GDP	0.0214	0.0225	0.0011
Unemployment Rate	7.2540	6.5250	−0.7290
Public Debt to GDP Ratio	63.4481	102.6700	39.2219**
Covered to Eligible Ratio	0.5554	0.7337	0.1783***
Ratio of Deposits for Top 25 Institutions	0.9261	0.8396	−0.0865
Observations	27	3	

Notes: Column 1 shows average values for the EU countries listed in table 1 except for Italy, whose average values are shown in column 2. Column 3 shows the mean difference between columns 2 and 1. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively. Weighted average deposit rate is the interest expenses per unit of deposit of each bank weighted by the bank's total assets for each country-year; the growth rate of total deposits is the yearly log change in the sum of each bank's total deposits in each country-year; the growth rate of real GDP (source: OECD) is the yearly log change of each country's real GDP; the unemployment rate and the public debt to GDP ratio are from OECD sources; covered to eligible ratio is taken from Cariboni and Uboldi (2008); the ratio of deposits for top 25 institutions is the ratio of total deposits of the 25 largest banks—defined using total assets—in each country-year to the sum of total deposits of all the banks in each country-year.

perhaps reflecting ex ante differences in deposit insurance regime. The growth rate of total deposits is measured as the annual average growth rate in the total amount of bank deposits aggregated by country. While average deposit rates in Italy are lower than in other countries before the policy was implemented, there is no significant difference in the growth rate of total deposits. Similarly, there is no difference in the growth rate of GDP and in the average unemployment rate, suggesting that the countries in our sample were experiencing similar macroeconomic trends before the policy change. Italy's ratio of public debt to GDP is larger than the average of other euro-zone countries. For this reason, we restrict the analysis to the years 2006–10, before the 2011 sovereign debt crisis affected some European countries, including Italy. The CtE ratio is larger in Italy than in the other European countries, suggesting that the amount of deposits below the limit is larger in Italy than in the rest of Europe. This finding is consistent with the higher deposit insurance limit in Italy than in other countries, since more eligible deposits are indeed covered by insurance, suggesting that the 2009/14/EC directive indeed increased the insurance coverage in euro-zone countries. Finally, the banking sector in Italy is slightly more competitive than in the rest of the sample countries. Thus, the average ratio of deposits held by the top 25 institutions (ranked by average total assets during the period 2006–08) is about 9 percentage points lower in Italy, suggesting less concentration in the deposit market, although the difference is not statistically different from zero.

In the next section, we estimate the impact of the increase in deposit insurance on the average (weighted) deposit interest rate and total customer deposits at the country level in a diff-in-diff analysis. The country fixed effects make it possible to de-mean the dependent variables and to exploit the within-country variation over time. The time fixed effects, on the other hand, make it possible to control for time factors that affect all euro-zone countries.

3. Country-Level Analysis

In this section, we provide preliminary cross-country evidence based on bank-level data. Since treatment occurs at the country level, we first run a cross-country analysis, weighting bank-level data by a bank's total assets within each country and imposing country fixed effects. The assumption underlying the analysis is that Italian banks were already subject to higher deposit insurance in 2009, thus providing a valid counterfactual to the trends of the other European banks absent the treatment. To study the causal impact of the EU directive in a diff-in-diff setting, we estimate the following equation:

$$y_{ict} = \gamma_c + \lambda_t + \delta(T_c \cdot post_t) + \epsilon_{ict}, \quad (1)$$

where y_{ict} is the outcome variable of interest for bank i at time t in country c. We consider both average deposit rates and the log of total deposits for this variable. γ_c captures the country fixed effect and λ_t captures the time trends. T_c is a dummy variable that equals 0 if country c is Italy and 1 otherwise, while $post_t$ is a time dummy

Table 3. Cross-Country Regressions

	(1)	**(2)**	**(3)**	**(4)**
	Average Deposit Rates		**Log of Deposits**	
T · Post	−0.3651*	−0.7388***	0.1250**	−0.0145
	(0.1764)	(0.1852)	(0.0496)	(0.0137)
Year Dummies	√	√	√	√
Country Fixed Effects	√	√	√	√
Weighted Regression	√		√	
Observations	3,123	3,123	8,390	8,390

Notes: T is a dummy variable that equals 0 if the bank operates in Italy and 1 otherwise; *Post* is a time dummy that equals 1 in the post-reform years (2009–10) and 0 in the pre-reform years (2006–08). Standard errors appear in parentheses and are clustered at country level. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

that equals 1 in the post-reform period (after 2008). δ is the causal effect of interest. Notice that the estimates in this section are from weighted regressions, in which the observation of a bank is weighted by its total assets. This allows us to interpret the empirical estimates as a country-level effect of the policy. The results are in fact equivalent to a regression of weighted average deposit rates and weighted log of deposits at the $\{c, t\}$ level. The results in column 1 of table 3 show that the increase in the deposit insurance limit is followed by a reduction in average deposit rates of approximately 0.36 percentage point in treated countries relative to Italy (significant at the 5.9 percent level).[7]

[7] Our empirical results refer to changes in average deposit interest rates that cannot be directly linked to deposit interest rates charged on insured versus uninsured deposit accounts. However, Cannas et al. (2014) provide evidence of a substantial increase in the CtE deposit ratio for EU countries in 2011 with respect to 2005. The average CtE deposit ratio reached a level of about 70 percent for the euro-zone countries in our sample in 2011 and remained stable for Italy over the same period. Interestingly, the average CtE ratio for euro-zone countries in 2011 converged to the level of Italy. In light of this aggregate figure, our identified changes in the average deposit interest rates for euro-zone countries after 2008 can be, at least partially, imputed to a change in the share of insured to uninsured deposits.

Column 3 shows that the increase in the deposit insurance limit is followed by a relative increase in total deposits of approximately 12.5 percent. The difference in the number of observations in the two columns reflects the fact that the average deposit rate is not observable for many of the banks in the sample.[8]

We also estimate the unweighted version of the regression in equation (1) for average deposit rates (column 2) and logged deposits (column 4). In the unweighted version, the reduction in average deposit rates is stronger in magnitude and more precisely estimated, while the impact on total deposits is negative though not statistically significant. The comparison of the estimation results between the weighted and nonweighted regressions suggests that the drop in average deposit rates is greater for smaller banks, while the increase in deposits is greater for larger banks.[9]

The reliability of a diff-in-diff analysis naturally hinges on the parallel trend assumption, namely that the relative trends in deposit rates between treatment and control groups would have remained unchanged if there had not been any policy change. We provide an indirect test of this assumption by estimating the following equation:

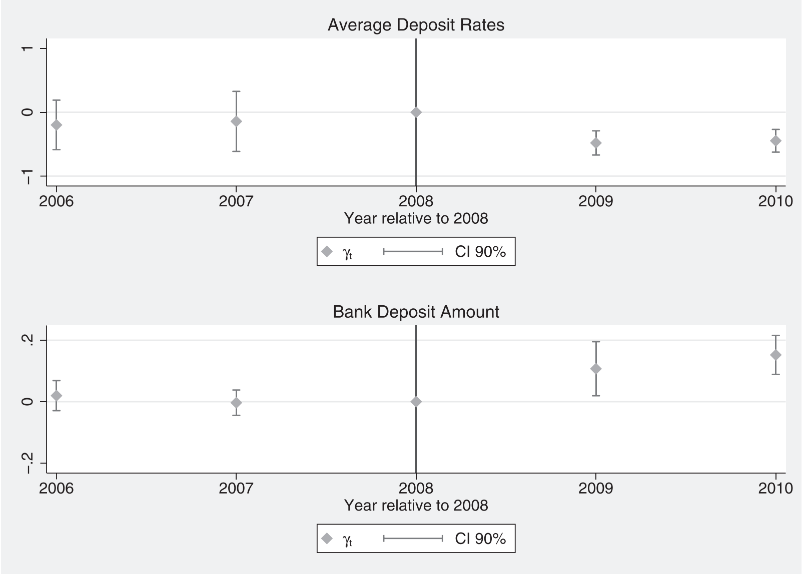
$$y_{ict} = \gamma_c + \lambda_t + \sum_{\tau=2006}^{2007} \gamma_\tau T_c 1(t=\tau) + \sum_{\tau=2009}^{2010} \gamma_\tau T_c 1(t=\tau) + \epsilon_{ict}, \tag{2}$$

where, unlike in equation (1), γ_τ are time-varying coefficients for the relationship between the outcome and T_c normalized relative to 2008, the year immediately prior to the policy change. Results are presented graphically in figure 1. Estimates for equation (2) are from a weighted regression with standard errors clustered at the country level.

[8]If we repeat the analysis employing only banks for which the deposit rate is observable, the results are practically unchanged.

[9]The results in table 3 are robust to the inclusion in equation (1) of additional control variables measured at country level, such as GDP growth rate, unemployment rate, and ratio of public debt to GDP. The robustness tests are not reported here, but are available upon request.

Figure 1. Event-Study Analysis: Country Level



Notes: The figure plots the pattern of the γ_τ coefficients from estimating equation (2) for average deposit rates as dependent variable (upper panel) and the log of deposits as dependent variable (lower panel). The capped lines show the 90 percent confidence interval on each coefficient relative to the reference year (2008).

Figure 1 presents two plots, each reporting the estimate from the above regression of the two different outcome variables: the average deposit rate (top panel) and the log of deposits (bottom panel). Each coefficient is normalized with respect to the estimated $\gamma_{\tau=0}$, where 0 is the value for 2008 and the reported confidence intervals are at the 90 percent level. The plots show that there is no statistically significant difference between the trends in either average deposit rates or total amount of deposits in 2006 and 2007 (pre-period). Consistent with the results displayed in table 3 and after controlling for country and time fixed effects, the average deposit interest rates decrease significantly in the treated countries relative to Italy after 2008, while the opposite occurs for total amount of deposits.

Taken together, the results indicate that the equilibrium reaction of average deposit rates (a price decrease) and of deposit amounts (a quantity increase) can be explained by a significant increase in supply of deposits following the increase in the deposit insurance limit. Since risk is being transferred away from depositors to the lender of last resort, deposits become more attractive relative to other investments, inducing depositors to increase their supply until the risk-adjusted return equals that of other asset classes (Sharpe 1994).

We consider the country-level analysis to be preliminary evidence of the macroeconomic changes caused by the increase in deposit insurance. To dig deeper into the identification of the effects of the EU policy change and to explain the economic mechanisms behind the empirical findings, we focus on a bank-level analysis in the following sections.

4. Bank-Level Analysis

In this section, we focus on bank-level data which provides a better understanding of the effects of an increase in deposit insurance limits on banks' average deposit rates and deposit amounts. In particular, we present results for the following empirical specification:

$$y_{ict} = \gamma_i + \lambda_t + \delta(T_c \cdot post_t) + \epsilon_{ict}, \tag{3}$$

where, unlike in equation (1), we include bank fixed effects to control for unobservable time-invariant bank characteristics (such as an individual bank's business model). Furthermore, we cluster standard errors at bank level and, unlike in the cross-country analysis, we give equal weight to each observation in the regression estimations. The estimation results for equation (3) are presented in table 4. The results in columns 1 and 2 are consistent with those for equation (1) in table 3.

However, these results must be interpreted with caution. Summary statistics reported in table 5 at the bank level for the treatment and control groups for the pre-period suggest strong unbalancing with respect to important variables that measure size, performance, and risk, including total assets, total deposits to total assets ratio,

Table 4. Bank-Level Analysis

	(1) Average Deposit Rates	(2) Log of Deposits
T · Post	−0.6404***	−0.0479***
	(0.1132)	(0.0161)
Year Dummies	√	√
Bank Fixed Effects	√	√
Observations	3,080	8,312

Notes: *T* is a dummy variable that equals 0 if the bank operates in Italy and 1 otherwise; *Post* is a time dummy that equals 1 in the post-reform years (2009–10) and 0 in the pre-reform years (2006–08). Standard errors appear in parentheses and are clustered at bank level. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Table 5. Summary Statistics: All Banks 2006–08

	(1) Treatment	(2) Control	(3) Difference
Total Assets (EUR Billions)	21.62	6.47	−15.15***
Average Deposit Interest Rates	3.47	1.74	−1.73***
Total Deposit to Total Assets Ratio	0.63	0.52	−0.11***
Tier 1 Capital to Total Assets Ratio	0.06	0.11	0.05***
Nonperforming Loans to Total Assets Ratio	0.02	0.04	0.02***
ROA	0.47	0.86	0.39***
Log(Z-score)	1.19	1.62	0.43***
Observations	3,651	1,370	

Notes: The table shows average values for banks operating in the EU countries listed in table 1 except for Italy (column 1) and banks operating in Italy (column 2); column 3 shows the mean difference between columns 2 and 1. Bank-level variables refer to key items from Bankscope. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

tier 1 capital to total assets ratio, nonperforming loans (NPLs) to total assets ratio, return on assets (ROA), and Z-score.[10]

[10]Following Laeven and Levine (2009), Z-score is calculated as the return on assets plus the capital-asset ratio divided by the standard deviation of asset returns in order to measure the distance from insolvency.

These pre-period differences in observable characteristics may potentially bias the empirical estimates of the coefficient of interest. In order to isolate the impact of the policy change, we seek a sample of banks that are ex ante comparable and that run on parallel trends in the pre-period. Therefore, in the next section, we build a sample of banks in the treated countries that is directly comparable to the sample of Italian banks by using a strategy based on the propensity score matching.

4.1 Propensity Score Matching

As previously mentioned, banks in the control group differ from treated banks in key financial variables. Therefore, a diff-in-diff analysis using Italian banks as a control group may lead to biased results. Differences in covariates between treated and control banks before the deposit insurance policy was implemented could affect the results since the control banks may not constitute a valid counterfactual for treated banks absent the treatment. In order to reduce this potential bias, we first run a propensity score matching that restricts the analysis to a more homogenous sample of treated and control banks and then use that subset in the empirical analysis.

In order to proceed with the matching strategy, we first average bank characteristics during the pre-treatment period (2006–08) since we wish to match treated banks with control banks in the years that preceded the policy change. We then restrict the control group according to the most relevant balance sheet variables. Finally, we match every bank in the control group with a bank in the treatment group that has the closest score, i.e., the same probability of being treated. We take their differences into account when estimating the following probit regression at the bank i − country c level:

$$M_{ic} = \alpha + \beta_1 Ta_{ic} + \beta_2 Tier1_{ic} + \beta_3 NPLs_{ic} + \beta_4 Dep_{ic} + \epsilon_{ic}, \quad (4)$$

where M_{ic} is a dummy that equals 1 if bank i in country c is treated and 0 otherwise. Ta_{ic} is total assets, $Tier1_{ic}$ is tier 1 capital divided by total assets, $NPLs_{ic}$ is the ratio of nonperforming loans to total

Table 6. Summary Statistics: Matched Sample 2006–08

	(1) Treatment	(2) Control	(3) Difference
Total Assets (EUR Billions)	35.49	44.59	9.11
Average Deposit Interest Rates	4.31	1.95	−2.36***
Total Deposit to Total Assets Ratio	0.50	0.48	−0.02
Tier 1 Capital to Total Assets Ratio	0.08	0.09	0.01
Nonperforming Loans to Total Assets Ratio	0.02	0.02	−0.00
ROA	0.81	0.80	−0.01
Log(Z-score)	1.23	1.38	0.16
Observations	137	133	

Notes: The table shows average values for banks operating in the EU countries listed in table 1 except for Italy (column 1) and banks operating in Italy (column 2); column 3 shows the mean difference between columns 2 and 1. The number of banks in the treatment and control group after implementing the propensity score matching procedure is 48. Bank-level variables refer to key items from Bankscope. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

assets, and Dep_{ic} is the ratio of total deposits to total assets. Matching is then carried out using a nearest-neighbor approach with a caliper equal to 0.005. In other words, the propensity scores of two matched banks cannot differ by more than this value.[11] Finally, the matching is done without replacement, so that there is a unique match between a bank in the treatment group and a bank in the control group.

Table 6 shows the post-matching summary statistics of the treated group and the control group in the years 2006–08. The two matched samples each contain 48 banks. The two groups do not show any significant differences in size (measured by total assets), capitalization (measured by the ratio of tier 1 capital to total assets), business model (measured by the ratio of total deposits to total assets),

[11] In the benchmark procedure, the caliper threshold was chosen to minimize the dissimilarities between the control and treatment groups of banks and to maximize the sample size. In the appendix, we provide a discussion of this choice and provide a robustness exercise with a more conservative caliper of 0.001. The main results remain unchanged in this case.

and risk (measured by the ratio of NPLs to total assets). Although not directly used as regressors in the probit regression in equation (4), the two samples do not show any significant differences in performance (measured by ROA) or distance from insolvency (measured by the log of the Z-score). This result reinforces the comparability of the two groups in terms of ex ante observables. We finally observe that average deposit rates in the matched treated sample are greater on average than the matched control group. The difference of about 2.4 percentage points is consistent with a deposit insurance limit that is higher for the control banks than for the treated ones in the years 2006–08. This difference cannot, however, be completely attributed to different deposit insurance regimes. In fact, there may still be differences in unobservable characteristics at bank level that may explain the difference in the average cost of funding during the period 2006–08. In order to control for the potential impact of unobservable characteristics, we rely on time variation, which makes it possible to include bank fixed effects in the model. Therefore in what follows, we can rely on a diff-in-diff strategy that exploits the variation generated by the 2009 EU policy change.

Notice that the matching procedure was implemented without any restrictions on the initial sample of candidates to be matched. The final matched treatment and control samples are characterized by a significantly lower average of total assets than those of the largest European banks. It is in fact desirable to have fewer large banks in the sample since they may have been subject to direct government intervention in the aftermath of the global financial crisis. This situation enhances the internal validity of our strategy. As a further check, we compared the matched sample of banks to the list of banks provided by Laeven and Valencia (2010),[12] in order to verify that none of the banks had been subject to nationalization, recapitalization, or some other purchase or guarantee program implemented by a national government prior to 2009.[13]

[12] We refer to tables A.1 and A.3.

[13] The only exception is Aegon Bank N.V. located in the Netherlands, which had been recapitalized. We decided to keep this bank in the sample and performed a robustness check (not shown here, but available upon request) after which we excluded it from the sample.

Table 7. Bank-Level Analysis: Matched Sample

	(1) Average Deposit Rates	(2) Log of Deposits
T · Post	−0.7814**	0.0406
	(0.3420)	(0.0993)
Year Dummies	√	√
Bank Fixed Effects	√	√
Observations	334	448

Notes: The sample is obtained after implementing the propensity score matching procedure. *T* is a dummy variable that equals 0 if the bank operates in Italy and 1 otherwise; *Post* is a time dummy that equals 1 in the post-reform years (2009–10) and 0 in the pre-reform years (2006–08). Standard errors appear in parentheses and are clustered at bank level. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

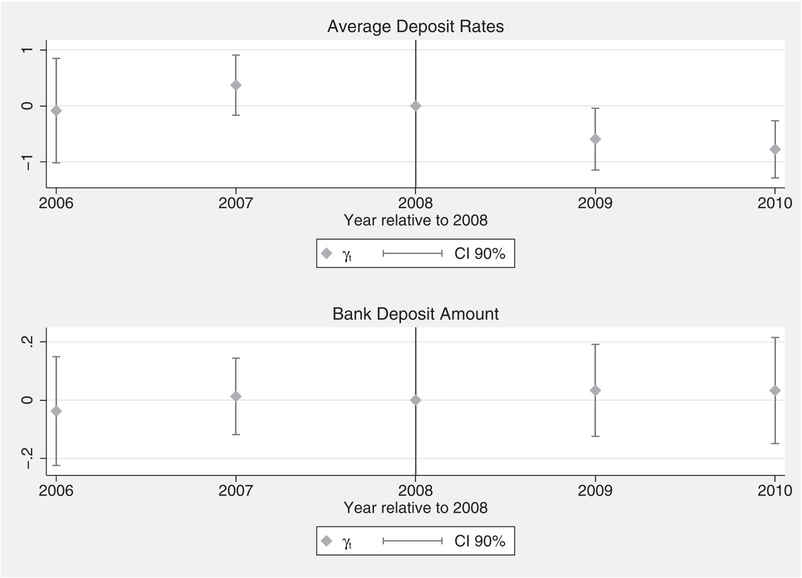
4.2 Empirical Results

Having obtained two matched samples of comparable banks, we can now estimate equation (3). Table 7 shows the estimation results for both average deposit rates and log of total bank deposits. Consistent with the results for the unmatched sample, we find a decrease in average deposit rates of approximately 78 basis points (column 1). In contrast to the previous results, the effect on total deposits is now positive but no longer statistically significant (column 2).[14]

We also test for the absence of pre-trends in the matched sample in order to assess our parallel trend assumption. Figure 2 indeed shows similar trends in the outcome variables before the policy change in 2008. The upper graph shows that the difference in average deposit rates between the treatment and control groups before treatment relative to 2008 is not significantly different from zero. In contrast, and consistent with the results presented in table 7, the

[14]As a robustness check, to control for the potential relationship between current and predetermined average deposit rates and amounts, we provide an additional test by augmenting the baseline model in equation (3) with the lagged dependent variable(s). That is, we estimate a version of the model in which we add the lagged values of average deposit rates and amounts as additional control variables. The results in table C.1 (in appendix C) show that the results are robust to this check since the coefficients of interest are only marginally affected in magnitude and significance.

Figure 2. Event-Study Analysis: Matched Sample



Notes: The figure plots the pattern of the γ_τ coefficients from estimating equation (2) for average deposit rates as dependent variable (upper panel) and the log of deposits as dependent variable (lower panel). The capped lines show the 90 percent confidence interval on each coefficient relative to the reference year (2008). The sample used in this analysis is after implementing the propensity score matching procedure.

difference decreases significantly in the years after the policy was introduced.

4.3 Impact on Risk

In order to clearly interpret the results, we also estimate the impact of deposit insurance on bank risk-taking. The empirical literature has discussed the effects of higher deposit insurance limits on financial stability. While Lambert, Noth, and Schüwer (2017) provide evidence that deposit insurance is associated with greater risk-taking, Anginer, Demirgüç-Kunt, and Zhu (2014) show that the higher risk induced by the moral hazard effect is dominated by the market stabilization effect in periods of greater financial distress. Given that

Table 8. Bank-Level Analysis: The Impact on Risk

	(1) Log(Z-score)	(2) $\frac{NPLs}{TA}$	(3) $\frac{Tier1}{TA}$
T · Post	−0.3146	0.0181*	0.0093
	(0.3400)	(0.0093)	(0.0079)
Year Dummies	√	√	√
Bank Fixed Effects	√	√	√
Observations	349	388	403

Notes: The regressions repeat the baseline analysis using the log Z-score (column 1), the nonperforming loans to total assets ratio (column 2), and the tier 1 to total assets ratio (column 3) as the dependent variable. The sample is obtained after implementing the propensity score matching procedure. T is a dummy variable that equals 0 if the bank operates in Italy and 1 otherwise; *Post* is a time dummy that equals 1 in the post-reform years (2009–10) and 0 in the pre-reform years (2006–08). Standard errors appear in parentheses and are clustered at bank level. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

the 2009 EU policy change occurred in the aftermath of the global financial crisis, it is not ex ante clear which effect dominated in our setting.

In the following analysis, we show the effect of an increase in the deposit insurance limit on banks' realized risk after 2008. We estimate equation (3) using alternative measures of risk as dependent variables. Following Celerier, Kick, and Ongena (2018), we employ three measures of bank risk: the Z-score, which is inversely related to the probability of default (the greater the Z-score, the safer is the bank); the share of NPLs within total assets, which captures changes in the riskiness of the bank loan portfolio; and the ratio of tier 1 capital to total assets, which captures changes in the bank's degree of capitalization. Estimation results are shown in table 8.

We do not find a significant increase in the Z-scores for banks that operate in treated countries relative to the control banks as a consequence of the increase in the deposit insurance limit. At the same time, there is a significant increase in NPLs and a positive, though not significant, effect on the level of capitalization. We interpret this result as evidence that banks in treated countries experienced an increase in the risk of their loan portfolios; however, they responded by increasing their capitalization. The statistically insignificant effect on Z-scores suggests that the overall bank level risk did not change as a result of the increase in the deposit insurance limit.

4.4 Interpretation of the Results

The empirical findings indicate that the 2009 increase in the deposit insurance limit was followed by a significant decline in average deposit interest rates and by a not-significant change in total deposits and risk. The findings reveal that when the deposit insurance limit is increased, the average deposit interest rate decreases, that is, the banks' per-unit cost of deposit funding is reduced.[15] These findings can be explained by a joint shift in the supply and demand of deposits, as banks and depositors reacted to a change in the riskiness of the deposit contract.

The interpretation of the results is in line with the theoretical predictions. With respect to depositors, the results are consistent with an outward shift in the supply of deposits. An increase in deposit insurance limits moves risk away from depositors who now face lower risk in the event of default. Since depositors allocate their funds by comparing risk-adjusted returns in different asset classes (Sharpe 1994), deposits become more attractive as their risk-adjusted return increases. Depositors will thus increase their supply of deposits as long as the risk-adjusted returns on deposits are higher than returns in other asset classes. An increase in the supply of deposits lowers the return on deposits until the risk-adjusted return on deposits again equals that in other asset classes. Moreover, an increase in deposit insurance limits makes depositors less risk sensitive since they are more protected in the event of bank default. Since depositors are now less risk sensitive, they invest less effort in monitoring and are willing to increase their supply of deposits (Cooper and Ross 2002). In light of these arguments, and keeping

[15] The detected decline in average interest rate may potentially be correlated with changes in the maturity structure of deposits. Unfortunately, we cannot distinguish between the marginal interest rates offered on deposit contracts with different maturities, nor between interest rates offered on insured versus uninsured deposits. This type of analysis would require proprietary information on deposit accounts and interest rates charged on each account which is, unfortunately, not accessible.

demand constant, an outward shift in supply of deposits will result in lower deposit rates and an increase in total deposits.

With respect to the banks, the reaction to a higher deposit insurance limit can be twofold. On the one hand, a higher deposit insurance limit makes deposits a relatively more expensive source of funding. Banks are charged with a higher deposit insurance premium, which is needed to fund larger deposit insurance payouts in the event of a bank default. As deposits become more expensive, banks will only partially pass through higher costs to depositors, which will decrease the demand for deposits. On the other hand, an increase in deposit insurance limits can also encourage banks to increase deposit interest rates. Since depositors are now less risk sensitive and expend less effort to monitor banks, deposits become a less expensive source of funding for banks, which leads them to increase their demand for deposits (Cooper and Ross 2002). Moreover, higher deposit insurance limits may also raise the elasticity of supply of deposits, forcing banks to compete more actively for deposits by offering higher deposit rates (Matutes and Vives 1996).

The empirical results show a significant decrease in average deposit rates and a nonsignificant increase in total deposits. This is consistent with an increase in supply of deposits by depositors and a contemporaneous decrease in demand for deposits by banks. The increase in the deposit insurance limit may, in fact, have increased banks' operating costs, which—if not compensated for by higher risk-taking and profitability—would have reduced their demand for deposits.

4.5 Heterogeneous Policy Effects

The bank-level comparison of similar groups of treatment and control banks showed that an increase in the deposit insurance limit negatively affects the average interest rate on bank deposits, since depositors, who are now more protected against bank default, require a lower return for a given amount of deposits. If this is indeed the case, then we should observe a larger reduction in the average interest rate on deposits among riskier banks. In fact, risk-averse depositors allocate their money according to the risk-adjusted return offered by banks (Sharpe 1994) and require higher returns for riskier investments. As a result, riskier banks must offer higher rates to attract depositors and reward them for the greater risk they take on (Acharya and Mora 2015). An increase in the deposit insurance limit decreases the risk associated with deposits and makes them more homogenous across different levels of risk. Consequently, the decrease in average deposit rates after an increase in the deposit insurance limit should be larger among riskier banks until the risk-adjusted returns equalize.

In this section, we examine the heterogeneity between banks in order to understand whether the baseline effect on average deposit rates and deposit amounts is stronger for riskier banks. In particular, we consider a heterogeneity dimension which is likely to be viewed by depositors as a proxy for risk, namely the ratio of nonperforming loans to total assets.[16]

We test this intuition by ranking the banks according to percentage of NPLs within total assets and, in particular, we split the sample into four quartiles according to this measure of risk. We first estimate equation (3) while excluding the banks in the first quartile (i.e., the safest banks). We then exclude banks whose NPLs ratio is below the median value and, finally, we keep only the banks in the fourth quartile. The results when the dependent variable is the average deposit interest rate are reported in table 9. Column 1 reports the baseline results contained in table 7; columns 2–4 report the estimates for subsamples that feature progressively riskier banks.

According to the results, banks with a higher share of nonperforming loans within total assets show a larger decrease in average deposit rates. By comparing the magnitude of the coefficients across the different samples, it can be seen that, while the decline in average deposit interest rates in the baseline case is about 78 basis points, among the riskiest banks the decline is about 147 basis points, thus confirming that the drop in average deposit rates is larger for riskier banks.

We repeat the analysis with total deposit as the outcome variable. The results in table 10 show that the total amount of deposits does not significantly differ between the quartiles. In contrast to the baseline analysis, we observe a decline in total deposits among the riskiest banks, although the estimate is not statistically significant.

[16] In appendix B, we consider two alternative measures of perceived risk—the ratio of tier 1 capital to total assets and the log of the Z-score.

Table 9. Heterogeneity in Risk: Average Deposit Rates

	(1) Matched Sample	(2) >25	(3) >50	(4) >75
T · Post	−0.7814**	−0.7534**	−0.9462***	−1.4734**
	(0.3420)	(0.3554)	(0.3457)	(0.5247)
Year Dummies	√	√	√	√
Bank Fixed Effects	√	√	√	√
Observations	334	249	165	81

Notes: Column 1 presents estimates from the regression analysis reported in table 7; column 2 reports the estimates of a regression analysis using a subsample that excludes the banks whose $\frac{NPLs}{TA}$ is below the 25th percentile of the distribution; column 3 reports the estimates when excluding the banks whose $\frac{NPLs}{TA}$ is below the median; column 4 reports the estimates when excluding the banks whose $\frac{NPLs}{TA}$ is below the 75th percentile of the distribution. T is a dummy variable that equals 0 if the bank operates in Italy and 1 otherwise; *Post* is a time dummy that equals 1 in the post-reform years (2009–10) and 0 in the pre-reform years (2006–08). Standard errors appear in parentheses and are clustered at bank level. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Table 10. Heterogeneity in Risk: Total Deposits

	(1) Matched Sample	(2) >25	(3) >50	(4) >75
T · Post	0.0406	0.0278	0.0328	−0.0675
	(0.0993)	(0.0528)	(0.0742)	(0.1185)
Year Dummies	√	√	√	√
Bank Fixed Effects	√	√	√	√
Observations	448	332	220	110

Notes: Column 1 presents estimates from the regression analysis reported in table 7; column 2 reports the estimates of a regression analysis using a subsample that excludes the banks whose $\frac{NPLs}{TA}$ is below the 25th percentile of the distribution; column 3 reports the estimates when excluding the banks whose $\frac{NPLs}{TA}$ is below the median; column 4 reports the estimates when excluding the banks whose $\frac{NPLs}{TA}$ is below the 75th percentile of the distribution. T is a dummy variable that equals 0 if the bank operates in Italy and 1 otherwise; *Post* is a time dummy that equals 1 in the post-reform years (2009–10) and 0 in the pre-reform years (2006–08). Standard errors appear in parentheses and are clustered at bank level. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Taken together, the heterogeneity results confirm that the reduction in average deposit rates was stronger for banks that are perceived to be riskier by depositors, absent the deposit insurance coverage. Since lower average deposit rates are not associated with a higher amount of deposits, the results provide evidence of a larger reduction in demand for deposits among riskier banks.

5. Conclusions

This paper studies the effect of an increase in deposit insurance limits on average deposit rates by examining the effect of the 2009/14/EC directive, which increased deposit insurance limits in the European Union from €20,000 to €100,000. We exploit the fact that the limit had already been increased in Italy in 1994. According to the findings, the average deposit rates decreased substantially among banks in the EU relative to banks in Italy. The drop in average rates was larger among riskier banks, thus confirming the theoretical prediction that deposit insurance negatively affects banks' deposit interest rates by reducing the return required by depositors. Employing a combination of diff-in-diff and propensity score matching in order to provide a consistent estimate of the policy's impact, we conclude that the introduction of a higher limit on deposit insurance in the EU led to a significant reduction in the per-unit cost of deposit funding for euro-zone banks and to an alignment of banks' deposit rates across countries. Our findings contribute to the policy debate on the harmonization of the deposit insurance limits as a first step toward the creation of a common European deposit insurance scheme within the EU banking union.

Appendix A. Propensity Score Matching

In section 4.1 we carried out a propensity score matching that restricts the sample and allows us to compare banks with similar characteristics in the diff-in-diff estimation. The benefit of reducing the sample size to a group of more similar banks is to eliminate any potential bias that could be picked up by heterogeneous bank characteristics. On the other hand, it reduces the amount of information available and the precision of the estimates.

Table A.1. Summary Statistics: Matched Sample 2006–08, Robustness

	(1) Treatment	(2) Control	(3) Difference
Total Assets (EUR Billions)	32.68	44.16	11.48
Average Deposit Rates	4.30	1.83	−2.47***
Total Deposit to Total Assets Ratio	0.49	0.50	0.01
Tier 1 Capital to Total Assets Ratio	0.09	0.09	−0.00
Nonperforming Loans to Total Assets Ratio	0.03	0.03	0.00
ROA	0.80	0.83	0.03
Log(Z-score)	1.12	1.50	0.38**
Observations	76	76	

Notes: The table shows average values for banks operating in the EU countries listed in table 1 except for Italy (column 1) and banks operating in Italy (column 2); column 3 shows the mean-difference between columns 2 and 1. The matched sample is obtained using a propensity score matching procedure with a caliper of 0.001. The number of banks in the treatment and control group after implementing the propensity score matching procedure is 27. Bank-level variables are taken from Bankscope. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

In this appendix, we carry out an alternative and more conservative selection of the banks. This involves narrowing the caliper, i.e., the maximum distance in the score between a treated bank and a control bank, to 0.001. This should lead to a more homogeneous group of banks, although it reduces the size of the sample. Table A.1 provides the summary statistics for treated and control banks after the implementation of the propensity score matching with a caliper of 0.001. There does not appear to be a significant improvement in terms of the balance between the treatment and control groups with a smaller caliper, while there is a significant reduction in number of banks selected (from 96 to 54). Using this smaller sample, we then estimate the baseline diff-in-diff in equation (3) at the bank level.

Table A.2 presents similar estimates to the baseline regression although the standard errors are higher, possibly due to the smaller number of observations. This robustness shows that the choice of a caliper of 0.005 does not impose any costs in terms of balancing observable characteristics between treated and control banks and, at

Table A.2. Bank-Level Analysis: Matched Sample, Robustness

	(1) Average Deposit Rates	(2) Log of Deposits
T · Post	−0.9107*	−0.1274
	(0.4766)	(0.1862)
Year Dummies	√	√
Bank Fixed Effects	√	√
Observations	184	250

Notes: The matched sample in the robustness check is obtained after implementing a propensity score matching procedure using a caliper equal to 0.001. *T* is a dummy variable that equals 0 if the bank operates in Italy and 1 otherwise; *Post* is a time dummy that equals 1 in the post-reform years (2009–10) and 0 in the pre-reform years (2006–08). Standard errors appear in parentheses and are clustered at bank level. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

the same time, has the advantage of a larger sample size. In contrast, we also tried larger calipers when implementing the propensity score matching (for example, 0.01 and 0.1), which enlarged the matched sample of banks, but worsened ex post matching between control and treatment banks in terms of observable characteristics (results are not presented here for brevity but are available upon request).

Appendix B. Heterogenous Impact: Alternative Risk Measures

In this section, we repeat the heterogeneity analysis in section 4.5 using two alternative measures of risk: the ratio of tier 1 capital to total assets and the log(Z-score). We proceed in a similar manner by splitting the sample into four quartiles based on the distribution of the risk variables and then run the regressions on subsamples which progressively exclude the less risky banks. Column 1 in each table shows the results of the baseline regression, while the estimation results for the various subsamples appear in the subsequent columns. We sequentially exclude an additional quartile of the safer bank. Table B.1 shows the results when using average deposit interest rates as the dependent variable, while table B.2

Table B.1. Heterogeneity in Risk: Average Deposit Rates, Robustness

	(1) Matched Sample	(2) >25	(3) >50	(4) >75
T · Post	−0.7814**	−0.8611**	−0.3076	−1.2302*
	(0.3420)	(0.3655)	(0.3220)	(0.6681)
Year Dummies	√	√	√	√
Bank Fixed Effects	√	√	√	√
Observations	334	249	165	81

Notes: Column 1 reports estimates from the regression analysis reported in table 7; column 2 reports the estimates of a regression analysis using a subsample that excludes the banks whose $\frac{NPLs}{TA}$ is below the 25th percentile of the distribution; column 3 reports the estimates when excluding the banks whose $\frac{NPLs}{TA}$ is below the median; column 4 reports the estimates when excluding the banks whose $\frac{NPLs}{TA}$ is below the 75th percentile of the distribution. T is a dummy variable that equals 0 if the bank operates in Italy and 1 otherwise; *Post* is a time dummy that equals 1 in the post-reform years (2009–10) and 0 in the pre-reform years (2006–08). Standard errors appear in parentheses and are clustered at bank level. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Table B.2. Heterogeneity in Risk: Total Deposits, Robustness

	(1) Matched Sample	(2) >25	(3) >50	(4) >75
T · Post	0.0406	0.0247	−0.0044	0.2811
	(0.0993)	(0.1230)	(0.1997)	(0.4738)
Year Dummies	√	√	√	√
Bank Fixed Effects	√	√	√	√
Observations	448	336	220	112

Notes: Column 1 reports estimates from the regression analysis reported in table 7; column 2 reports the estimates of a regression analysis using a subsample that excludes the banks whose $\frac{NPLs}{TA}$ is below the 25th percentile of the distribution; column 3 reports the estimates when excluding the banks whose $\frac{NPLs}{TA}$ is below the median; column 4 reports the estimates when excluding the banks whose $\frac{NPLs}{TA}$ is below the 75th percentile of the distribution. T is a dummy variable that equals 0 if the bank operates in Italy and 1 otherwise; *Post* is a time dummy that equals 1 in the post-reform years (2009–10) and 0 in the pre-reform years (2006–08). Standard errors appear in parentheses and are clustered at bank level. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Table B.3. Heterogeneity in Risk: Average Deposit Rates, Robustness II

	(1) Matched Sample	(2) >25	(3) >50	(4) >75
T · Post	−0.7814**	−0.9153**	−0.4744	−0.8431
	(0.3420)	(0.4441)	(0.4384)	(0.6861)
Year Dummies	√	√	√	√
Bank Fixed Effects	√	√	√	√
Observations	334	250	168	83

Notes: Column 1 reports estimates from the regression analysis reported in table 7; column 2 reports the estimates of a regression analysis on a subsample which excludes the banks whose Log(Z-score) is below the 25th percentile of the distribution; column 3 reports estimates of a regression analysis on a subsample which excludes the banks whose Log(Z-score) is below the median; column 4 reports estimates of a regression analysis on a subsample which excludes the banks whose Log(Z-score) is below the 75th percentile of the distribution. *T* is a dummy variable that equals 0 if the bank operates in Italy and 1 otherwise; *Post* is a time dummy that equals 1 in the post-reform years (2009–10) and 0 in the pre-reform years (2006–08). Standard errors appear in parentheses and are clustered at bank level. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

shows the result for total deposits. The results confirm that deposit insurance has a larger negative impact among banks in the fourth quartile, while there is no significant difference in the case of total deposits.

Similarly, tables B.3 and B.4 show results when a bank' riskiness is measured by the log(Z-score). With respect to average deposit rates, we find a larger negative effect when excluding the first quartile of the distribution (column 2), but not for banks above the median of the log(Z-score). In particular, the nonsignificant effect on average interest rates among the banks in the fourth quartile can be explained by the significant increase in total deposits observed in column 4 of table B.4. This result is theoretically compatible with an increase in the supply of deposits that is not matched by a sizable decrease in the demand for deposits by banks that are closer to default.

Table B.4. Heterogeneity in Risk: Total Deposit, Robustness II

	(1) Matched Sample	(2) >25	(3) >50	(4) >75
T · Post	0.0406	0.0858	0.1906	0.1413**
	(0.0993)	(0.1022)	(0.1255)	(0.0604)
Year Dummies	√	√	√	√
Bank Fixed Effects	√	√	√	√
Observations	448	334	221	110

Notes: Column 1 reports estimates from the regression analysis reported in table 7; column 2 reports the estimates of a regression analysis using a subsample that excludes the banks whose $\frac{NPLs}{TA}$ is below the 25th percentile of the distribution; column 3 reports the estimates when excluding the banks whose $\frac{NPLs}{TA}$ is below the median; column 4 reports the estimates when excluding the banks whose $\frac{NPLs}{TA}$ is below the 75th percentile of the distribution. T is a dummy variable that equals 0 if the bank operates in Italy and 1 otherwise; *Post* is a time dummy that equals 1 in the post-reform years (2009–10) and 0 in the pre-reform years (2006–08). Standard errors appear in parentheses and are clustered at bank level. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Appendix C. Cross-Border Banks

We check how many banks in our matched sample operate cross-border. As highlighted by Azevedo and Bonfim (2019), for cross-border banks that operate as subsidiaries in the European Union, the host deposit insurance fund is responsible for reimbursing insured depositors. We identify nine banks (six in the treated group and three in the control group) in our matched sample that are mother banks of cross-border subsidiaries. As a robustness check, we repeat the bank-level analysis after excluding those banks from the matched sample. For these banks, indeed, the consolidated balance sheet items that measure the cost of deposit funding could be potentially affected by changes in deposit insurance schemes in both the origin and the host jurisdictions. Results, reported in table C.2, are robust to this check. In particular, the effect of the increase in deposit insurance limit on average deposit rates is strongly significant, while no significant effect is detected on the total amount of customer deposits.

Table C.1. Bank-Level Analysis: Matched Sample, Robustness

	(1)	(2)	(3)	(4)
	Average Deposit Rates		Log of Deposits	
T · Post	−0.6796**	−0.6587**	0.0864	0.0178
	(0.3014)	(0.3031)	(0.0627)	(0.0516)
Lagged Average Deposit Rates	0.2411***	0.0878		
	(0.0445)	(0.0651)		
T · Lagged Average Deposit Rates		0.1886***		
		(0.0667)		
Lagged Log of Deposits			0.3966***	0.1232
			(0.0946)	(0.1228)
T · Lagged Log of Deposits				0.3722***
				(0.1281)
Year Dummies	√	√	√	√
Bank Fixed Effects	√	√	√	√
Observations	246	246	349	349

Notes: The estimates are based on a sample obtained using propensity score matching. *T* is a dummy variable that equals 0 if the bank operates in Italy and 1 otherwise; *Post* is a time dummy that equals 1 in the post-reform years (2009–10) and 0 in the pre-reform years (2006–08). Standard errors appear in parentheses and are clustered at bank level. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Table C.2. Bank-Level Analysis: Matched Sample, Robustness II

	(1) Average Deposit Rates	(2) Log of Deposits
T · Post	−1.0621***	0.0710
	(0.3989)	(0.1031)
Year Dummies	√	√
Bank Fixed Effects	√	√
Observations	295	403

Notes: The sample is obtained after implementing the propensity score matching procedure and after excluding banks that operate cross-border. *T* is a dummy variable that equals 0 if the bank operates in Italy and 1 otherwise; *Post* is a time dummy that equals 1 in the post-reform years (2009–10) and 0 in the pre-reform years (2006–08). Standard errors appear in parentheses and are clustered at bank level. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

References

Acharya, V. V., and N. Mora. 2015. "A Crisis of Banks as Liquidity Providers." *Journal of Finance* 70 (1): 1–43.

Anginer, D., and A. C. Bertay. 2019. "Deposit Insurance." *ifo DICE Report* 17 (1): 3–8.

Anginer, D., A. Demirgüç-Kunt, and M. Zhu. 2014. "How Does Deposit Insurance Affect Bank Risk? Evidence from the Recent Crisis." *Journal of Banking and Finance* 48 (November): 312–21.

Azevedo, J. V., and D. Bonfim. 2019. "Deposit Insurance and Cross-Border Banks." *ifo DICE Report* 17 (1): 14–20.

Bartholdy, J., G. W. Boyle, and R. D. Stover. 2003. "Deposit Insurance and the Risk Premium in Bank Deposit Rates." *Journal of Banking and Finance* 27 (4): 699–717.

Bonfim, D., and J. A. C. Santos. 2018. "The Importance of Deposit Insurance Credibility." Working Paper.

Cannas, G., J. Cariboni, J., L. K. Veisari, and A. Pagano. 2014. "Updated Estimates of EU Eligible and Covered Deposits." Technical Report No. JRC87531, Joint Research Centre, European Commission.

Cariboni, J., and A. Uboldi. 2008. "Investigating the Efficiency of EU Deposit Guarantee Schemes." Technical Report No. JRC48944, Joint Research Centre, European Commission.

Celerier, C., T. K. Kick, and S. Ongena. 2018. "Taxing Bank Leverage: The Effects on Bank Capital Structure, Credit Supply and Risk-Taking." Working Paper.

Chernykh, L., and R. A. Cole. 2011. "Does Deposit Insurance Improve Financial Intermediation? Evidence from the Russian Experiment." *Journal of Banking and Finance* 35 (2): 388–402.

Cooper, R., and T. Ross. 2002. "Bank Runs: Deposit Insurance and Capital Requirements." *International Economic Review* 43 (1): 55–72.

Davila, E., and I. Goldstein. 2015. "Optimal Deposit Insurance." Working Paper.

Demirgüç-Kunt, A., and E. Detragiache. 2002. "Does Deposit Insurance Increase Banking System Stability? An Empirical Investigation." *Journal of Monetary Economics* 49 (7): 1373–1406.

Demirgüç-Kunt, A., and H. Huizinga. 2004. "Market Discipline and Deposit Insurance." *Journal of Monetary Economics* 51 (2): 375–99.

Demirgüç-Kunt, A., E. Kane, and L. Laeven. 2015. "Deposit Insurance around the World: A Comprehensive Analysis and Database." *Journal of Financial Stability* 20 (October): 155–83.

Dewenter, K. L., A. C. Hess, and J. Brogaard. 2018. "Institutions and Deposit Insurance: Empirical Evidence." *Journal of Financial Services Research* 54 (3): 269–92.

Diamond, D. W. 1984. "Financial Intermediation and Delegated Monitoring." *Review of Economic Studies* 51 (3): 393–414.

Diamond, D. W., and P. H. Dybvig. 1983. "Bank Runs, Deposit Insurance, and Liquidity." *Journal of Political Economy* 91 (3): 401–19.

Gambacorta, L., and H. S. Shin. 2018. "Why Bank Capital Matters for Monetary Policy." *Journal of Financial Intermediation* 35 (Part B): 17–29.

Iyer, R., T. Jensen, N. Johannesen, and A. Sheridan. 2017. "The Run for Safety: Financial Fragility and Deposit Insurance." Working Paper.

Laeven, L., and R. Levine. 2009. "Bank Governance, Regulation and Risk Taking." *Journal of Financial Economics* 93 (2): 259–75.

Laeven, L., and F. Valencia. 2010. "Resolution of Banking Crises: The Good, the Bad, and the Ugly." IMF Working Paper No. 10/146.

Lambert, C., F. Noth, and U. Schüwer. 2017. "How Do Insured Deposits Affect Bank Risk? Evidence from the 2008 Emergency Economic Stabilization Act. *Journal of Financial Intermediation* 29 (January): 81–102.

Matutes, C., and X. Vives. 1996. "Competition for Deposits, Fragility, and Insurance." *Journal of Financial Intermediation* 5 (2): 184–216.

———. 2000. "Imperfect Competition, Risk Taking, and Regulation in Banking." *European Economic Review* 44 (1): 1–34.

Peia, O., and R. Vranceanu. 2017. "Experimental Evidence on Bank Runs under Partial Deposit Insurance." ESSEC Working Paper No.1705.

Sharpe, W. 1994. "The Sharpe Ratio." *Journal of Portfolio Management* 21 (1): 49–58.