Public Bailouts, Bank's Risk and Spillover Effects: The case of European Banks

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Abstract

This article analyses empirically both the effects of public bailouts on rescued banks' activities and the competitive effects of such public policies on rescued banks' competitors. Leveraging a unique hand-collected dataset on public interventions in Europe as of 2007 to 2014, we find empirical evidence that these public interventions affect bank conducts. Particularly, our results suggest that public bailouts increase the risk-taking not only of rescued banks but also the bank's risk of non-rescued competitors.

Keywords: bank bailouts, risk-taking, banking competition
JEL Codes: G21, G28, L51, L53,

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1. Introduction

Do public bailouts affect the behaviour of rescued banks? Are rescued banks' competitors affected by such policies during the banking crises?

In this paper, we seek to provide some evidences on these two timely questions about the effects of public bailouts on bank conducts. In fact, in response to the last financial turmoil, governments worldwide and other public authorities supported their troubled banks by interrupting the multi-year trend of the State withdrawal from the economy. In this context, this has stimulated the current debates among policymakers, supervisory agencies, and scholars on the choice of the provisioning of public supports for ailing banks and on the effects that these policies have on banking system.

Though recent papers have investigated the effect of public bailouts (among others, Dam and Koetter, 2012; Calderon and Schaeck, 2016, Berger et al., 2016, Kick et al., 2016), to the best of our knowledge, there is currently no evidence about the impact of such policies in Europe on the rescued bank's risk and on the rescued banks' competitors at bank-level during the whole crisis period, including the US-mortgage crisis and the EU-sovereign debt crisis. In regards to rescued bank's risk, previous studies posit conflicting predictions about the effects of public bailouts (see Section 3 and Section 4). In relation to rescued banks' non-bailed-out competitors, we know of no empirical study on the effects of bailouts on bank's risk during the crisis period even if there are some related theories on this aspect. For instance, Acharya and Yorulmazer (2007) predict time-inconsistency of public bailouts since they can create herding incentives among banks distorting competitive behaviours during systemic events.

Our main findings are as follows. First, our results indicate that public bailouts affect the rescued banks' risk. The effect is statistically and economically significant. Additionally, we also explore the mechanisms behind this main result. Particularly, we focus on the following variables: bank's liquidity, bank's ability to convert its deposits into loans, bank's lending quality, proxied by the percentage of non-performing loans (See Section 5.2 for a better explanation of our main variables).

In line with Berger et al. (2016), we find that public bailouts do not affect bank's liquidity. Next, we find that banks, after receiving the public intervention, expand their lending activities by worsening the related quality (Giannetti and Simonov, 2013).

Second, we provide some evidence that public supports to banks create spillover effects on their non-rescued competitors. Specifically, after a bank received the treatment, rescued bank's competitors (non-bailed out) decreases their liquidity and, simultaneously, increases the fraction of non-performing loans (Column 3). This effect is mainly driven by an increase in the volume of lending activities due to the lower costs in bank's funding (*Intermediation Ratio*) and a decrease in the quality of bank's lending.

To examine our research questions, we build a dataset on all public interventions provided by national governments in Europe for a sample 345 commercial banks across 15 European countries as of 2007 to 2014. We focus on European banks for two reasons. First, it allows studying a longer period covering the sovereign debt crisis (Fiordelisi and Ricci, 2016). Second, past works are one-country setting studies without providing a comprehensive view of the effects of public bailouts across different countries. Third, focusing on Europe allow us to cover different rescue measures for banks. In fact, to counterbalance the spillover effects of the crisis, each member state proceeded differently to fund banks (e.g. state guarantee schemes, recapitalisation, provision of loans).

However, addressing our research questions is challenging for three reasons. Information on public interventions is usually dispersed among several data sources. We overcome this problem by bringing to bear a unique hand-collected dataset including information on all bailouts issued by public authorities in Europe from 2007 to 2014. As we explain better later, we prefer using the term *public authorities* because depending the decision of bailing out financial institutions in Europe require the involvement of different authorities (e.g. central banks, governments, bankers' associations). In addition, in some countries there is the direct involvement of the government for the provision of

bank bailouts (Ireland, Italy, Spain, and the United Kingdom, while in other countries special entities backed by national governments may rescue banks (Denmark, France, and Germany).

The second challenge is related to our identification strategy. Particularly, because of the behavioural component[2] of such public bailouts (Dam and Koetter, 2012), naïve regressions raise endogeneity and reverse causality concerns. For example, troubled banks may be aware of their financial fragility so that they may adjust their riskiness independently of the public bailout in order to avoid the default.[3] Previous papers in the literature on this topic make use of an instrumental variable approach to deal with endogeneity and reverse causality (Dam and Koetter, 2012; Berger et al., 2016, Kick et al., 2016, Calderon and Schaeck, 2016). Among others, Dam and Koetter (2012) rely on an instrumental variable estimation approach (*IV regressions*) to estimate the effects of bailouts in Germany[4] on bank's risk. They exploit regional political factors, such as state parliament election, the vote share difference, [5] and the possibility that State and federal prime ministers are from the same party to allow for endogeneity and identify causal explanations for the moral hazard channel of bank bailouts. Berger et al (2016), use the distance between the bank and the bankers association's insurance scheme and the availability of a possible acquirer for distressed banks. Conversely, our empirical framework differs from previous studies since we do not resort to IV regressions because it may be argued that it is difficult to find a theoretically-strong instrument affecting the potentially endogenous variable (the public bailout) without being correlated with the variable of our interest, bank's risk. Our identification strategy is based on a fully saturated difference-in-difference model

[2] Bank bailouts are unlikely to be randomly assigned (Dam and Koetter, 2012; Berger et al., 2016; Kick et al., 2016).
[3] Additionally, the treatment may be partially driven by unobservable factors to the econometrician (Angrist, 2006; Dam and Koetter, 2012).
[4] The German banking sector is featured by three pillars: public sector, private-sector, and cooperative banks. As outlined in Berger et al. (2016), the authorities in charge of the provision of bank bailouts are government agencies and bank associations' insurance schemes.
[5] Dam and Koetter (2012) define this variable as the difference between the vote share of total votes cast for the governing coalition less the vote share cast for the strongest opposition party per municipality in state parliament elections.

both for rescued banks and rescued banks' competitors not receiving the public intervention during the sample period.

The third challenge of our paper is related to the identification of the rescued banks' competitors not receiving the public interventions. This step is auxiliary to identify the spillover effects of these interventions. Based on bank-specific variables in line with previous literature on the determinants of bank bailouts (Faccio et al., 2006, Bayazitova and Shivdasani, 2012; Schaeck and Calderon, 2016), we match rescued banks with their non-rescued peers through their propensity to be treated year by year.[6] This also allows us also to understand the bank fundamentals according to which public authorities are more likely to intervene.

Our contribution to the literature is threefold. To our knowledge, we are the first paper to provide some evidence of the influence of public bailouts on bank behaviour in Europe during the whole crisis period by finding that the economic impact of these policies is substantial. This evidence provides some insights around the debate on the optimal safety-net among supervisory agencies, policymakers, and scholars. Second, prior works analyse mainly the effect of public bailouts mainly regarding the bailed-out banks. In addition, we also take into account that such policies affect non-bailed out banks. In doing so, we compute the ex-ante likelihood that the bank will be rescued. This has important implications since it underlines public bailouts do not exhaust their effects only on rescued banks. Third, our evidence supports the idea that public bailouts may create spillover effects by generating risk-increasing incentives for non-rescued competitors. This is important in lights of the other debate in the literature on the competitive effects of such policies.

The rest of the paper is organized as follows. Section 2 provides the institutional background of public bailouts in Europe during the crisis period. Section 3 discusses how this work is related to the previous literature and highlights the main contributions to the literature. Section 4 discusses the development of our testable hypotheses. Section 5 presents our data and describes the main variables

[6] We use a propensity score matching technique based on a probit model procedure.

to test our hypotheses. Section 6 describes the empirical framework, while in Section 7 we report the results. Section 8 provides our concluding remarks.

2. Institutional Background: Public Bailouts in Europe

As of the wake of the 2007 financial crisis, governments and other public authorities launched emergency measures to stabilise the functioning of the European banking sector and to mitigate the negative externalities of bank defaults on the real economy. According to the European Commission State Aid Scorecard (2012),[7] in 2011 EU-governments allocated more than € 3 trillion to bail their credit institutions out under the coordination and close cooperation of the Council of the European Union, the European Central Bank, and the European Commission.

The public interventions were launched across Member states in accordance with guidelines of the Economic and Financial Affairs Council (Ecofin) and as long as they were temporary, of limited amount, and based on the scrutiny of European public authorities to ensure the *level-playing-field* in the European banking industry and to avoid any abuse onto taxpayers' funds.

To counterbalance the spillover effects of the crisis, each member state proceeded differently to fund banks. Generally, all rescue measures may be related to three different categories: i) State guarantee schemes, ii) recapitalisation, iii) provision of loans, iv) "bad banks" measures, and v) nationalisation of distressed financial institutions. Each one of the emergency measures had a specific aim. The guarantee schemes were aimed at calming markets by lowering risk-premia and at preventing potential bank runs. The public authorities made extensively use of recapitalizations to restore banks' capital base. Last but not least, a number of public authorities has also introduced the provision of loans to strengthen bank's liquidity positions. Finally, and in the much worse cases, public authorities resorted either to purchasing of impaired assets by taking over the related risks inherent in them or to nationalising distressed banks with the aim of restructuring them.

[7] http://ec.europa.eu/competition/state_aid/scoreboard/index_en.html

3. Related Literature and Contributions

This paper bridges two strands of the financial economics literature. The first literature our study is related to is the prior literature on the effects of public bailouts on the rescued banks' conduct, while the second investigates the influence of the spillover effects of these policies on rescued banks' competitors.

In relation to the first strand, many papers have investigated the effect of public bailouts by focusing on the value of banks' financial claims (Veronesi and Zingales, 2010) bank's liquidity creation (Berger et al., 2016), lending activities (Diamond and Rajan, 2000; Diamond, 2001; Giannetti and Simonov, 2013), and risk-taking (Dam and Koetter, 2012; Gropp et al. 2010; Duchin and Sosyura, 2014). In principle, public bailouts have stabilizing effects especially during financial crises since they may impinge on the cutback of bank's risk (Bhattacharya et al., 1998; Diamond and Rajan, 2005; Hoshi and Kashyap, 2010) allowing the survival of undercapitalized banks and the repayments of bank's creditors.

The second strand of the literature our study is related to is the emerging body of research on the spillover effects of public bailouts on bank's competitors. Indeed, there are some evidence and theoretical arguments outlining the possibility that government interventions affect not only bailed-out banks but also non-bailed-out banks (Acharya and Yorulmazer 2007; Hakenes and Schnabel, 2010; Gropp et al., 2010; Calderon and Schaeck, 2016). Such public policies might distort the competition in the banking industry. Although public bailouts have the stabilizing effect to support the survival of undercapitalized banks, the presence of rescued weak banks (not exiting the market) distorts the optimal resource allocation undermining the competition. Indeed, as well as arguing the bank's possibility to anticipate public bailouts, Gropp et al. (2010) show that a higher protection of the banking industry may encourage a stronger competition among financial institutions by tightening bank's margins.

The starting point for our paper is Gropp et al. (2010): in comparison with other papers in literature which analyse the effects of public bailout policies on banks' risk-taking, the authors focus not only on the effects of government bailout on *protected banks*[8] risk-taking but also on the competitive effects of these policies across OECD countries in the year 2003. To this end, they construct a measure of bailout perception based on bank rating data to understand the effect of such government policies on the risk-taking of competitor banks and rescued banks. Briefly, they find that government guarantees increase the riskiness of competitor banks, but they do not find any evidence that such policies affected *protected banks*. Nevertheless, their article does not take into account effective support measure to banks (e.g. recapitalization, guarantees, and provision of loans) and refers to non-crisis period.

In lights of these considerations, this analysis can be considered both an exploration and the extension of the literature of the effects of public interventions on bank's risk along three directions. First, this is the first paper investigating on the effects of public bailouts on bank's risk at *bank-level* across 15 European countries. In fact, other paper in the literature are "one-country setting" studies (Bayazitova and Shivdasani, 2012, Dam and Koetter, 2012; Gropp et al., 2013; Berger et al. 2016). It allows us to take into account the variation in crisis management across countries. Second, to the best of our knowledge, this is also the first first paper analysing empirically the effects of public bailouts on the competition at bank-level over the financial crisis. Calderon and Schaeck (2016) provide some evidence on the distortive effects of public bailouts on the competition but at country-level. Third, in our investigation we cover the whole financial crisis period including both the US-mortgage crisis and the sovereign debt crisis periods, while other papers focus mainly on period of limited turbulence (Dam and Koetter, 2012; Berger et al., 2016). It is more appropriate this setting here since it allows us to evaluate how such policies work on the bank's behaviour in the aftermath

[8] In Gropp et al. (2010), protected banks are those financial institutions protected by government guarantees.

of the financial crisis. This is also consistent with the growing literature on other public interventions upon the banking system (Fiordelisi and Ricci, 2016).

4. Testable Hypotheses

In this section, we develop our hypotheses. The first set of hypotheses refers to the effect of public bailouts on bank's risk and activities, while the second set focuses on the spillover effects of public bailouts on non-bailed-out banks. At the end of the two next two sub-sections, Table 1 summarises the state of the literature.

4.1. Direct effects of Public Bailouts on Bank's Risk

In principle, public bailouts have the primary role to relieve troubled financial institutions by lowering their intrinsic riskiness and strengthening bank capital base. However, the literature provides mixed results on the effects of public bailouts on bank's risk.

Some studies argue that public bailouts increasing banks' survival odds through a better level of capitalisation. This is particularly confirmed during banking crises (Richardson and Troost, 2009, Berger and Bouwman, 2013). Additionally, public bailouts can also crowd out risk-incentives because rescued banks raise funds at lower refinancing costs than their non-rescued competitors by experiencing higher charter values[9] and, thus, better margins. Hence, because of lower refinancing costs, banks exert more monitoring efforts (Gropp and Vesala, 2004, Mehran and Thakor, 2011) are less prone to pursue risky strategies in order to avoid losing this rent.

Along the same lines as the Merton's argument (1977) about the deposit insurance scheme, other set of studies demonstrate public bailouts might encourage banks to take additional risk in order to maximise the value of the put-option against the public authorities in charge of the rescue packages (Hovakiminian and Kane, 2000; Laeven and Valencia, 2012). This problem is more pronounced

[9] Following Keeley (1990), charters might be considered the recognised rent to the bank about the possibility to be able to refinance at subsidized rates below the market-rate.

especially as the number of bank defaults in the economy (Acharya and Yorulmazer, 2008). Cordella and Yeyati (2003) posit that the net effect of public bailouts on bank's risk depends on the trade-off between the aforementioned explanations and which of the two arguments prevails.

Thus, the relation between public bailouts on bank's riskiness is not a clear *a priori* since it depends on whether the charter values explanations dominates (or compensates) the moral hazard argument, or vice versa. We put forward three alternative hypotheses:

H1A. *Public bailouts are associated to a reduction of the rescued bank's risk.*

H1B. *Public bailouts are associated to an increase in the rescued bank's risk.*

H1C. *Public bailouts have no effect on the bank's risk.*

4.2. Spillover effects of Public Bailouts

Although we have a relation in mind about the spillover effects of public bailouts on non-rescued banks (Gropp et al., 2010), we borrow some hints on the previous theoretical frameworks (Acharya and Yorulmazer, 2007; Hakens and Schnabel, 2010) to develop the other set of testable hypothesis. Besides the direct effect of the public bailouts on rescued bank's risk, the theoretical and empirical literatures argue also about a competitive effect of such policies. Of course, supporting *too-big-to-fail institutions* may have beneficial effects – both in short-run and in long-run periods - on other competitors because of the well-known interconnected nature of financial markets (Zawadowski, 2013). The presence of public bailouts reduces the possibility of endangering bank's counterparts.

Yet, government interventions on ailing banks may also create economic distortions in the common *level-playing field* inducing banks to anticipate the future bailouts (Claessens, 2009a; Calderon and Schaeck, 2016). Hakenes and Schnabel (2010) argue that the possibility of future bailouts increases the bank's risk of *protected banks'* competitors because these policies create incentives for protected banks to expand by depressing the competitors' margins due to a higher level of rivalry in the deposit market. Similar predictions are also confirmed in Gropp et al. (2010). This

distortion is even more severe in presence of generalized distressed in the banking industry (Acharya and Yorulmazer, 2007). Indeed, banks herd ex-ante their rescued-peers in order to increase the likelihood of being bailed out by worsening the level of risk and the quality of their lending activities.

Thus, given the aforementioned inconclusive predictions, we formulate two following hypotheses:

H2A. *Public bailouts are associated to an increase in the rescued bank competitor's risk.*

H2B. *Public bailouts are associated to a decrease in the rescued bank competitor's risk.*

[INSERT TABLE 1]

5. Data and Variables

To empirically investigate our hypotheses, we build a new hand-collected dataset with information on public bailouts in Europe for the period from 2007-2014. We combine this sample with balance sheet data from Bankscope and macroeconomic data from AMECO database from European Commission and the World Bank database. The sample period starts in 2007, the year of the first bank bailout in European countries[10] in response to the financial crisis.[11] Furthermore, choosing 2014 as the final year of our sample period allow us to avoid potential distortions in our analysis due to potentially confounding events. For instance, since the beginning 2015, the European Central Bank has put the quantity easing (QE) into practise.

To define our sample, we start with the universe of European banks listed on Bankscope. Next, we consider only those banks which adopt IFRS accounting standard in order to avoid that our results are driven by differences in accounting standards (Onali et al., 2016). Then, we limit our sample to those financial institutions classified as commercial banks. Commercial banks behave differently from other banks (e.g. investment banks and other specialized financial institutions) by showing

[10] We consider Europe region all those banks whose headquarters are located respectively in Austria, Belgium, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.
[11] Ryan (2008) highlights that the first effects of the financial crisis find evidence as of 2007.

distinctive incentives and competitive environments (Fiordelisi and Marqués-Ibanez, 2013). Indeed, the theory on bank's riskiness stresses mainly the lending and deposit bank activities (Cubillas et al., 2015). A total number of 466 financial institutions fulfil the aforementioned search criteria. Finally, we stipulate to exclude institutions which are subsidiaries of foreign banks whose headquarters are not in Europe, since these banks are less likely to be rescued from national public authorities. The final sample is composed of 345 commercial banks.

[INSERT TABLE 2]

Table 2 and Table 3 show respectively the steps of the sample selection and a detailed description of the number of banks per country. Our sample of banks is an unbalanced panel with 2,136 observations for 345 commercial banks.

[INSERT TABLE 3]

5.1. Public Bailouts

We focus on bank bailouts performed by public authorities on EU-commercial banks between 2007 and 2014. Economists distinguish between explicit guarantees and implicit guarantees (Hakenes et al. al., 2010). The latters represent the market expectations that a financial institution is rescued even if there is no explicit governmental intervention on. For example, larger banks may presumably benefit from *a too-big-to-fail* protection and, thus, they are expected to be rescued more likely. We focus on the explicit measures since they are supposed to have more impact on banks. (Philippon and Schnabl, 2013).

As mentioned before, there are several types of public bailouts. First, *recapitalizations* are at the core of different national rescue programs since they enhance the bank likelihood to survive during financial crises (Kick et al., 2010). In fact, they are capital injections using public funding to strengthen bank capital base. In some cases, this emergency measure may also give rise to a nationalization whereby the government acquires a controlling equity stake in the distressed bank. Second, *guarantees* are commitments provided by national governments to repay bank's creditors

and depositors as the bank may not be able to repay its creditors. They are issued in the effort to re-establish confidence in the banking system and avoid potential bank runs. In this regard, they may be both past or future oriented depending whether they refer to either existing obligations or future debt. Next, liquidity facilities are public interventions aimed to enhance bank liquidity provisions through the provision of loans (*Credit lines*). Finally, governments may also resort to *assets relief measures* which are particular public supports aimed at "relieving" banks from toxic or impaired assets.[12] In this context, there are two possible schemes. The government may either buy directly impaired assets from the financial institutions to prop up them or may arrange transfers of toxic assets to a public asset management agency responsible for the managing over the financial markets.

[INSERT TABLE 4]

For the sake of exposition, we have used so far the term "public". Indeed, the decision to rescue banks usually requires the involvement of several authorities, such as governments, supervisory agencies, central banks, and bankers' associations' insurance schemes (Dam and Koetter, 2012). In addition, in some countries, other public agencies can provide bank bailouts as well as the government (Denmark, Germany and France).

To test our hypotheses, we assume a broader definition of public interventions on banks during the crisis period. Specifically, we make use of a two-step procedure to construct the variable of our main interest, *Public Bailout*. First, we collect information on all different kinds of public interventions on banks across European countries of our sample by classifying them among recapitalizations, guarantees, and provisions of loans. Next, we define three dummy variables for each kind of public intervention: *i) Recapitalization* is a dummy variable taking the value of one if the bank *i*'s received a capital support at time *t* and zero otherwise; *ii) Guarantee* is a dummy variable taking the value of one if the bank *i*'s received a governmental guarantee at time *t* and zero otherwise;

[12] Impaired assets are both all those assets incorporating high expected losses and long-term assets without incurring high losses, but "*that still need to be hived off the balance sheet, because of the negative carry they generate due to increased funding costs for banks*". (P.32, Boudghene and Maes, 2012).

iii) Provision of loans is a dummy that takes on the value one if the bank *i*'s received a credit line from public authorities at time *t* and zero otherwise. As the last step, we create a broader dummy which is a combination of the three dummy variables aforementioned, so that *Public Bailout* is a variable that takes the value of 1 if the bank *i's* received at least one of any kinds of public interventions at time *t*, and 0 otherwise.

Table 4 reports the number of public interventions over the sample period on banks by year and by country.

5.2. Measures of Bank Risk and Activities

As dependent variables, we make use of various accounting measures for bank risk-taking. First, we consider *Risk-weighted assets ratio* which is calculated as the ratio between the bank's assets exposures weighted by their intrinsic risk and the bank total assets. It represents a bank measure of riskiness from the supervisory viewpoint. Second, the *liquid assets ratio* is defined by the amount of total liquid assets scaled by total assets and measures the percentage of total assets that the bank may easily convert into cash. Finally, to capture the quality of bank's lending activities, we use the non-performing loans ratio (*NPLs Ratio*), defined as the ratio between the amount of non-performing loans and bank's total loans.

As proxies for bank activities, we consider two other proxies, *Intermediation Ratio* and *Interest Margins Ratio. Intermediation Ratio* is defined as the ratio between total loans to total deposits. It is a measure of bank's ability to transform customer deposits into lending activities. *Interest Margins Ratio*, defined as interest margins to total assets, is also auxiliary to test the charter value explanations and to understand whether non-rescued competitors are more likely to behave more aggressively after their peer have been bailed-out (Hakenes and Schnabel, 2010, Calderon and Schaeck, 2016).

Although it may be argued that accounting data are affected by their well-known drawbacks of *backward-looking* measures, their use is appropriate here since the use of market data would drastically constrain our sample size,[13] which is mainly composed by non-listed commercial banks.[14]

5.3. Control variables

In the empirical analysis, we use a standard set of bank-specific and macroeconomic controls. All controls are lagged by one year to reduce simultaneity problems. We use *Size* (the logarithm of bank's total assets) to control for bank's market power and returns to scale. In addition, the inclusion of this variable is important to disentangle the risk effects of public bailouts and those implicit ones due to bank's size (*too-big-to-fail argument*). Next, we control for bank's profitability by using *ROA*, defined as the net income of the bank scaled by total assets (Adams and Ferreira, 2009). We also control for bank's capital adequacy using *Total Capital Ratio*, calculated as the sum of tier 1 plus tier 2 scaled by total assets. Additionally, we control for different bank features by inserting two dummies – *Listed Bank Dummy* and *M&A Dummy*. We also allow for business cycle effects by controlling for *GDP growth*, defined as the annual percentage growth rate of the GDP at market prices based on constant local currency.

In further tests aimed at identifying non-rescued banks, we also consider other bank-specific variables as controls. To capture bank's lending activities, we use *Loans Share* defined as the ratio between total loans to total assets. Furthermore, we consider two proxies of bank funding mix. First, we consider *Deposits Liabilities Ratio* (total deposits to total liabilities) in order to take into account bank dependence on stable funding (Ivashina and Scharfstein, 2010). Second, we consider the *Interbank Ratio* as a proxy for bank exposures to other credit institutions. Third, in line with Bayazitova and Shivdasani (2012), we use *Net Charge-Offs Ratio* as the measure of bank asset quality. Last but not least, we also account for diversification in bank activities since regulators have

[13] Our purpose is to preserve the sample size as in Gropp et al. (2010).
[14] Our unbalanced panel is composed by 241 unlisted banks and 104 listed banks.

incentives to support banks in certain kind of activities. For this purpose, we use *Fee Income Ratio*, calculated as total fee commissions scaled by total assets. Finally, to evaluate the bank off-balance sheet activities, we use the notional value of the derivatives contracts to total assets (*Derivatives Assets Ratio*).

5.4. Descriptive Statistics

In Table 5 Panel A, we report the descriptive statistics. For this purpose, we present mean, standard deviation, minimum, and maximum. At first glance, our data show a large variability across the banks during the sample period. For instance, the *RWA Ratio* varies from a low of about -0.41 and high of 184.15. Other variables (e.g. *Liquid Assets Ratio* and *NPLs Ratio*) show display a similar variation, except for bank's margins (*Interest Margins Assets Ratio*), which are sticky over the whole sample period. The mean bank in our sample has 4.40 billion €, while its mean ROA is around 0.001. More than 30% of all European commercial banks in our sample are listed, while almost 3% of banks were involved in M&A operations over the sample period.

In Table 5 Panel B, we also provide the univariate comparisons between bailed-out banks and non-bailed out banks along all array of variables used in our tests. Specifically, we present the average values for bailed-out banks and non-bailed out banks and the p-values of two-sided t-tests. Surprisingly, our evidence suggests that non-rescued banks have a higher RWA ratio than their rescued peers and this difference is statistically significant even if non-rescued banks have a better liquidity and a lower fraction of non-performing loans. Although there are some differences among the two groups (e.g. better capitalization and profitability), we do not find evidence that rescued banks differ substantially and statistically from those did not in terms of size, ability to transform deposits into loans (*Intermediation Ratio*), lending activities (*Loans Share*), asset quality (*Net-charge offs Ratio*) and off-balance sheet activities (*Derivatives Assets Ratio*). This is an important result for our identification strategy. We will explain the latter in the next section.

[INSERT TABLE 5]

6. Methodology

We use a three-step approach in order to identify the effects of public bailouts on rescued banks' risk-taking and their competitive effects on bank's competitors.

First, we focus on rescued banks by estimating the change in the bank's risk-taking and the level of bank's activities during the years preceding and following the public bailout.

For this purpose, we use the following fully saturated model:

$$Y_{i,t} = \beta_0 + \sum_{S=-3}^{-1} \gamma_S \, Pre - Bailout(-s)_{i,t} + \sum_{S=0}^{3} \gamma_S \, Bailout(+s)_{i,t} + \sum_{m=1}^{M} \omega_m \, Controls_{i,t-1} + \delta_i + \delta_{sxt} + \varepsilon_{i,t} \quad (1)$$

where the dependent variable $Y_{i,t}$ (i indexes bank and t indexes observation year) is a measure of either bank risk or bank activities. *Pre-Bailout* is a dummy variable takes on the value of one if it "*s*" years before the bank received a public bailout and zero otherwise. For example, *Pre-Bailout -2* is a variable equal one if it is two years before the bank received a public bailout, while *Bailout +2* is a variable is equal to one if it is two years after the bank received the government intervention. The model is fully saturated with the year immediately before the bank received the public bailout as the excluded category. Furthermore, the coefficients on *Pre-Bailout (-s)* and *Bailout(+s)* compare the level of each dependent variable "*s*" years before and after the public bailout. *Controls* is a vector of lagged variables[15] related to bank-specific characteristics, macroeconomic and institutional factors. Additionally, using bank-fixed effects allows that each variable is estimated using the within bank variation in the dependent variables. We also include bailout-year fixed effects to control for bailout-time level trends (δ_{sxt}). We cluster standard errors at bank-level to allow for serial correlation within each bank.

This regression setup is appropriate here to identify the effects of the public bailouts on rescued banks' risk. Public bailouts are not exogenous shocks since public authorities are more likely to assign

[15] All controls are lagged by one year to reduce simultaneity problems.

them when a bank is in default. However, it may be argued that ailing banks may be aware of their status and modify their conduct endogenously (Dam and Koetter, 2012, Berger et al., 2016) so that naïve regressions ignoring this fact may lead to biased estimates.

Second, we focus on the competitive effects of public bailouts on rescued banks' competitors. Our analysis implicitly assumes that public bailouts may also influence non-rescued banks. This argument is not far-fetched. Many evidences and theoretical models in the literature (Hakenes and Schnabel, 2010; Gropp et al., 2010; Calderon and Schaek, 2016) outline that public bailouts might trigger changes in competitor banks conducts. The main explanation is that they increase the level of the competition in the banking system and decrease bank's competitors' charter values. In contrast with Gropp et al. (2010), we follow an alternative strategy: we identify the non-rescued banks (having the same probability to be bailed out) did not receive a public bailout during the sample period and then we re-estimate the same fully saturated model for only non-rescued banks. Specifically, to estimate the spillover effect of these policies on non-rescued banks, we implement a Propensity Score Matching (hereafter, PSM) technique based on a probit model. This non-parametric approach results in the *ex-ante* probability of receiving a public bailout given a set of explanatory variables, namely the propensity score. The advantage of this procedure lies in the fact that allows identifying a reasonable counterfactual sub-sample of non-treated units with similar characteristics to rescued banks. In line with Bayazitova and Shivdasani (2012) we consider a vector of 11 variables indicatives of bank's systemic importance (*Size*), level of activities (*Liquid Assets Ratio*, *Loans Share*), asset quality (*Net Charge Offs Ratio*), funding mix (*Deposits Liabilities Ratio*, *Interbank ratio*), capital adequacy (*Total Capital Ratio*), off-balance sheet activities (*Derivatives Assets Ratio*), bank's corporate outcomes (*ROA* and *NPLs Ratio*), and diversification activities (*Fee Income Ratio*). This estimation procedure is repeated for each year of the sample period (2007-2014). We estimate the following regression model:

$$\Pr(S_i = 1 | V_i) = \phi(Systemic\ Importance, Activities, Asset\ quality, Funding\ mix, Capital\ Adequacy, Off - balance\ sheet\ activities, Corporate\ Outcomes, Diversification) \quad (2)$$

Once we compute the propensity score for all the banks composing our sample for each year, we match each rescued banks with its two nearest neighbours who did not receive a bailout in that year. Then we estimate the spillover effects on non-rescued banks by using the following saturated model:

$$Y_{i,t} = \beta_0 + \gamma_{-1} Pre - Matched(-1)_{i,t} + \sum_{S=0}^{3} \gamma_S\, Matched(+s)_{i,t} + \sum_{m=1}^{M} \omega_m\, Controls_{i,t-1} + \delta_i + \delta_{sxt} + \varepsilon_{i,t} \quad (3)$$

The dependent variable is defined as before, namely a proxy for bank risk and bank activities. *Pre-Matched (-1)* is a dummy variable takes the value of one if it is the year before the bank has been selected as "matched bank" and zero otherwise. *Matched* is a dummy variable taking the value of one if the bank is selected in a given year among one of the top two similar banks of a bank that received a public bailout in the same year and zero otherwise. *Matched (+s)* is a dummy variable that takes the value of one if it is "s" year after the bank has been selected as "matched bank" and zero otherwise. Again, we include the same set of bank-specific and macroeconomic controls, bank-fixed effects, year-fixed effects and bailout-year-fixed effects. Again, standard errors are clustered at bank-level. The econometric strategy used to identify the spillover effects on bank's competitor follows that used to evaluate the effects of public bailouts on bank's risk with the only exception that we use a fully saturated dynamic difference-in-difference based on the interval [-1, +3] due to the temporary nature of herding incentives raising from such policies (Acharya and Yorulmazer, 2007).

7. Results

We report the results on the effect of public bailouts on rescued banks in Section 7.1. In section 7.2, we show the results related to our econometric strategy to identify non-rescued banks, while in 7.3 we report the results of the spillover effects of public bailouts.

7.1. The direct effect of public bailouts on bank risk

Table 7 reports the results on the relationship between public bailouts and bank's risk. Our estimates show that public bailout increase bank's risk-taking. Specifically, bailouts impinge on the bank's risk-taking not only in the proximity of the public intervention but also over the three next years. This effect is statistically and economically significant. In our sample, the mean value of the *Risk-Weighted Assets Ratio* is around 0.6938. Hence, our results suggest that banks increase their riskiness around 23% (0.1614/0.6938) in the year after the public bailout is imposed (the increase is 26% and 17% after two and three years the public intervention).

[INSERT TABLE 7]

In line with Berger et al. (2016), we do not find any statistically significant effect of public bailouts on the *Liquidity Assets Ratio* of rescued banks. Whilst, we find that the effects of public bailouts on the *NPLs ratio* is positive and statistically significant at 5% or better. For instance, when a bank receives a public bailout there is a substantial increase in the percentage of NPLs ratio around 92% three years after the public bailout. These results are consistent with the hypothesis that public bailouts may incentive bank to misbehave. Indeed, banks increase their risk by lowering the quality of the lending activities, proxied by *NPLs Ratio*.

Furthermore, moving onto other variables, Table 6 shows also that there is a decline in the lending activities two years before the bailout is provided. This effect is statistically significant. The decline in the lending activities is around 8%. We also find that banks, once received a public bailout increase their *Intermediation Ratio*, defined as total loans to total deposits, respectively of 33%, 34%, and 36%, while before of the public interventions, there is a drop in the *Intermediation Ratio*.

Our results provide evidence that public bailouts can affect bank's risk-taking and the economic significance is not trivial. More specifically, we find that rescued banks increase their risk (*RWA-ratio*). In turn, the latter is mainly driven by an increase in the volume of lending activities due to the lower costs in bank's funding (*Intermediation Ratio*) and a decrease in the quality of bank's lending.

7.2. Finding matching banks

In this section, we identify the bank's competitors characterised by similar features in respect of rescued banks. At this end, we resort to propensity score matching estimation procedure. The aim is to find most comparable non-bailed-out units. This procedure is auxiliary in order to investigate on the spillover effects of public bailouts on non-rescued competitors.

The identification of those untreated units (banks did not receive a public bailout but are similar to bailed-out banks) reporting similar levels of propensity scores given a set of explanatory variables is based on the prominent literature of the predictors of public bailouts (Faccio et al., 2006, Bayazitova and Shivdasani, 2012). Furthermore, this step allows us to shed some lights on the key variables explaining the probability of receiving a public bailout during the crisis period. As well as showing the distribution of non-bailed-out banks in Table 8, we also report the results of cross-sectional probit regressions run yearly from the whole sample period (2007 to 2014).

[INSERT TABLE 8]

Not surprisingly, we find that the probability of receiving a public bailout is negatively related to *Liquidity Assets Ratio* and bank's profitability, proxied by *ROA*. Performance and liquidity are indicators of bank's soundness. Whilst, the probability of receiving a public bailout is positively related to bank's size and realized losses on loans. These results are strictly in line with Bayazitova and Shivdasani (2012), provided that banks with higher systemic risk in terms of distress costs due to their size are more likely to be rescued.

In Table 8, we also show the goodness-of-fit of our propensity score matching estimation procedure. Particularly, we report the Receiver Operating Characteristic (*ROC*) curves[16] year by year. This test allows understanding the quality of the matching based on probit regressions for the identification of untreated peers by comparing the true positive rate and the false positive rate.

[16] The ROC curves is estimated by comparing and plotting the true positive rate, labeled "*sensitivity*", and the false positive rate, labelled as "*1-specificity*", at various threshold settings.

Overall, our results show a relatively high performance in the identification of the peers of probit regressions. Particularly, the area under the ROC curve is more than 0.80 (by reaching the peak of 0.9751) in all specifications over the sample period.

7.3. The spillover effects of public bailouts

As a next step, we focus our attention on banks did not receive a public bailout but have similar characteristic to the rescued banks. We refer to these banks as "matched" since we identified them through a propensity score matching procedure. Along the same line as before, our main independent variable to test the second set of hypotheses (**H2A - H2B**) is a dummy taking the value of one if the bank is among the top-two similar banks,[17] and zero otherwise. As dependent variables, we again use the variables explained in Section 5.2.

As mentioned, we make implicitly an identification assumption: we assume that public bailouts may have spillover effects on non-rescued banks' competitors risk and volume of activities. This argument is unlikely to be far-fetched because there are many theoretical explanations about spillover effects of public bailouts (Acharya and Yorulmazer, 2007; Hakenes and Schnabel, 2010). Furthermore, the empirical evaluation of our assumption has an important policy implication: if such spillover effect is verified public interventions should be discouraged in order to avoid risk-increasing incentives in the bank's competitors during banking crises. Conversely, if no spillover effect is verified, it entails that public bailouts do not generate risk-increasing incentives of rescued banks' peers without determining a distortion in the competition.

Our econometric strategy follows the previous section with the only exception that we implement a fully saturated dynamic difference-in-difference based on the interval [-1, +3] due to the temporary nature of herding incentives raising from such policies (Acharya and Yorulmazer, 2007).

[INSERT TABLE 9]

[17] We use a 2-nearest-neighbor matching on a propensity score.

Table 9 reports our results. We find that relative to the year preceding the public bailout of the rescued-peers, the pre-bailout coefficients are unrelated with proxies for bank's risk and activities, with the only exception of the *Intermediation Ratio*. Conversely, in the post-bailout period, the *Risk Weighted Assets Ratio* increases, but this increase is not statistically significant. Furthermore, we also find that after a bank received a public bailout, rescued bank's competitor decreases the proportion of liquid assets (*Liquid Assets Ratio*), and, simultaneously, increases the fraction of non-performing loans (Column 3). Both estimated effects for rescued banks' competitors are not negligible. Additionally, in line with the theoretical framework of Hakenes and Schnabel (2010), we find banks decrease their margins immediately after a competitor has been rescued by public authorities, but this drop is not statistically significant.

8. Conclusions

This paper is the first attempt to study the impact of public bailouts in Europe both on rescued banks and on rescued banks' competitors risk. Building a new hand-collected dataset on all European commercial banks for the period from 2007 to 2014, our paper examines two timely research questions. First, we examine whether public bailouts affect the conduct of rescued banks. We find that rescued banks increase their risk by increasing the fraction of non-performing loans, while we do not find that banks benefit from higher charter values reflected in higher interest margins. In line with Berger et al. (2016), we find that banks do not create more liquidity after receiving the public interventions. Second, we examine whether there exist spillover effects of such policies on rescued banks' competitors. We partially confirm the competitive effects of the public bailouts. In fact, we find that banks that are very similar to the bailed-out banks herd, increase their risk, and reduce their liquidity. In addition, we find no evidence that non-rescued banks behave more aggressively by depressing their margins (Hakenes and Schnabel, 2010).

Our evidence suggests a straightforward policy implication for the EU-banking system: public bailouts may undermine the overall financial stability. The main explanation is not only based on the

well-established *moral hazard problem* (Merton, 1977) of rescued banks when benefitting from public interventions but lies in the fact that public bailouts may threaten the financial stability through their spillover effects on the rescued banks' competitors. Indeed, when a public authority rescues a bank (Acharya and Yorulmazer, 2007), rescued banks' competitors appear to react by worsening the quality of their credit portfolio and their level of liquidity. Hence, our evidence allows us to conclude that the social costs of such policies lie not only in the risk-increasing incentives of the beneficiary banks but also of rescued banks' competitors.

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Table 1. Selected Literature on the effects of public bailouts

This table summarises the literature on the effects of public bailouts on banks.

Panel A: Effect of Public bailout on Rescued Banks							
Authors	*Sample*	*Period of analysis*	*Level*	*Method*	*Dependent Variables*	*Key Variables*	*Main findings*
Gropp et al. (2010)	Cross-section of banks from all OECD countries	2003	Bank	OLS - IV approach	Problem loans ratio, risk asset ratio, liquidity ratio equity ratio	Measure of bailout perceptions based on rating information	There is no evidence that public guarantees increase the risk of protect banks, with the only exception banks having public ownership
Zingales and Veronesi (2010)	All US listed banks*	October 13, 2008	Bank	Event Study	-	-	US government interventions increase the value of banks' financial claims
Dam and Koetter (2012)	All German banks	1995-2006	Bank	IV approach	PD	Dummy variable: 1 if the regulator bails out the bank, 0 otherwise	Bank bailouts increase the probability of distress.
Duchin and Sosyura (2014)	521 US banks	2006-2010	Bank	Linear probability model with Difference-in-difference models	Dummy variable: 1 if the loans was approved and 0 if it was denied	Dummy variable: 1 in 2009-2010 and 0 in 2006-2008 – Loan-to-income	They find that approved banks (TARP) show higher risk-taking.
Berger et al. (2016)	Small and medium banks in Germany	1999-2009	Bank	IV approach	Δ[Z-score(ln)], Δ(RWA/total assets)	Dummy variable: 1 if the bank receives a capital support , 0 otherwise	They find that capital supports decline bank's risk-taking.
Panel B: Effect of public bailout on rescued banks' competitors							
Authors	*Sample*	*Period of analysis*	*Level*	*Method*			*Main findings*
Gropp et al. (2010)	Cross-section of banks from all OECD countries	2003	Bank	OLS - IV approach	Problem loans ratio, risk asset ratio, liquidity ratio equity ratio	Measure of bailout perceptions based on rating information	Government guarantees increase only the risk of competitor banks
Calderon and Schaeck (2016)	124 countries	1996-2010	Country	Difference-in-difference estimation	Lerner Index, Net interest margin	Dummy variables:1 in the year the intervention was announced, and 0 otherwise	They provide evidence that public bailouts increase the competition among banks.
This study	All commercial banks across 15 EU-countries	2007-2014	Bank	Fully satured dynamic difference in difference model	RWA Ratio, Liquidity Assets Ratio, NPLs Ratio, Intermediation Ratio, Interest Margins Ratio	Dummy variable: 1 if the bank receives a public bailout, 0 otherwise	First, we find that during the financial crisis public bailouts create risk-increasing incentives on banks. Second, we also find a spillover effect on rescued banks' competitors

Table 2. Stages of the sample selection

Stages	Search Criterion	Number of Banks
Stage 1	All banks in Bankscope in the World Region: Austria Belgium Denmark France Germany Greece Iceland Ireland Italy Netherlands Portugal Spain Sweden Switzerland UK	8,211
Stage 2	Accounting Standards -IFRS	5,576
Stage 3	Commercial Banks	466
Stage 4	Removal of all subsidiaries of foreign banks	345

Table 3. Sample description

Country	Banks	Sample %	Obs.	Sample %
Austria	10	2.9	79	3.7
Belgium	7	2.03	54	2.53
Denmark	19	5.51	123	5.76
France	21	6.09	165	7.72
Germany	9	2.61	61	2.86
Greece	25	7.25	110	5.15
Iceland	3	0.87	20	0.94
Ireland	6	1.74	40	1.87
Italy	106	30.72	671	31.41
Netherlands	21	6.09	137	6.41
Portugal	18	5.22	96	4.49
Spain	45	13.04	248	11.61
Sweden	12	3.48	56	2.62
Switzerland	5	1.45	29	1.36
United Kingdom	38	11.01	247	11.56
Total	345	100	2,136	100

Table 4. Distribution of Public Bailout by Year and Country, 2007-2014

This table shows the distribution of public interventions on banks in the European banking system between 2007 and 2014. Panel A reports the number of public bailouts performed by public authorities. Data on public bailouts are taken from Mediobanca bulletin and European Commission database. Panel A reports the description of public bailouts by year. Panel B depicts the distribution of public bailouts by country. "Recapitalizations" are a capital injection aimed at strengthen bank capital. "Guarantees" are any governmental commitment to repay bank's creditors and depositors if the bank may not be able to do so. "*Liquidity Facilities*" are public intervention aimed to enhance bank liquidity provisions through c*redit lines. "Assets relief measures"* are a public support aimed at "relieving" ailing banks from toxic or impaired assets.

Panel A:				
Year	Recapitalizations	Guarantees	Liquidity facilities	Asset relief measures
2007	1	0	0	0
2008	8	8	1	2
2009	18	9	0	2
2010	6	5	1	1
2011	12	6	2	0
2012	10	10	1	2
2013	5	2	0	4
2014	1	1	0	1
Total	61	41	5	12
Panel B:				
Country	Recapitalizations	Guarantees	Liquidity facilities	Asset relief measures
AT	4	3	0	1
BE	2	1	0	0
CH	0	0	0	0
DE	2	1	0	0
DK	2	1	2	0
ES	5	4	1	3
FR	0	0	0	0
GB	4	3	0	0
GR	23	13	1	3
IE	3	5	0	1
IS	0	0	0	0
IT	2	1	0	0
NL	6	4	1	3
PT	8	5	0	1
SE	0	0	0	0
Total	61	41	5	12

Table 5. Descriptive Statistics

This table reports summary statistics for our analysis. Panel A reports for each variable the following statistics: number of observations (Obs.), mean (Mean), standard deviation (Std. Dev), the minimum (Min.) and the maximum (Max.). Panel B reports two-sided t-tests by allowing for the unequal variance between rescued banks and non-rescued banks.

		Panel A: Summary Statistics					**Panel B: T-tests**		
		Obs.	Mean	Std. Dev	Min.	Max.	Non-Rescued Banks	Rescued Banks	Differences t-test p-value
***Dependent Variables: Bank risk-taking* and activities**									
RWA ratio	Risk Weighted Assets scaled by total assets	2,136	0.6938	5.7269	-0.4083	184.1517	0.7080	0.3755	0.0124**
Liquid Assets Ratio	Liquid Assets scaled by total assets	2,136	0.2330	0.2182	0.0000	1.0000	0.2379	0.1241	0.0000***
NPLs Ratio	Non-performing loans scaled by total loans	2,136	0.0595	0.0853	0.0000	0.6679	0.0584	0.0825	0.0253**
Intermediation Ratio	Total loans to total deposits	2,136	0.8781	0.6483	0	8	0.8785	0.8729	0.9321
Interest Margins Assets Ratio	Interest margins to total assets	2,136	0.0001	0.0004	-0.0000	0.0192	0.0000	0.0000	0.0770*
Control Variables									
Size	Log of Total Assets	2,136	15.5921	3.0127	0.0000	21.5128	15.6197	14.9714	0.3620
ROA	Return on Assets	2,136	0.0008	0.0346	-1.0114	0.2750	0.0013	-0.0106	0.0003***
Total Capital Ratio	Sum of tier 1 plus tier 2 scaled by total assets	2,136	0.1414	0.2223	-0.0510	4.3240	0.1432	0.1027	0.0000***
Listed Bank Dummy	Dummy Variable: 1 if the bank is listed, and 0 otherwise.	2,136	0.3127	0.4637	0.0000	1.0000	0.2998	0.6044	0.0000***
M&A Dummy	Dummy Variable: 1 if the bank is involved in mergers and acquisitions.	2,136	0.0303	0.1713	0.0000	1.0000	0.0299	0.0395	0.6762
Other control variables used to identify peers									
Loans Share	Total loans scaled by total assets	2,136	0.5516	0.2573	0.0000	0.9943	0.5530	0.5188	0.2220
Deposits Liabilities Ratio	Total deposits scaled by total liabilities	2,136	0.5124	0.2733	0.0000	0.9990	0.5178	0.3907	0.0000***
Interbank Ratio	Due from banks scaled by due to banks	2,136	0.9996	1.5703	0.0000	9.9354	1.0134	0.6904	0.0035***
Net Charge Offs Ratio	Net Charge offs scaled by total assets	2,136	0.0012	0.0299	-0.0417	1.3123	0.0010	0.0053	0.1419
Fee Income Ratio	Total fee commissions scaled by total assets	2,136	0.0090	0.0413	-1.7200	0.2585	0.0093	0.0034	0.0000***
Derivatives Assets Ratio	Total Derivatives scaled by total assets	2,136	0.0278	0.0659	0.0000	0.5365	0.0273	0.0393	0.1732

Table 6. First differences of dependent variables

This table reports the yearly change of our dependent variables over the sample period (2007-2014). *Risk-weighted assets ratio* (ratio between the bank's assets exposures weighted by their intrinsic risk and the bank total assets), *liquidity assets ratio* (total liquid assets to total assets), *NPLs Ratio* (non-performing loans to total loans), *Intermediation Ratio*, defined as the ratio between total loans to total deposits, and *Interest Margins Assets Ratio*, margins scaled by total assets.

Variables	Δ*RWA Ratio*		Δ*Liquidity Assets Ratio*		Δ*NPLs Ratio*		Δ*Intermediation Ratio*		Δ*Interest Margins Ratio*	
Year(s)	Rescued Banks	Non-Rescued Banks	Rescued Banks	Non-Rescued Banks	Rescued Banks	Non-Rescued Banks	Rescued Banks	Non-Rescued Banks	Rescued Banks	Non-Rescued Banks
2007	-	-	-	-	-	-	-	-	-	-
2008	-0.0481	-0.126	-0.2652	-0.0145	0.8695	3.1062	0.1291	0.0713	0.0650	-0.3867
2009	-0.0362	-0.045	0.1716	0.5818	0.6564	0.9817	16.773	0.0348	-0.2156	0.0020
2010	-0.0451	-0.0186	-0.1634	1.6703	0.4578	0.1229	-0.0020	0.1364	0.3660	-0.0734
2011	-0.1589	-0.048	-0.1411	0.1182	0.7452	0.5061	-0.1760	3.3819	-0.0814	1.0103
2012	-0.3024	-0.0771	-0.1539	0.2236	0.2950	0.4688	-0.2167	-0.0169	-0.2070	0.4678
2013	-0.1445	-0.0287	-0.2033	0.5568	-0.1940	0.6550	-0.2307	0.0097	-0.2380	-0.2035
2014	-0.3324	-0.0170	-0.2450	0.1070	-0.2185	0.0721	-0.3445	0.0630	-0.1270	0.0696

Table 7. The effects of public bailouts on bank's risk and activities

This table shows the results of the effects of public bailouts on bank's risk and activities. The dependent variables are respectively *Risk-weighted assets ratio* (ratio between the bank's assets exposures weighted by their intrinsic risk and the bank total assets), *Liquidity Assets Ratio* (total liquid assets to total assets), *NPLs Ratio* (non-performing loans to total loans), *Intermediation Ratio*, defined as the ratio between total loans to total deposits, and *Interest Margins Assets Ratio*, margins scaled by total assets. *Pre-Bailout* is a dummy takes the value of one if it is "s" year before the bank received a public bailout and zero otherwise. *Bailout* is a dummy takes the value of one if it is "s" year after the bank received a public bailout and zero otherwise. Our regressions include bank-specific controls and macroeconomic controls. *Size* is logarithm of total assets (€ thousands). *ROA* is calculated as net income scaled by total assets. *Total capital* ratio is calculated as the sum of tier 1 plus tier 2 scaled by total assets. *Listed bank Dummy* is a dummy takes the value of one if the bank is listed, and zero otherwise. and *M&A Dummy* is a dummy takes the value of one if the bank is involved in mergers and acquisitions, and zero otherwise. *GDP growth* is annual percentage growth rate of GDP at market prices based on constant local currency. All controls are lagged by one year. Robust t-statistics are reported in parentheses. Standard errors are clustered at the bank level. ***, **, and * indicate the statistical significance respectively at 1%, 5%, and 10%.

Variables	*Risk Weighted Assets Ratio* *(1)*	*Liquid Assets Ratio* *(2)*	*NPLs Ratio* *(3)*	*Intermediation Ratio* *(4)*	*Interest Margins Assets Ratio* *(5)*
Pre-Bailout (-3)	0.0961	0.0042	-0.0090	0.0626	-0.0000
	(0.9743)	(0.1703)	(-1.0883)	(0.2885)	(-0.1475)
Pre-Bailout (-2)	0.0998	-0.0061	-0.0156	-0.4013**	0.0000
	(0.7751)	(-0.5273)	(-1.5224)	(-2.1209)	(0.1098)
Pre-Bailout (-1)	0.1161	0.0057	0.0125	-0.1983	-0.0002
	(1.1583)	(0.1912)	(1.1065)	(-1.2848)	(-0.6869)
Bailout (0)	-0.0729	0.0234	0.1059***	0.2315*	-0.0000
	(-0.4098)	(0.7350)	(6.0409)	(1.9111)	(-0.0863)
Bailout (+1)	0.1614**	0.0012	0.0654***	0.2787***	0.0001
	(2.1280)	(0.4292)	(5.7337)	(3.7121)	(0.2347)
Bailout (+2)	0.1841**	-0.0196	0.0543***	0.2910***	0.0006
	(2.2067)	(-1.2169)	(4.9193)	(4.6721)	(1.5031)
Bailout (+3)	0.1232*	-0.0016	0.0551***	0.2984***	0.0009**
	(1.7251)	(-0.8512)	(4.5686)	(5.3388)	(2.0755)
$Size_{t-1}$	-0.0021	-0.0022	0.0003	0.0078***	-0.0000
	(-0.8390)	(-1.1950)	(0.8305)	(3.7379)	(-0.4011)
ROA_{t-1}	0.4469	-0.8161*	-0.1725	-0.2371	-0.0699***
	(0.5500)	(-1.7988)	(-0.9086)	(-0.5399)	(-2.7408)
Total Capital Ratio $_{t-1}$	-0.0333	0.0987***	0.0058	0.0807**	0.0001
	(-0.8865)	(8.2855)	(0.4360)	(2.4476)	(0.4859)
GDP growth $_{t-1}$	0.2021	0.4364	0.0119	-0.4937	0.0019
	(0.2165)	(1.4858)	(0.0930)	(-0.8927)	(0.5382)
Intercept	Yes	Yes	Yes	Yes	Yes
M&A Dummy	Yes	Yes	Yes	Yes	Yes
Listed Bank Dummy	Yes	Yes	Yes	Yes	Yes
Observations	365	365	365	365	365
R-squared	0.068	0.147	0.540	0.271	0.659
Number of bank	196	196	196	196	196
Cluster	Bank	Bank	Bank	Bank	Bank
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time x Bailout Effect	Yes	Yes	Yes	Yes	Yes

Table 8. Finding rescued banks' competitors

This table shows the propensity score matching estimations. We estimate the propensity score matching using probit model specifications. Each specification is estimated yearly by using the model (2). The propensity score matching is based on k-nearest neighbour method with *k=2*. The dependent variable is a dummy variable that takes the value of one if the bank has received a public bailout at the specific year and 0 otherwise. All explanatory variables are lagged by one year to reduce simultaneity concerns and are summarized in Table 4. All regressions use heteroscedasticity-robust standard errors. At bottom, we also report yearly the *ROC test* based on the evaluation of the Receiver Operating Characteristic (*ROC*) curves illustrating the goodness-of-fit of the predictive propensity scores. ***, **, and * indicate the statistical significance respectively at 1%, 5%, and 10%.

Variables	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
Loans Share$_{t-1}$	-0.0147*	-0.0081	-0.0125*	0.0081	0.0004	-0.0058	0.0058	-0.0073
	(-1.6607)	(-1.2615)	(-1.9351)	(1.2556)	(0.0611)	(-0.9949)	(1.0069)	(-1.3926)
Liquidity Assets Ratio $_{t-1}$	-5.1831***	-1.8439**	-0.5107	-0.5707***	-0.4911	-2.1062	-0.1963	-7.8595***
	(-3.4668)	(-2.1187)	(-0.9325)	(-2.8442)	(-0.6478)	(-1.6061)	(-0.3185)	(-4.0075)
Size $_{t-1}$	0.6566***	0.1194	0.2940***	0.2496**	-0.0476	-0.0269	-0.1061*	-0.0139
	(3.0451)	(1.3051)	(4.2726)	(2.3594)	(-0.7881)	(-0.4952)	(-1.9399)	(-0.1993)
ROA $_{t-1}$	5.0474	-3.2386	0.1028	7.9233*	-15.0220**	-9.8158**	5.2988	-24.0454**
	(1.3475)	(-1.2307)	(0.0258)	(1.8901)	(-2.5612)	(-2.3347)	(1.0986)	(-2.2668)
Total Capital Ratio $_{t-1}$	-3.1885*	1.1172	0.0917	1.0798**	-2.3821**	-0.0864	-0.4997	-1.5571
	(-1.6842)	(1.1584)	(0.1255)	(2.2037)	(-2.1565)	(-0.2059)	(-0.6903)	(-0.9003)
Deposits Liabilities Ratio $_{t-1}$	2.6016***	-0.1902	0.3472	-0.2206	-1.2343**	-0.7501	-0.7367	0.9851**
	(2.7182)	(-0.3433)	(0.6789)	(-0.2680)	(-2.3962)	(-1.3558)	(-1.5949)	(2.2712)
Interbank Ratio$_{t-1}$	0.1454	-0.1024	0.0841	0.1862	0.0713	0.0909	-0.0806	-2.1911
	(1.3086)	(-0.9048)	(1.0389)	(1.5087)	(0.8360)	(1.6193)	(-0.4374)	(-1.1398)
Non-performing loans $_{t-1}$	5.6293*	-12.8384*	-2.0282	2.2770	0.6037	2.0645	3.0711**	1.7094
	(1.8894)	(-1.7640)	(-0.9003)	(1.2575)	(0.4689)	(1.3591)	(1.9687)	(0.7468)
Net Charge offs Ratio $_{t-1}$	-67.8441**	5.3647	9.3647	-0.1934	28.2675**	39.4783**	11.1644***	0.2873
	(-2.4506)	(0.6461)	(0.9507)	(-0.0098)	(2.3507)	(2.3194)	(3.9730)	(0.6643)
Fee income Ratio	-141.8146**	-58.6597	-157.9761***	-160.9200***	0.8374*	-49.0399*	-94.5469*	-8.3677
	(-2.4661)	(-1.3487)	(-5.6213)	(-3.1753)	(1.8147)	(-1.7983)	(-1.8220)	(-0.6246)
Derivatives Assets Ratio	-6.7024**	1.1191	-2.0825	0.3370	3.0367	2.5885	0.7367	12.5420**
	(-2.3382)	(0.5735)	(-1.0639)	(0.1155)	(1.2875)	(0.9461)	(0.4254)	(2.0700)
Intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	242	255	263	283	288	291	265	244
Matched Banks	2	22	0	20	19	22	10	6
Un-matched Banks	240	233	263	263	269	269	255	238
ROC test (area under the curve)	0.9751	0.8241	0.8757	0.8930	0.8535	0.8918	0.8720	0.9751

Table 9. Spillover effects of public bailouts.

This table shows the results of the spillover effects of public bailouts on rescued bank's competitors risk-taking and activities. The dependent variables are respectively *Risk-weighted assets ratio* (ratio between the bank's assets exposures weighted by their intrinsic risk and the bank total assets), *Liquidity Assets Ratio* (total liquid assets to total assets), *NPLs Ratio* (non-performing loans to total loans), *Intermediation Ratio*, defined as the ratio between total loans to total deposits, and *Interest Margins Assets Ratio*, margins scaled by total assets. *Pre-Matched (-1)* is a dummy takes the value of one if it is the year before the bank has been selected as "matched bank" and zero otherwise. *Matched* is a dummy variable taking the value of one if the bank is selected in a given year among one of the top two similar banks of a bank that received a public bailout in the same year and zero otherwise. *Matched (+s)* is a dummy variable that takes the value of one if it is "s" year after the bank has been selected as "matched bank" and zero otherwise. *Size* is logarithm of total assets (€ thousands). *ROA* is calculated as net income scaled by total assets. *Total capital* ratio is calculated as the sum of tier 1 plus tier 2 scaled by total assets. *Listed bank Dummy* is a dummy takes the value of one if the bank is listed, and zero otherwise. and *M&A Dummy* is a dummy takes the value of one if the bank is involved in mergers and acquisitions, and zero otherwise. *GDP growth* is annual percentage growth rate of GDP at market prices based on constant local currency. All controls are lagged by one year. Robust t-statistics are reported in parentheses. Standard errors are clustered at the bank level. ***, **, and * indicate the statistical significance respectively at 1%, 5%, and 10%.

Variables	*Risk Weighted Assets Ratio* *(1)*	*Liquid Assets Ratio* *(2)*	*NPLs Ratio* *(3)*	*Intermediation Ratio* *(4)*	*Interest Margins Assets Ratio* *(5)*
Pre-Matched (-1)	0.0274	-1.7305	0.0228	0.1106**	-0.0000
	(0.8657)	(-1.0980)	(1.3014)	(2.4288)	(-0.1055)
Matched	0.0985	-1.3186	0.0443**	0.1009	-0.0000
	(1.4340)	(-0.8082)	(2.5396)	(1.4698)	(-0.7712)
Matched (+1)	0.0207	-1.2627**	0.0443***	0.0421	-0.0000
	(0.5408)	(-2.1990)	(3.0867)	(0.7034)	(-1.1412)
Matched (+2)	0.0096	-0.5152	0.0198*	-0.0355	-0.0000
	(0.4580)	(-1.6086)	(1.9146)	(-0.8137)	(-1.0006)
Matched (+3)	-0.0118	-0.6323*	0.0088	-0.0920	-0.0000
	(-0.4069)	(-1.7457)	(0.7902)	(-1.6056)	(-1.1257)
$Size_{t-1}$	-0.0045	0.1248	0.0009	0.0054	-0.0000
	(-0.9279)	(0.3321)	(0.8744)	(0.8045)	(-1.2544)
ROA_{t-1}	0.1129	-48.3666	-0.3775*	1.2046	-0.0005
	(0.1224)	(-0.8364)	(-1.8666)	(1.0282)	(-1.1112)
Total Capital Ratio $_{t-1}$	-0.0043	-0.1725	-0.0127***	0.0515	-0.0000
	(-0.2947)	(-0.7900)	(-2.6100)	(1.5278)	(-1.1954)
GDP growth $_{t-1}$	-0.0282	23.0781	-0.2560	1.1406	0.0002
	(-0.0289)	(0.8789)	(-1.3869)	(1.3152)	(1.1357)
Intercept	Yes	Yes	Yes	Yes	Yes
Observations	751	751	751	751	614
R-squared	0.017	0.056	0.228	0.088	0.150
Number of bank	237	237	237	237	201
Cluster	Bank	Bank	Bank	Bank	Bank
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time x Matched Effect	Yes	Yes	Yes	Yes	Yes