DISCUSSION PAPER SERIES

DP15009

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FINANCIAL ECONOMICS

ISSN 0265-8003

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Discussion Paper DP15009
Published 07 July 2020
Submitted 23 June 2020

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www.cepr.org

This Discussion Paper is issued under the auspices of the Centre's research programmes:

- Financial Economics

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Abstract

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JEL Classification: E44, G21, G28, G32, G34

Keywords: Forbearance, evergreening, zombie lending, sovereign debt crisis, Bank Recapitalization, fiscal constraints, political economy

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Acknowledgements
We thank Tobias Berg, Allen Berger, Tim Eisert, Florian Heider, Zorka Simon, Daniel Streitz, Anjan Thakor and seminar participants at The Financial Crisis Ten Years Afterwards conference (Yale), the SEEK Regulating Sovereign Debt Restructuring in the Eurozone conference (Mannheim), and ZEW (Mannheim) for valuable comments and suggestions. We thank Quirin Fleckenstein and Can Yilanci for excellent research assistance. Contact: vacharya@stern.nyu.edu, lea.borchert@web.de, maximilian.jager@gess.uni-mannheim.de, s.steffen@fs.de (Corresponding Author)

Kicking the can down the road: government interventions in the European banking sector*

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Abstract

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Data for government interventions available at: Link to government intervention data

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1 Introduction

Governments in an economy whose banking sector exhibits systemic distress have two types of interventions at their hand: system-wide measures affecting the banking sector as a whole and single-bank measures aimed at banks most in need (Farhi & Tirole, 2012). In most cases, system-wide measures are performed by monetary authorities in the form of conventional policy (i.e. lowering interest rates) and/or unconventional policy (e.g. larger-scale asset purchase programs, such as TARP). In contrast, single-bank measures are usually conducted by the fiscal authority with either immediate incidence of fiscal costs or using government guarantees. Following Pazarbasioglu et al. (2011), bank-level measures in recent banking crises can be grouped into three categories, which are usually implemented sequentially as a crisis worsens: i) guarantees, ii) capital injections, iii) asset restructuring/resolution. While step i) implies a short-run fiscal cost close to 0, steps ii) and iii) typically require governments to run a higher fiscal deficit, which has to be financed with higher debt or taxes. Therefore, fiscally constrained governments may deploy guarantees and/or engage in some form of forbearance (e.g. relax capital requirements or and asset quality recognition norms), and, in particular, decide not to implement step ii).[1]

We investigate these government interventions choices in the context of the Global Financial Crisis (GFC) and its impact on the European banking sector. While banks across all European countries were in distress, there was no centralized scheme at the European level to provide aid for individual banks. Therefore, bailout decisions were subject to the discretion and the fiscal constraints of the national governments.

Our analysis of government interventions builds on a novel, hand-collected dataset of all aid measures granted to eurozone banks during the 2007 to 2009 period. A key measure of fiscal capacity is the country's ratio of government revenues to GDP (e.g. Dincecco & Prado, 2012). Higher revenues increase the capacity to recapitalize banks in distress (Stavrakeva, 2020). Another widely used measure for fiscal strength is the total debt stock as a percentage

[1] According to Pazarbasioglu et al. (2011), step iii) is a rare event even in crisis times.

of GDP (e.g. Demirgüç-Kunt & Huizinga, 2013). A high government debt level can imply a tight budget, especially if debt is short term and has to be refinanced in the near future. We thus also include the proportion of maturing debt of a country as a relevant fiscal metric. In addition, we employ the current account surplus/deficit as a potential determinant as fiscal constraints are likely to become more binding when a country borrows from abroad.

We use a bank-level hazard model to analyze the time until the first government intervention for a distressed bank. We show that banks located in countries with lower fiscal capacity were at least as likely to receive any form of government support as banks located in countries with stronger public finances.[2] However, consistent with the hypothesis that capital injections are costly in the sense that they tighten the government budget constraint in the short run, fiscally constrained governments delayed or suspended capital injections more than fiscally stronger countries. The effect is economically significant. For instance, the likelihood that a bank is recapitalized increases by about 30% when the sovereign's revenues-to-GDP ratio increases by 1 percentage point (p.p.). The result is robust across different measures of fiscal capacity and holds after controlling for an array of bank-level, banking sector-level, and macro-level variables, as well as political control variables, such as CAMEL type bank-level controls, too-many-to-fail effects (Acharya & Yorulmazer, 2007; Brown & Dinç, 2011), election cycles (Brown & Dinc, 2005), and other factors.

In a next step, we investigate portfolio and lending decisions of banks that remained undercapitalized at the end of 2009, i.e. after the GFC. A key identification challenge is that undercapitalization itself is endogenous and depends on both pre-crisis bank characteristics, i.e. banks' predisposition to require a bailout, and the ability and willingness of governments to bail out banks. To address this challenge, we use an econometric method developed by Hirano et al. (2003), and used, among others, by Jordà and Taylor (2016), called "inverse probability weighting".

This method does not produce a classification as to which banks are undercapitalized but

[2]Duration analysis is widely used to analyze bank failures and/or government interventions in the banking sector (see, e.g. Lane et al., 1986; Whalen et al., 1991; Brown & Dinc, 2005; Brown & Dinç, 2011). In particular, it has been shown to be superior to single-period models for forecasting the occurrence of events such as bankruptcy (Shambaugh et al., 2012).

requires this information as an input. To that end, we classify a bank as undercapitalized if one of the following three conditions is met: (1) the Tier 1-capital ratio is below 8%, or, if this data is not available, (2) the equity-to-assets ratio is below 3% (the BCBS[3] leverage ratio requirement) or (3) the non-performing loans (NPL)-to-total-loans ratio is in the top 5% of all banks in our sample at the end of 2009.[4] We then regress this indicator variable of a bank being undercapitalized on a set of bank and country characteristics (and their interaction terms) that we found to be important determinants in our first test of whether or not a bank is recapitalized. Since this regression captures the factors that were on average important in determining banks' capitalization status in 2009, the difference between the prediction of the model and the actual outcome for a banking sector can be interpreted as the degree of the country's governmental discretion. For example, consider two banks that are similarly weak according to their bank-level characteristics, one located in Germany and the other one in Ireland, which both do not receive a bailout and end up being undercapitalized. Given the higher level of fiscal capacity, the degree of forbearance for the bank in Germany would be considered higher than the degree of forbearance for the bank in Ireland, where fiscal capacity was more likely the binding constraint.

Reweighting the sample with weights corresponding to the extent of governmental discretion implied by the bank's outcome then allows us to put the spotlight on those banks that were still undercapitalized because of forbearance. From a statistical point of view, the weights allow us to reduce (or even eliminate) the bias from endogenous treatment assignment in the subsequent treatment effects models.[5]

Armed with these weights, we investigate the effect of being undercapitalized on bank-

[3]BCBS stands for Basel Committee on Banking Supervision.

[4]Our results are robust to alternative definitions of "undercapitalized banks".

[5]This method has been used extensively in the recent literature: Angrist et al. (2018), Yim (2013), Jordà and Taylor (2016), Acemoglu et al. (2019), and Kuvshinov and Zimmermann (2019). The reweighting with weights based on a prediction of the treatment status allows the bias from endogeneity of treatment assignment to be reduced. Taking the example of Kuvshinov and Zimmermann (2019), factors which were relevant ex ante as to whether a sovereign will default ("treatment"), e.g. lower economic growth, can also be relevant for the cost of the sovereign default ("treatment effect"). The weighting approach allows removal of the bias caused in the default cost estimation due to differences in GDP growth between defaulted and non-defaulted countries. The more (observable) factors one can control for, the more bias is removed and the more "exogenous" the treatment becomes. Obviously, missing variables or information affecting both treatment status and treatment effect can be a constraint for the method.

level outcomes during the period 2009 to 2012. Our second main result is that banks that were undercapitalized at the end of 2009 were more vulnerable or financially unstable. Over the next three years, undercapitalized banks lost further equity capital, reduced lending, but increased their loan loss provisions compared to their better-capitalized peers. Undercapitalized banks also increased their short-term borrowing from the European Central Bank (ECB) using its three-year Long-Term Refinancing Operation (LTRO) facility introduced in 2011. Undercapitalized banks did not, however, have a higher probability to default, likely because their liquidity was secured via ECB funding.

We then analyze individual lending decisions by banks using the intersection of loan-level data from the Thomson Reuter Dealscan and Bureau van Dijk's Amadeus database to identify both banks and firms. Using a regression framework similar to Khwaja and Mian (2008), which captures firm demand for loans using firm fixed effects, we find that undercapitalized banks reduced loan supply to non-financial firms, both for relationship borrowers (intensive margin) and for new borrowers (extensive margin). Investigating the effect on lending as a function of borrower risk, we find that undercapitalized banks significantly reduced their loan supply to risky firms relative to better-capitalized banks.

This is intuitive as riskier lending binds (regulatory) capital. Interestingly, however, we do not find evidence that undercapitalized banks reduced lending to risky relationship firms, suggesting an evergreening of loans to "zombie" firms. We test this hypothesis directly using the definition of "zombie" firms in Acharya et al. (2018). This definition requires a low credit quality firm to be receiving subsidized credit, i.e., paying an interest rate below the average for highly rated borrowers of the same industry. We find that undercapitalized banks increased the supply of credit to "zombie" firms while reducing lending to "non-zombie" firms, relative to better-capitalized banks. We also provide evidence that the "zombie" firms that are matched with banks that become undercapitalized in the lending market, perform worse than similar firms matched with better-capitalized banks.

Moreover, we investigate a behavior we call "search-for-yield lending". Within a risk class, and therefore within a regulatory risk weight and capital cost category, undercapital-

ized banks gamble for resurrection by seeking borrowers accepting a higher interest rate. That is, for the same cost, undercapitalized banks prefer the potential upside relative to the (within-rating category) risk more than better-capitalized banks do. We find strong evidence for such behavior in the intensive margin of lending of undercapitalized banks.[6]

Finally, we examine the composition of assets on undercapitalized banks' balance sheets. We observe that they shift a considerable part of their portfolio from real sector lending to government bonds during the period from 2009 to 2012. The average undercapitalized (better-capitalized) bank reduces (increases) its lending portfolio by 1 p.p. (2 p.p.) of total assets and increases (also increases) its security exposure by 5.5 p.p. (0.25 p.p.) of total assets. These heightened government bond purchases by undercapitalized banks happen particularly in the years 2011 and 2012 when several government bond yields had spiked with the onset of the European sovereign debt crisis.

Our results are robust to alternative weights in the application of Hirano et al. (2003) that are based on other fiscal variables or timings. Not using any weights and thus treating the undercapitalization status as exogenous, however, reveals that our loan-level results could not have been uncovered. It therefore seems to be the case that the perverse lending incentives are particularly strong for banks whose undercapitalization is a consequence of forbearance. Hence, the fact that governments "kicked the can down the road" on banking sector repair affected subsequent outcomes in two ways. First, they delayed fiscal costs, which had to be borne in the subsequent sovereign debt crisis in the form of larger amounts of quasi-fiscal central bank support and a weakened credit supply to the real economy. Second, they provided perverse lending incentives to banks on which they exerted forbearance, leading to misallocation of capital in the form of "zombie" lending and search-for-yield behavior.

The remainder of the paper is organized as follows. Section 2 discusses the related literature. Section 3 introduces the dataset, focusing especially on the novel, hand-collected dataset comprising all government interventions benefiting eurozone banks over the 2007

[6]Similar behavior has been documented in Jiménez et al. (2017).

to 2012 period. Section 4 presents empirical evidence on forbearance by fiscally weaker governments in the European banking sector during the financial crisis from 2007 to 2009. In Section 5, we derive which banks are undercapitalized and describe the methodology of our treatment effects model. Sections 6 and 7 describe the main results for bank-level outcomes and lending decisions over the 2009 to 2012 period. The analyses of government debt holdings and the portfolio shifting of undercapitalized banks are in Section 8. Section 9 concludes.

2 Related literature

Our paper contributes to several strands of literature. First, it relates to the literature on regulatory forbearance that dates back to at least the 1980s and the discussion of "zombie thrifts" in the U.S. by Edward Kane and other authors, showing that regulatory forbearance is not a new phenomenon but one that has played out over decades (see, e.g. Kane, 1989 and references therein). More recent research in this area focuses on the drivers of (regulatory) forbearance, e.g. why governments do not intervene in the banking sector, even though it would be optimal from a general welfare perspective. Governments postpone the resolution of distressed banks if there are many weak banks in the banking sector (Acharya & Yorulmazer, 2007: Acharya & Yorulmazer, 2008; Kroszner & Strahan, 1996; Hoshi & Kashyap, 2010; Brown & Dinç, 2011) or for political economy reasons, such as timing in electoral cycles (Brown & Dinc, 2005; Imai, 2009; Bian et al., 2017). Our paper highlights empirically - as posited by some of this literature - that fiscal capacity is an additional driver behind (regulatory) forbearance. In addition to most of the previous literature, we also investigate the implications of (regulatory) forbearance. Gropp et al. (2017), for example, show that regulatory forbearance in the U.S. - due to the Federal Deposit Insurance Corporation's (FDIC) decision not to let banks fail - affects growth and employment in some regions; we show that a sovereign's debt overhang can significantly impede an undercapitalized banking sector's recovery after a financial crisis, especially its financial stability, credit supply and risk-taking incentives.

Second, our paper adds to the growing literature investigating the cost-benefit trade-offs involved in government interventions in the banking sector. The main benefit is that recapitalizations help alleviate negative externalities from failing the severely undercapitalized banks (Diamond et al., 2001). Costs mainly comprise large fiscal outlays (Acharya et al., 2014) and moral hazard arising from bailout expectations (Mailath & Mester, 1994; Dam & Koetter, 2012; Fischer et al., 2014).[7] Several papers analyze this trade-off during the GFC, focusing predominantly on the Capital Purchase Program in the United States (Veronesi & Zingales, 2010; Bayazitova & Shivdasani, 2012; Li, 2013; Duchin & Sosyura, 2014; Berger et al., 2019; Black & Hazelwood, 2013). Evidence from the U.S. suggests that recapitalizations stabilized bank lending growth, but also increased lending to riskier borrowers. In contrast, we investigate government interventions during the European financial and sovereign debt crisis.[8] Homar and van Wijnbergen (2017) show that timely bank recapitalizations reduce the duration of recessions using an international sample of banking crises. We provide new evidence that government interventions need to be large enough to overcome banks' debt overhang problems, a theme reminiscent of the work of Caballero et al. (2008), Diamond et al. (2001), Giannetti and Simonov (2013), and Brei et al. (2013).

Finally, our paper relates to the literature on the role of bank capital, particularly during financial crises. Berger and Bouwman (2013) document the importance of capital for banks, particularly medium- and large-sized banks, during crises. Several studies document that higher capital was associated with lower probability of bank failure during the 1990 credit crunch (Cole & Gunther, 1995; Estrella et al., 2000; Wheelock & Wilson, 2000) and during the 2008–2009 financial crisis (e.g. Cole & White, 2012; Berger et al., 2016). Beltratti and Stulz (2012) find that bank capital is key to understanding bank performance during the subprime crisis, and Fahlenbrach et al. (2012) show that poorly capitalized banks during the Russian debt crisis also performed poorly during the subprime mortgage crisis. By

[7] While most theoretical and empirical papers highlight the negative incentives arising from government interventions associated with decreased investor monitoring, some authors highlight that bailouts may also lower moral hazard as government guarantees increase the charter value of banks (Keeley, 1990; Cordella & Yeyati, 2003).

[8] Homar, 2016 investigates the benefits of bank recapitalizations for publicly traded banks, highlighting that recapitalizations need to be large enough, but does not investigate the costs of interventions.

evaluating aggregated time series of sovereign and financial shocks simultaneously, Manzo and Picca (2020) show that fiscal capacity of governments is an important determinant of sovereign shocks, which in turn spill over to the financial sector. We show on a disaggregate level that banks that were left undercapitalized by their governments during the GFC were more likely to eventually require greater government support, performed worse, lent poorly, and searched for yield in portfolio composition decisions.

3 Data

3.1 Government interventions

This paper builds on a novel, hand-collected dataset comprising all government interventions for eurozone banks over the 2007 to 2012 period. Our primary data source is the State Aid Register of the European Commission (EC), which contains detailed information on government interventions in the European banking sector. The Treaty on the Functioning of the European Union (TFEU) generally prohibits government support to individual companies but government support can be admissible in exceptional cases, such as to "remedy a serious disturbance in the economy of a Member State" (TFEU Article 107(3.b)). Any such exception must be reviewed and approved by the EC on a case-by-case basis and is documented in the State Aid Register.

While the State Aid Register collects government interventions in the entire EU, we restrict our sample to eurozone banks to ensure that all banks in our sample have equal access to the ECB facilities (including non-standard monetary policy measures such as the LTRO).[9] Since the LTROs were provided with full allotment in our sample period, there was no heterogeneity in the access to the ECB funding across banks. Thus, we do not expect our results to be biased by the existence of LTRO.

We start building our database by manually extracting information from all State Aid cases listed in European Commission for the 2007 to 2012 period.[10] Government support

[9] We exclude Cypriot banks from our sample given the extraordinary dependence of the Cypriot banking sector on foreign funding sources.

[10] Link to State Aid Register.

can be approved for one of two cases: (i) as an ad hoc support measure to an individual bank, or (ii) as a sector-wide scheme making available a maximal amount for a certain aid measure and being accessible to eligible banks.[11]

For reasons of confidentiality, not all details of government support measures are made available in the State Aid Register. Also, decisions on sector-wide schemes do not contain information on individual beneficiaries. Therefore, when necessary, we augment the data with information from banks' press releases, information from banks' regular reporting activities, regulators' and central banks' reports, and newspaper articles. For every State Aid case number, we further cross-check whether approved intervention measures have been implemented.

As in Laeven and Valencia (2008), we classify government support into four categories: (1) recapitalizations, (2) guarantees, (3) other liquidity support and (4) troubled asset relief.[12] Recapitalizations comprise all measures involving government-funded capital increases and conversions of existing capital or hybrid instruments into higher-order capital instruments.[13] Guarantees comprise all government guarantees on non-deposit liabilities, including both existing and newly issued liabilities. Other liquidity support comprises all interventions other than guarantees that are targeted at stabilizing a bank's liquidity.[14] Finally, troubled asset relief programs are government interventions targeted at removing impaired or defaulted assets from a bank's balance sheets by means of asset sales or guarantees.[15]

[11] Table A1 in the Online Appendix provides an example excerpt from this list for the case of Austria. Table A2 in the Appendix provides an excerpt from a State aid case for the recapitalization of the Austrian bank Hypo Tirol.

[12] We exclude all policies that were not put into use during the financial crisis, such as deposit freezes. We also exclude sector-wide policies such as changes in sector-wide deposit guarantees, which simultaneously benefited all banks in a country.

[13] Banks can be recapitalized using cash, ordinary shares, other Core Tier 1 capital instruments, preferred shares, silent participations, hybrid capital instruments, commitment letters and rights issues.

[14] Our definition of liquidity support differs from the one employed in Laeven and Valencia (2008), where liquidity support indicates liquidity support from the central bank.

[15] For each type of intervention, our database collects a wide range of characteristics including the identity of the beneficiary, the intervention amount, the specific design of the measure, its remuneration and possible conditions for the beneficiary. We also collect the announcement date (when available), the implementation date, the approval date by the EC and whether the intervention was granted as part of a sector-wide intervention scheme. We provide a detailed overview of all information as to government interventions recorded in our dataset in an Online Appendix.

3.2 Bank-level and macro-level data

3.2.1 Sample construction

We obtain bank-level financial data for the 2007 to 2012 period from the Bureau van Dijk Bankscope database. Consistent with the literature (e.g. Sufi, 2007), all information is aggregated to the ultimate parent level using shareholder information from Bankscope and various other sources. We remove all banks that receive a government intervention but cannot be matched to the Bankscope database. We also drop banks whose ultimate parent is not incorporated in a eurozone country, as the propensity of a bailout for these banks likely depends on the parent's home country. The dataset is further constrained to large banks and those of domestic importance—those whose failure creates a threat of financial contagion or has a large negative impact on the domestic economy. That is, we keep banks with a market share larger than 1% (measured in bank size/size of the national banking sector), with size of at least 10% of GDP, balance sheets larger than €1 billion, or banks that are among the 5 largest banks in the country.

We further exclude banks with very high Tier 1 ratios ($> 30\%$) or equity-to-assets ratios ($> 20\%$). All those cleaning steps leave us with a sample of 830 banks, of which 76 received at least one form of government intervention. Finally, we augment our data with country-level variables from Eurostat, the World Bank and the IMF.

3.2.2 Summary statistics

Cross-sectional summary statistics for bank-level variables are shown in Panel A of Table 1 for the baseline year 2007. Banks show considerable variation in their overall condition prior to the financial crisis. For example, the equity-to-assets ratio ($Equity/TA$) has a cross-sectional mean of 6.51% with a standard deviation of 2.75%. There is also considerable variation in other variables, such as loan loss provisions ($LLP/Loans$) and NPLs ($NPLs/Loans$). Cross-sectional summary statistics for macro-level variables in 2007 are shown in Panel B of Table 1. The variation in current account balances is striking: it ranges from a current account deficit of -14.0% to a current account surplus of 9.9%. Similarly, the maturing gov-

ernment debt as a share of GDP ranges from 1.2% to 18.1%.

[Table 1 about here]

3.3 Loan-level and firm-level data

We obtain loan-level data from the Thomson Reuters LPC DealScan database, which provides detailed information on European syndicated loans including information on lenders as well as loan contract terms. For banks to be included in the sample, we follow the previous literature (e.g. Ivashina, 2009; Heider et al., 2019) and require that banks must serve as lead arranger in the syndicate.[16] If the loan allocation between syndicate members is unknown, we divide the loan facility equally among syndicate members. Also following the previous literature (e.g. Acharya et al., 2018; Gropp et al., 2019), we transform the data and calculate the annual outstanding exposure of bank b in country c to non-financial firm j, using the maturity information on each loan at the end of each year.

We hand-match DealScan lenders to Bankscope at the ultimate parent level and match DealScan borrowers in our sample to firms in the Amadeus database. The final loan-level sample comprises 209 banks that arrange loans to 8,321 non-financial firms.[17]

4 Do weak governments delay interventions?

Governments may postpone recapitalizations by issuing rolling guarantees, by injecting just enough capital to avoid immediate insolvency, or by allowing banks to hide their losses. This section investigates the determinants of a government's decision not to resolve a bank's debt overhang immediately, but to practice (regulatory) forbearance. We use Cox regression models to formally investigate the role of a country's fiscal capacity and the overall capitalization of the banking sector for the timing and type of an intervention.

[16] Following Ivashina (2009), a bank is classified as lead arranger if it has any one of the following lender roles in DealScan: administrative agent, bookrunner, lead arranger, lead bank, lead manager, agent or arranger. The subsequent results are robust to extending the sample of lead arrangers to match the definition in Heider et al. (2019). In this case, lead banks comprise all banks that provide 100% of a given loan or act as lead bank, lead manager, (mandated) lead arranger, joint arranger, co-lead arranger, co-arranger, coordinating arranger, mandated arranger, (administrative) agent, or bookrunner.

[17] Possible differences in the number of lead arrangers in this paper in comparison to other papers on syndicated lending in the European banking sector (e.g. Heider et al., 2019) may be due to the match of lenders to the Bankscope database rather than to the smaller SNL Financials database.

4.1 Methodology

Theory suggests that forbearance and postponing costly capital interventions is an attractive alternative for fiscally constrained governments as new debt can only be issued at the expense of the sovereign's creditworthiness (Acharya et al., 2014). Based on this theory, we ask two questions. First, are fiscally constrained governments as likely as unconstrained countries to provide recapitalizations? Second, are they equally likely to support distressed banks, when we do not take into account the type of support (recapitalization, liquidity support)?

We study determinants of government interventions in the 2007 to 2009 period, using an exponential hazard model similar to Brown and Dinc (2005).[18] The hazard rate $h_{AID,i}(t)$, $AID \in \{Recap, Any\}$, is the instantaneous probability that bank i receives government support AID at time t, conditional on not having obtained AID prior to t. h_{Recap} is the hazard rate for being recapitalized, and h_{Any} denotes the hazard rate for obtaining any type of intervention. We follow banks from the date Lehman filed for insolvency (15 September 2008) until one of the two following exit events: (i) the bank receives its first intervention $AID \in \{Any, Recap\}$ or (ii) the end of the sample period, 31 December 2009, is reached. In the Cox regression framework, the hazard rate takes the exponential form

$$h_{AID,i}(t) = h_{AID,0}(t) * exp(\beta_0 X_{i,t-1} + \beta_1 b_{c,t-1} + \beta_2 m_{c,t-1}), \tag{1}$$

where $h_{AID,0}(t)$ is the baseline hazard; $X_{i,t-1}$ is a vector of bank-specific characteristics; $b_{c,t-1}$ are banking-sector-specific characteristics; and $m_{c,t-1}$ are macroeconomic variables. The analysis is conducted based on daily intervention data but is robust to monthly aggregation. Standard errors are clustered at the country level, allowing government interventions to be correlated within a country.

Fiscal capacity. The main determinants for our model are measures of fiscal capacity. Different proxies have been proposed in the literature. One key measure is a country's tax

[18] Shambaugh et al. (2012) highlight the advantage of hazard models in forecasting bankruptcy. We use logit regressions as robustness checks. The results are very similar and remain unreported for brevity.

revenues (*GovernmentRevenue*) expressed as a percentage of GDP (Dincecco & Prado, 2012). A larger income increases the capacity to recapitalize banks in distress (Stavrakeva, 2020). Another widely used factor is the total debt stock ($Debt/GDP$) also measured in units of GDP (e.g. Demirgüç-Kunt & Huizinga, 2013). However, high total debt is only a potential problem if government revenues are low and/or if debt has to be refinanced. We thus also include a measure for maturing debt, by dividing the stock of outstanding government debt by its average maturity ($MaturingDebt(\%GDP)$). This allows us to distinguish between countries that have a high outstanding debt stock but a low current debt service and countries with a low stock but a high current debt service, since only the latter should be relevant for forbearance. Lastly, we use the current account surplus/deficit ($CABalance$) as a potential determinant as fiscal constraints might become binding when a country borrows from abroad (Freund & Warnock, 2007).[19]

Figure 1 about here

Figure 1 shows that these metrics of fiscal constraints show substantial cross-sectional variation, especially between GIIPS and other Eurozone countries. In case of debt-to-GDP, government revenues-to-GDP, and current account balance, the differences were large at the time of the onset of the global financial crisis; interestingly, debt-to-GDP (and also maturing debt-to-GDP) worsen for GIIPS relative to other Eurozone countries after the global financial crisis, whereas the current account balance improves from being in deficit towards neutrality as for the other Eurozone countries.

A further measure that we considered is a country's current budget balance. It is a short-term flow measure, meaning it will quickly react to dynamics that might be relevant for bailout provision such as a deterioration of the macroeconomic environment which the government counteracts with a fiscal stimulus package. Moreover, it might be subject to reverse

[19] If a country is not borrowing from abroad (and c.p. has a current account surplus), it is not at risk of becoming constrained as it can engage in financial depression to secure its funding, e.g. through an increase in domestic taxes. However, if a country is borrowing from abroad on a net basis, it is subject to market discipline and possible sudden stops when foreign investors become unwilling to roll over their funds. Sudden stops have detrimental effects on future tax income through output contractions, increases in unemployment and asset price declines (Freund & Warnock, 2007).

causality, if some bank aid measures were provided in 2007 as this would immediately and significantly affect the budget balance, while it would only have minor effects on government revenues or the stock of outstanding government debt. Hence, we decided not to include the budget balance in our study.

Banking sector. As a banking-sector-specific variable, we include the average book equity-to-assets ratio (*Avg.EquityRatio*). Brown and Dinç (2011) show that governments are less likely to intervene if the banking sector as a whole is undercapitalized (too-many-to-fail effect). As a further relevant determinant of the need for bailouts, we include the level of household debt over GDP ($HHDebt/GDP$). Mian et al. (2017) show that a high level of household debt is a strong predictor of economic downturns because of the sensitivity of mortgage credit to house price busts, which is exactly what was observed during the GFC. We also include the number of banks that have already received a bailout (*NumberBailouts*).

Bank characteristics. We include bank-level characteristics to control for bank health and their differential probability of becoming distressed. Specifically, we include bank size ($TotalAssets/GDP$), equity-to-assets ratio ($Equity/TA$), wholesale funding dependence ($STfunding/TA$) and profitability ($ROAA$). We hypothesize that larger banks with lower capital ratios are more likely to obtain support. Short-term funding dependence, in addition, renders banks vulnerable to interbank funding freezes. ROAA might be an indicator for a sound business model as well as high pre-crisis risk-taking. All variables are measured at the end of the year preceding day t in the hazard model.

Elections. As in Brown and Dinç (2011), we include proxies that relate to the political environment in each country. We include the logarithm of the time until the next election (*LogTimetoElection*) and an index indicating to what extent the current parliament is supporting the European Union (*ProEU*).

4.2 Determinants of government bailouts

Table 2 reports the main results. We only show the measures of fiscal capacity; the full specifications are reported in an Online Appendix to this paper. The dependent variable is

h_{Recap} in Panel A of Table 2. While the control variables are included in all regressions, we sequentially include proxies for fiscal capacity.[20]

Table 2 about here

As the main determinant of a country's fiscal strength, we include government revenues in all four regressions. Throughout all specifications, this variable is an economically and statistically significant predictor of recapitalizations. In columns 1 to 3, we add different additional proxies for the financial well-being of a country. First, we add the total debt-to-GDP ratio. While the coefficient shows the right sign - higher debt makes bailouts less likely - the result is not statistically significant. However, for any given debt level, a higher share of debt that has to be repaid in the current year induces immediate budgetary constraints and thus should reduce the incentives to recapitalize banks. We find that a large proportion of maturing debt (in the same year as the bailout decision) decreases the hazard rate and thus the likelihood of a recapitalization (column 2). When looking at the current account balance in column 3, the coefficient again shows an intuitive sign (higher current account surplus predicts higher likelihood of bailouts), but is not significant. In column 4, we run a horse race of all those three explanatory variables on top of the government revenues. We observe that maturing debt stays highly significant and important in size. Moreover, both the current account balance and the total debt level turn significant in this specification. A higher current account is associated with a higher likelihood of recapitalizations. A higher debt level is, too, suggesting that after partialling out the effect of the debt service burden, a higher debt level corresponds to a country's willingness to spend, thus making a recapitalization more likely. Overall, the results consistently show that countries that had more fiscal capacity when entering the GFC in 2008 to 2009 were more likely to recapitalize their banks.[21]

[20] The control variables are as expected. Larger banks and those that have more short-term funding are more likely to be recapitalized. Banks with higher pre-crisis equity capital ratios and more profitable banks are less likely to be recapitalized. Moreover, coefficient on Avg. Equity Ratio echoes the results from Brown and Dinç (2011) that governments are more likely to delay an intervention when the banking sector as a whole is weakly capitalized. A new government is less likely to recapitalize a bank, while more Pro-EU governments are more likely to provide direct recapitalizations to banks.

[21] For robustness, we also add additional CAMELS proxies, including non-performing loan ratios, age, and loans-to-deposit

In Panel B of Table 2, we show the results, where the dependent variable is Any, i.e. we predict the likelihood of any kind of government intervention (recapitalization or liquidity support). None of our measures of fiscal strength turns out to be a significant predictor of government interventions.

5 Identifying undercapitalized banks at the end of 2009

5.1 Methodology

In the following we want to study the implications of banks leaving the GFC period in a status of undercapitalization. Naturally, this status is by no means exogenous. It depends on the capitalization of the bank before the crisis shock hits, its lending portfolio, profitability, and many other bank-specific factors. Moreover, as shown above, it strongly depends on whether the bank was located in a country whose government was able to provide a recapitalization if needed. That is, the probability of being undercapitalized at the end of 2009 depends on a bank's performance in pre-crisis years as well as the fiscal capacity of the local government. In order to obtain a plausibly exogenous measure of undercapitalization, we therefore have to purge these factors from our measure.

To formalize this idea, we rely on an inverse probability weighting method developed by Hirano et al. (2003) and recently used in a time series context by Jordà and Taylor (2016), among others. The basic idea of this method is to remove all observable factors that are associated with the treatment assignment. For this purpose, the treatment probability is estimated and used to reweight the sample in all subsequent treatment effect models to reduce, or in the optimal case even eliminate, the bias from endogenous treatment assignment.

In our case, the bank-level treatment is "being undercapitalized at the end of 2009", i.e. after the GFC. In order to run a logit model for estimating the treatment probability, we need to construct a binary indicator for undercapitalization. Hence, we define a bank as

ratios. The coefficient estimates on both bank-level characteristics and macro-level variables are unchanged, while the R^2 remains largely unchanged. We also substitute ROAA with the z-score—the results remain quantitatively and qualitatively unchanged. The analysis is also robust to setting the starting point of the financial crisis to 9 August 2007, when the withdrawal of BNP Paribas from three hedge funds marked the beginning of a liquidity crisis. Logit regressions produce virtually identical results to Cox regressions. These results remain unreported for brevity.

being undercapitalized if one of the following three conditions holds at the end of 2009: i) its Tier 1-capital ratio is below 8%[22], and if Tier 1 ratio data is not available, ii) its equity-to-assets ratio is below 3% (the BCBS leverage ratio requirement), or iii) its NPL-to-loans ratio is in the top 5% of all banks in our sample. Our results are not very sensitive to the choice of these criteria. Removing the third criterion, or varying the thresholds for the first two criteria, does not qualitatively alter our results.

We then estimate a logit model predicting the treatment status based on bank-level and macro-level determinants (including our measures of fiscal capacity) and interactions of bank-level and fiscal variables as of end-2007. The results are robust to using inputs as of end-2006 (see Table A1). However, we use bank and government characteristics as of 2007 as they are arguably better predictors of post-crisis outcomes.

$$Undercap_i = \frac{exp(\beta X_i)}{1 + (exp(\beta X_i)}, \tag{2}$$

$$\text{where} \quad \beta X_i = \beta_0 \times X_{i,2007} + \beta_1 \times b_{c,2007} + \beta_2 \times m_{c,2007} + \beta_3 \times X_{i,2007} * m_{c,2007}.$$

It is important to interact bank-level and fiscal measures to create within-country variation in the predictions at the bank level. Moreover, the interactions are economically sensible and important. A government with higher fiscal capacity can afford to bail out bigger banks, banks that are better capitalized, and banks that are less profitable. From this regression, we obtain the fitted values ($\widehat{Prob_i}$) and use them to calculate "inverse probability weights" (IPW):

$$IPW_i = \frac{1}{\widehat{Prob_i}} \quad \text{for treated,} \tag{3}$$

$$IPW_i = \frac{1}{1 - \widehat{Prob_i}} \quad \text{for non-treated.} \tag{4}$$

The distinction in the weight calculation between treated and non-treated is important. To reduce the endogeneity bias, a higher weight needs to imply a less predictable treatment

[22]The FDIC defines the threshold for undercapitalization as a Tier 1-capital ratio below 4% for U.S. banks. In Europe, however, banks benefit from more lenient policies on government debt, for example, the absence of which would result in lower Tier 1-capital ratios (cf. Kirschenmann et al., forthcoming). As a result, 8% is roughly the first quintile in our sample, substantially below the mean of 10.7%.

status. Hence, if our model failed to predict that a bank is going to be treated, we want a higher weight than if the treatment was predicted. Thus, the weight formula for treated banks is a decreasing function of the treatment likelihood obtained from estimating Equation 3, and vice versa for non-treated banks.[23]

5.2 Descriptive statistics

We report descriptive statistics in Table 3. In Panel A of Table 3, we show which banks received government support during the 2008 to 2009 GFC and which are classified as undercapitalized. Around 10% of the banks in our sample (81 out of 830) are classified as undercapitalized according to our measure. Out of those 81 banks, 8 actually received a recapitalization, which therefore seemed to have been insufficient to stabilize those banks. The other 27 recapitalizations we observe were successful in that the receiving banks are not classified as undercapitalized in 2009. These numbers suggest that recapitalizations were, on average, a very prolific tool to stabilize banks.

[Table 3 about here]

Panel B of Table 4 shows the share of undercapitalized banks by country at the end of 2009. The countries with the largest share of undercapitalized banks are Ireland (IE), Slovenia (SI) and Italy (IT), while France (FR) and Germany (DE) exhibit the lowest share of undercapitalized banks, which is reasonable as these countries implemented large-scale recapitalization measures and both belong to the group of fiscally strong countries.

5.3 Likelihood of being undercapitalized

Table 4 reports the results of the logit model described in Equation 3 to calculate the IPW. Table 4 shows that larger and better-capitalized banks are less likely to be undercapitalized

[23] This method has been applied in various economic contexts over recent years, e.g. Angrist et al. (2018), Yim (2013), Jordà and Taylor (2016), Acemoglu et al. (2019), Kuvshinov and Zimmermann (2019). From a technical point of view, advantages over a simple OLS model with control variables are: higher efficiency (Hirano et al., 2003), possibility of capturing non-linear relationships between covariates and the treatment assignment (Rosenbaum & Rubin, 1983), doubly robust estimation structure (Jordà & Taylor, 2016) and measuring of interpretable probability weights.

post-GFC in countries with higher (tax) revenues, i.e. in which governments have more fiscal space.

[Table 4 about here]

Similarly, columns 1 to 3 show that our other measures for fiscal capacity - total debt, maturing debt, and the current account balance - all interact with bank variables in determining the likelihood of a bank being undercapitalized. Column 4, similar to section 4, runs a horse race of all fiscal variables, highlighting that all of them have their distinct importance. However, the average variance inflation factor for those fiscal variables in column 4 is around 25, which is beyond any acceptable threshold. Due to possible multicollinearity of the covariates used in the specification reported in column 4, we use column 2 as our baseline regression model.[24]

We want to stress the finding that the interplay of fiscal capacity and bank characteristics is a very important determinant of banks' capitalization outcome. Hence, specifying the inverse probability weighting model the way we did is crucial to fully capture the endogeneity in the undercapitalization status driven by differences in fiscal capacity across countries.[25]

Overall, the results reported in Table 4 show that being undercapitalized in 2009 is not an exogenous event, but depends on a variety of factors. To purge these factors, we use the IPW obtained from the baseline logit in Table 4, column 2, when evaluating the effect of being undercapitalized on real economic outcomes in the following sections.

[Figure 2 about here]

Panel (a) of Figure 2 shows the difference of the average IPW per country and 1.[26] The higher these values, the less the outcomes can be linked to the observable factors used as explanatory variables in Table 4. This difference therefore helps us to assess the extent of

[24] We provide robustness tests using weights obtained from the other regression models in the Online Appendix.

[25] Note that a country fixed effect would not suffice to adequately model the underlying mechanisms since the fiscal capacity interacts heavily with bank-level characteristics.

[26] An IPW of 1 for the treated (i.e. undercapitalized) bank suggests that the treatment is endogenous, i.e. being undercapitalized is perfectly predictable based on observable characteristics.

discretion applied by national governments in their recapitalization decision. We find the five GIIPS (Greece, Ireland, Italy, Portugal, and Spain) countries in the top 6 of the ranking in Panel (a) of Figure 2. Similarly, Panel (b) of Figure 3 shows a scatterplot of the same country-level average of IPW and the government revenue-to-GDP ratio. The plot clearly suggests a negative relationship, i.e. fiscally stronger governments exerted less discretion.

5.4 Understanding inverse probability weights

[Figure 3 about here]

Figure 3 uses an example to demonstrate how inverse probability weighting can be understood in our setup. We document above that countries provided bailouts to their banks as a function of their capitalization. This is shown by the vertical black lines in the graph, where Ireland, Spain and Germany are ranked by their respective government revenues from low to high. The vertical black lines imply that Spain and Germany bailed out banks that had higher capital ratios compared to Ireland. That is, comparing an Irish bank (with a 4.25% capital ratio in 2007) to a German bank (also with a 4.25% capital ratio in 2007) at the end of 2009 ignores that Irish banks have never been bailed out with such a high capital ratio; however, a bailout was quite likely for a German bank, arguably because of Germany's fiscal strength. Therefore, the inverse probability weighting allows us to remove the differences indicated by the vertical black lines, which would induce a bias in subsequent treatment effect estimations.

By removing all the bank-specific and country-specific drivers of undercapitalization, as well as their interactions, the resulting weights then give us an estimate of the extent of discretion applied by the governments when deciding about recapitalizations. An undercapitalized bank with a high weight is a bank that should have been bailed out (given its situation) and could have been bailed out (given its governments' situation), but was not, and vice versa for better-capitalized banks. As highlighted in the section above, these cases of elevated discretion are themselves negatively correlated with fiscal stability. Moving forward, we thus interpret our bank results as the impact of banks being undercapitalized due

to governmental discretion linked to fiscal weakness.

6 Undercapitalization and bank balance sheets

Delaying government interventions might cause distressed banks' health to further deteriorate, as necessary recapitalizations are either omitted or severely limited. Undercapitalized banks likely have insufficient capital buffers to withstand future shocks. Moreover, a debt overhang might increase agency costs due to moral hazard, including risk-shifting (Meckling & Jensen, 1976; Diamond et al., 2001) and zombie-lending (Peek & Rosengren, 2005; Giannetti & Simonov, 2013; Blattner et al., 2019).

6.1 Methodology

In a first step, we ask whether banks that were left undercapitalized after the 2008–2009 GFC further deteriorate in their health relative to other banks. We estimate the following cross-sectional weighted-least squares (WLS) regressions, where we use the IPW as weights:

$$\Delta Y_{i,09-12} = \alpha + \beta \times Undercap_i + \gamma X_{i,09} + u_i, \tag{5}$$

$$Y_i = \alpha + \beta \times Undercap_i + \gamma \times X_{i,2009} + v_i. \tag{6}$$

The dependent variable $\Delta Y_{i,09-12}$ is the log change in characteristic Y of bank i over the 2009 to 2012 period. Y_i are outcome variables measured at the end of 2012. The set of Y_i comprises: equity-to-assets ratio, Tier 1-capital ratio, gross loans, loan loss provisions, share of NPLs, return on average asset, net interest margin, and the risk weighted assets-to-total assets ratio. Bank-level variables $X_{i,09}$ comprise total assets to domestic GDP ($Total\,Assets/GDP$), the equity-to-assets ratio ($Equity/TA$), the loans-to-deposits ratio ($Loans/Deposits$) and return on average assets ($ROAA$), as of end-2009. These measures are supposed to capture the state of each bank at the beginning of the evaluated period with respect to its size, health, funding structure, and profitability.

6.2 Undercapitalization and bank balance sheets

The results of the balance sheet impact regressions are summarized in Panel A of Table 5. Columns 1 and 2 highlight that while undercapitalized banks' equity-to-asset ratios further declined in the years 2009 to 2012, their risk-weighted Tier 1-capital ratio increased. This suggests that these banks did not build up additional equity but instead pushed the risk weights downward by lending less to risky borrowers.

[Table 5 about here]

Column 4 shows that the level of loan loss provisions of undercapitalized banks went up distinctly from 2009 to 2012, indicating a badly performing lending portfolio inherited from the GFC period. All these results are highly significant and robust to using alternative IPWs.

Interestingly, NPLs did not increase over the 2009 to 2012 period despite the increase in loan loss provisions (column 5). A possible interpretation is that undercapitalized banks continued to extend loans to these borrowers to avoid writing down their exposures. The return on assets is somewhat lower for undercapitalized banks (column 6). Net interest margins and risk intensity (columns 7 and 8) are unaffected by undercapitalization.

How do undercapitalized banks perform during the sovereign debt crisis? In particular, we investigate three dimensions: whether a company needs a recapitalization, files for insolvency or needs funding from the LTRO introduced in December 2011 and continued in March 2012. We report the results in Panel B of Table 5.

While we find an economically meaningful (but statistically insignificant) positive effect of undercapitalization on the likelihood to be recapitalized, and a lower likelihood to survive, we find a highly economically and statistically significant effect on LTRO in that undercapitalized banks borrow substantially from the LTRO facilities compared to better-capitalized peers. This shows that leaving banks in a state of undercapitalization, by not providing sufficient recapitalizations during the GFC, induced higher funding needs for

these banks down the line, again to be borne by governments' budgets, showing that governments just kicked the can down the road.

The results are not sensitive to the chosen weighting scheme, as Panels A and B in Table A2 show. An alternative weighting scheme and no weighting scheme at all provide similar albeit economically weaker results with lower explanatory power (R^2).

7 Undercapitalization and bank lending decisions

Figure 4 shows the "excess reduction" in lending by undercapitalized banks, i.e. the reduction in lending relative to all other banks, for all firms (left bars), for "high-risk" firms (middle bars) and for "zombie" firms, in particular (right bars). The grey bars show the descriptive differences in the lending behavior, while the black bars show the estimated coefficients from regressions described later in the text. We leave the formal definition of "high-risk" and "zombie" firms to the main text below. The differences are striking. While undercapitalized banks significantly reduce their lending more relative to other banks, especially to riskier borrowers, they increase lending to "zombie" firms. In other words, the remaining equity capital of already constrained banks appears to be withdrawn from risky, "non-zombie", firms and tied up in lending to "zombie" firms.

[Figure 4 about here]

7.1 Loan volume

So far we have seen evidence for undercapitalized banks cutting back lending (Figure 4, left bars; Table 5, column 3). In this section, we want to drill down further into the lending decisions by undercapitalized banks by investigating the lending behavior at a more granular level.

We start our loan-level analysis by studying the effect of government interventions on overall loan supply. Our main dependent variable is $\Delta Loan_{09-12,i,c,j}$, which captures the change in outstanding loan exposure of bank i in country c to firm j from the year just after the financial crisis, 2009, to the year 2012. Similar to Peydró et al. (2017), we define

the change in outstanding loan exposure following the definition of Davis and Haltiwanger (1992) as[27]

$$\Delta Loan_{09-12,i,c,j} = \frac{Loan_{12,i,c,j} - Loan_{09,i,c,j}}{0.5 * Loan_{12,i,c,j} + 0.5 * Loan_{09,i,c,j}}. \quad (7)$$

We estimate the following WLS model,

$$\Delta Loan_{09-12,i,c,j} = \beta \times Undercap_i + \gamma X_{i,09} + \eta_j + \eta_c + u_{i,c,j}, \quad (8)$$

where all variables are defined as before and bank-level characteristics are measured at the end of 2009. All variables are weighted using the IPWs obtained in section 5. Following Khwaja and Mian (2008), we exploit the fact that some firms borrow from more than one bank and use a within-firm estimator to disentangle loan supply from loan demand. Specifically, firm fixed effects η_j control for observable and unobservable firm characteristics that may affect firm-level demand. Firm fixed effects are identified by multiple bank–firm relationships, where firms borrow from at least two distinct borrowers. Bank-level control variables $X_{i,09}$ comprise log total assets ($LogTotalAssets$), the equity-to-assets ratio ($Equity/TotAssets$), the return on average assets ($ROAA$), and the NPLs-to-loans ratio ($NPL/Loans$), as of end-2009.[28] We also include country-level fixed effects to control for country-level differences in credit supply. Standard errors are clustered at the bank level.[29]

We present the results for the baseline specification in column 1 of Panel A of Table 6. We find that undercapitalized banks significantly reduce their loan supply, which is consistent with the balance sheet regressions shown above. Undercapitalized banks reduce their loan supply by 14 p.p. more than better-capitalized banks.

[Table 6 about here]

As a robustness check, we also employ other dependent variables to measure changes in loan supply (columns (2) and (3)). First, we use the first difference in log loan exposure

[27] Using this definition has two main advantages. First, we avoid the regression results being driven by outliers as $\Delta Loan_{09-12,i,c,j}$ lies on the closed interval [-2,2]. Second, the measure facilitates the treatment of zeros, where either no bank–firm relationship exists in 2009 but emerges over the 2010 to 2012 period, or the bank–firm relationship is terminated between 2009 and 2012.

[28] This set of controls is the same set as chosen in Acharya et al. (2018).

[29] We follow Abadie et al. (2017). We interpret our reweighted sample as a quasi-experimental setting implying the need to cluster at the treatment provision level. Since bailouts are provided at the bank level, we cluster at the bank level.

of bank i in country c to firm j, $\Delta logLoan = log(1 + Loan_{12,i,c,j}) - log(1 + Loan_{09,i,c,j})$, as in Peydró et al. (2017).[30] Second, we follow Peek and Rosengren (2005) and Giannetti and Simonov (2013) and use the indicator $LoanIncr_{i,c,j}$ that takes value 1 if bank i increases its loan exposure to firm j from 2009 to 2012, and 0 otherwise. The results confirm the robustness of the result in column (1): undercapitalized banks generally reduce their loan supply from 2009 to 2012.

Simple bank lending theory suggests that weakly capitalized banks lend less to risky borrowers, since the regulatory risk weights make such loans capital-intense. We investigate this theory by including a measure of borrower risk ($LowRating$) in the interaction terms to investigate lending decisions with respect to borrower quality and estimate the following WLS model:

$$\Delta Loan_{09-12,i,c,j} = \beta_1 \times Undercap_i + \beta_2 \times Undercap_i * LowRating_j + \gamma X_{i,09} + \eta_j + \eta_c + u_{i,c,j}, \tag{9}$$

where all variables are defined as before. All variables are weighted using the IPWs obtained in section 5. The results are shown in Panel B of Table 6. We classify borrowers as risky if their credit rating is BB or lower at the end of 2009 ($LowRating$).[31]

For reasons of brevity, we only report the coefficient on $Undercap$ and the interaction term. Consistent with Figure 4 above, we find that undercapitalized banks reduce lending to low-quality firms, which is reasonable as these loans c.p. need to be funded with more regulatory capital.

It is a testable hypothesis that undercapitalized banks were more likely to sustain lending to "zombie" firms, i.e. to extend loans to distressed firms at subsidized terms. We identify a firm to be a "zombie" firm ($Zombie$) if its rating is BB or lower and it pays interest on its loans that is below the benchmark interest of loans to very safe, publicly traded firms. To identify if a firm pays below-benchmark interest rates, we follow the approach of Acharya,

[30] For cases where $Loan_{12,i,c,j} = 0$, we normalize the growth rate to -1.

[31] For many firms we do not observe an external rating. In those cases we construct a rating using a mapping table provided by Moody's and taking as input the interest coverage ratio and sector (cf. Acharya, Crosignani, et al., 2019).

Eisert, et al. (2019): we use information from Amadeus to derive a proxy for average interest payments by firm j. Amadeus reports total interest paid and total outstanding debt of firm j in industry s in year t. We calculate the average interest paid(r_j) by firm j by dividing the total interest payment by the total outstanding debt in 2009. Firms have a high (low) reliance on short-term debt if the ratio of short-term debt to long-term debt is above (below) the median.

We calculate the benchmark interest R as the median interest rate paid by publicly traded firms within the same industry j in 2009 that were incorporated in non-GIIPS countries and had an AAA or AA rating. This is done separately for firms with low and high reliance on short-term debt (as a proxy for the maturity structure of debt). A firm pays below-benchmark interest rates if the average interest paid on its debt r_j is below the benchmark R, with firms split according to their reliance on short-term debt. To test the change in lending to "zombie" firms, we estimate the cross-sectional WLS regressions interacting *Undercap* with *Zombie*:

$$\Delta Loan_{09-12,i,c,j} = \beta_1 \times Undercap_i + \beta_2 \times Undercap_i * Zombie_j + \gamma X_{i,09} + \eta_j + \eta_c + u_{i,c,j}. \tag{10}$$

All variables are weighted using the inverse probability weights obtained in section 5. We report the results in Panel C of Table 6. Consistent with our hypothesis, we find that undercapitalized banks reduce lending to "non-zombie" firms relative to better-capitalized banks. However, they lend substantially more to "zombie" firms.

Lastly, to maximize their cost-return trade-off, undercapitalized banks could be incentivized to lend to riskier borrowers within a rating, and therefore regulatory risk weight and capital cost category, if it allows them to charge a higher interest rate. We term this "search-for-yield" lending, as banks seek to maximize the rent for the given cost, ignoring the (within-rating category) risk.

We investigate this hypothesis with the following regression:

$$\Delta Loan_{09-12,i,c,j} = \beta_1 \times Undercap_i + \beta_2 \times Undercap_i * LowRating_j + + \tag{11}$$

$$\beta_3 \times Undercap_i * HighIR_j + + \beta_4 \times Undercap_i * LowRating_j * HighIR_j + \tag{12}$$

$$\gamma X_{i,09} + \eta_j + \eta_c + u_{i,c,j}, \tag{13}$$

where $HighIR_j$ is defined as a dummy which equals 1 if a firm pays interest rates above the average in its industry in 2009. Since higher interest rates are paid by riskier borrowers, we additionally interact this dummy with the low rating indicator from before to identify variations within this risky borrower class. The results in Panel D of Table 6 show some indication in favor of the hypothesis without being particularly robust.

7.2 Extensive vs. intensive margin

We also measure changes in loan supply at the extensive margin. First, to capture the propensity to maintain lending to a relationship borrower, we construct the indicator variable $Relationship_{i,c,j}$ that takes value 1 if bank i has lent to firm j in the year 2009 and therefore had a standing relationship entering the period of investigation, and 0 otherwise. Bank–firm relationships with no lending exposure in 2009, respectively a relationship value of 0, are then excluded from these regressions. Second, to capture a bank's willingness to enter a new lending relationship, we use as a dependent variable the product of the logarithm of the exposure and indicator $NewLoan_{i,c,j}$ that takes value 1 if bank i has a strictly positive (new) exposure to firm j in 2012 and 0 otherwise.

The results of the extensive and intensive margin regressions for aggregate lending decisions, estimated with WLS, are presented in Panel A of Table 7. We document a significant effect in both the subsample for relationship borrowers and the subsample of new borrowers, i.e. undercapitalized banks decreased lending to customers across the board.

When turning to the subset of risky borrowers, interestingly, we do not find a significant effect for relationship loans (Table 7, Panel B). A possible interpretation is that undercapitalized banks continue lending to lower-rated, particularly "zombie" firms, to avoid writing

these loans off and further eroding their capital.

[Table 7 about here]

Consistent with the interpretation of "zombie" lending as effectively evergreening of existing loans to distressed firms, we find such an effect particularly in the subsample of relationship customers (Table 7, Panel C, column 1), but not the subsample of new relationships, where the coefficient is actually negative even though statistically insignificant (Table 7, Panel C, column 2). This is intuitive, as banks would not want to engage in a new lending relationship with a firm that is close to default.

We provide robustness tests with respect to our model specification. In Panels C to F of Table A2, we show that the lending results described above are robust to using a different weighting scheme. The coefficients hardly change. Using no weight, and therefore treating the undercapitalization status as exogenous, weakens the results distinctively. It appears that the endogeneity associated with the classification of being undercapitalized would bias the results for the model at hand. Hence, it proves important to use the reweighting scheme to obtain more credible parameter estimates, in particular regarding the micro-level lending behavior of undercapitalized banks.

7.3 Real effects

We want to substantiate our claim that continued lending to the firms we identified as "zombies" is in fact evergreening, as opposed to banks using their informational advantage to provide loans to firms that are in a solid economic state but, for example, suffer from a short-term liquidity problem. To this end, Table 8 gives a comparison of "zombie" firms that undercapitalized banks are lending to, compared to "zombie" firms that better-capitalized banks are lending to. In the years 2010 to 2012, i.e. in the period where the lending was documented, the "zombie" firms matched with undercapitalized banks performed considerably worse. Their return on assets is lower and their EBITDA over total assets is significantly lower, as is their cash flow over total assets. Moreover, similar to the "zombie" firms in

Acharya, Eisert, et al. (2019), our "zombie" firms have higher leverage but lower cash, even though they are roughly of the same size. All in all, we clearly document that the economic situation of "zombie" firms matched with undercapitalized banks would not warrant loans to such preferential interest rates, especially because it further seems that they could pledge less collateral as their tangibility ratio is lower than that of their peers.

Lastly, revisiting the hypothesis about "search-for-yield lending", we turn to Panel D in Table 7. While we have strong significance in the relationship lending column, it is important to note that the parameter estimates almost cancel each other out, implying that there is no economically meaningful effect to be found. In the new lending segment, however, we observe a statistically significant coefficient with large economic magnitude. While undercapitalized banks lend less to high-risk borrowers per se (negative double interaction), they cut lending less to those risky borrowers who pay a higher interest rate (positive triple interaction). The results thus show strong evidence in favor of "search-for-yield lending" behavior by undercapitalized banks.[32]

8 Undercapitalization and portfolio composition

As a final channel of impact of being left undercapitalized, we investigate the portfolio composition of affected banks. As we pointed out above, undercapitalized banks engage in serious efforts to improve their capital position, both regulatory by lending less to risky borrowers, and economically by stalling the write-off of "zombie" loans. A further way to reach this goal available to European banks is holding government debt issued by European sovereigns, as the risk weights are set to 0 by the regulator for these exposures.

For the purpose of investigating this channel, we first take a look at the change of the securities-to-loans ratio of the banks in our sample from 2009 to 2012 by running an analogous WLS regression to the one in Section 6. The results are displayed in column 1 of Table 9. The coefficient for the undercapitalization indicator is sizeable and highly significant: undercapitalized banks increased their securities-to-loans ratio significantly compared to their

[32] Similar behavior has been documented in Jiménez et al. (2017).

better-capitalized peers.

To get a better feel for the economic magnitudes, see Figure 5. Better-capitalized banks increased their loan-to-assets ratio by 2 p.p. and the securities-to-assets ratio by 0.25 p.p. on average. Undercapitalized banks, on the other hand, decreased their loans-to-assets ratio by 1 p.p. and increased their securities-to-assets ratio by 5.5 p.p. from 2009 to 2012.

[Figure 5 about here]

In order to understand in greater detail which securities were bought by the undercapitalized banks, we use the EBA's stress test data providing information on government debt holdings at the bank level. The results, estimated via WLS, for examining the change to the domestic government debt holdings, as well as the GIIPS government debt holdings, as a proxy for risky government debt, are displayed in columns 2 and 3 of Table 9. We document that undercapitalized banks increased both their domestic and their GIIPS government bond holdings significantly. To see to what extent the results in column 3 are driven by GIIPS banks, where the GIIPS bonds are domestic bonds, we split the results in column 3 by including a GIIPS dummy showing that undercapitalized banks across the board increased their GIIPS government bond holdings significantly, but banks located in GIIPS countries did it even more.[33]

[Table 9 about here]

Figure 6 helps in dissecting the time line of the government bond purchases by undercapitalized banks in our sample during the years 2010 to 2012. While in 2010 undercapitalized banks seemed not to be buying considerably more government debt than better-capitalized banks, the picture changes starkly in 2011.[34] Undercapitalized banks now increased their load on GIIPS government bonds by 5.5 p.p relative to their better-capitalized peers. This gap opened even further in 2012, reaching values of around 7.75 p.p. This time line suggests that banks did not immediately shift to government bonds by the mere fact of leaving the

[33] As before, we show robustness of the results using alternative weighting schemes in Panel F of Figure A2.
[34] The shaded red area depicts the 95% confidence interval.

crisis undercapitalized (2009 and 2010). Instead, sovereign yields first had to rise considerably to make it an attractive business, especially in the light of zero risk weights.

[Figure 6 about here]

Altogether, we see that banks not only optimized their economic and regulatory capital ratios by cutting back lending to risky borrowers and evergreening loans to "zombie" firms, but also by massive purchases of zero risk weight government bonds during the European sovereign debt crisis. This behavior kick-started the diabolic bank-sovereign loop, as documented by Acharya et al. (2014) and others.

9 Conclusion

We analyzed the consequences of distressed banking sectors being left undercapitalized by fiscally stretched European governments during the GFC. Despite the increasingly cross-border nature of the European banking sector, recapitalizations of distressed banks were closely tied to the fiscal capacity of the domestic sovereign that was also responsible for its supervision. In the absence of an insolvency regime for banks, governments with lower fiscal capacity were effectively practicing forbearance instead of implementing fully fledged recapitalizations. Such "kicking the can down the road" left distressed banking sectors vulnerable to future economic shocks which materialized post-2009, and led to evergreening of loans to poor-quality borrowers by insufficiently stabilized banks as well as a shift from real sector lending to risky government bond holdings by such banks.

Consequently, our analysis informs the debate about the future design of the eurozone banking sector and the desirable institutional framework to underpin it. In particular, our results highlight the importance of reducing the dependence between the health of eurozone banks and the immediate sovereigns both in terms of decision-making processes for bank support and also at the fiscal level so as to minimize the possibility for forbearance in the future. The more that supervision and resolution of banks becomes shielded from the discretionary decision-making of national governments, the lower will be the opportunity for

governments to resort to forbearance. By centralizing the supervision of banks with the ECB under the Single Supervisory Mechanism and by establishing the Single Resolution Mechanism as a common, standardized resolution scheme, the eurozone has made an important step towards resolving these interlinkages. However, an additional necessary ingredient for reducing forbearance is a common European fiscal backstop for recapitalization of the financial sector. To minimize moral hazard at the sovereign level, such fiscal backstops could be accompanied by strong rules for public finances, macroeconomic stability, and pre-arranged fiscal burden sharing.

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A Figures

Figure 1: **Developments of fiscal capacity: GIIPS vs non-GIIPS countries**

(a) Total Debt

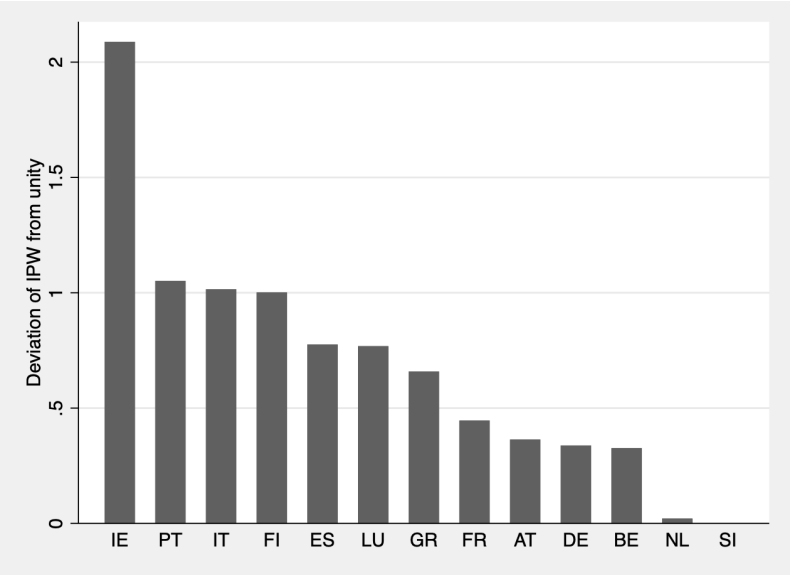
(b) Maturing Debt

(c) Government Revenues

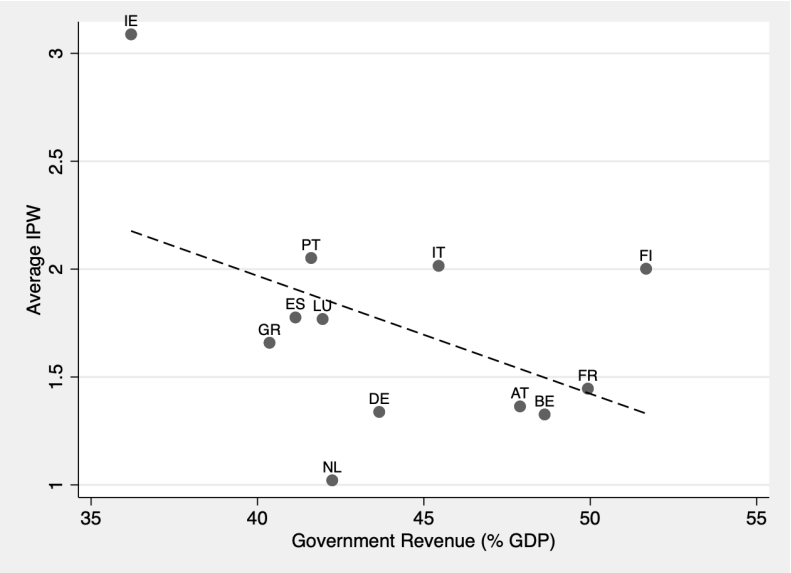
(d) Current Account

Sources: IMF, OECD, World Bank.
Notes: GIIPS refers to Greece, Ireland, Italy, Portugal, and Spain, while non-GIIPS refers to Eurozone countries other than GIIPS.

Figure 2: **Inverse Probability Weights (IPW): Descriptives**



(a) Deviation of IPW from unity per country ("randomness")



(b) Scatterplot of average IPW vs. government revenue at the country level

Notes: AT = Austria, BE = Belgium, DE = Germany, ES = Spain, FI = Finland, FR = France, GR = Greece, IE = Ireland, IT = Italy, LU = Luxembourg, NL = Netherlands, PT = Portugal, SI = Slovenia.

Figure 3: **Stylized Depiction of Endogeneity in Recapitalizations**

This graph shows a stylized depiction of how recapitalization ("bailout") of banks depends on the national government. Germany could afford to bailout banks with higher equity-to-asset ratio than Spain and Ireland. Our statistical approach allows us to eliminate this endogeneity, while ignoring this induces estimation bias.

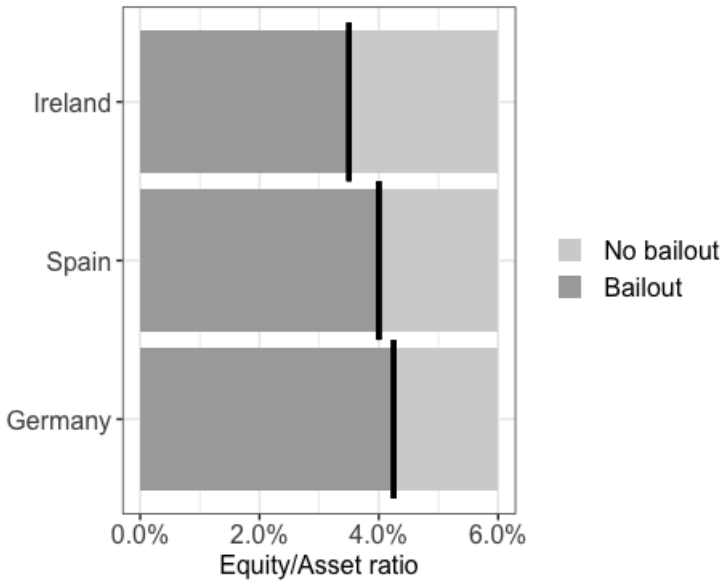


Figure 4: **Excess Reduction in Lending by Undercapitalized Banks relative to Better-capitalized Ones**

This graph shows the difference between the reduction in lending between undercapitalized and better-capitalized banks ("excess reduction"). Positive values refer to negative loan growth, and vice versa. "Analytical" refers to the coefficient estimates from the regression models in Section 7. "Descriptive" refers to the purely descriptive difference between the lending reductions in the sample. "Overall", "High Risk", and "Zombie" are all as defined in Section 7.

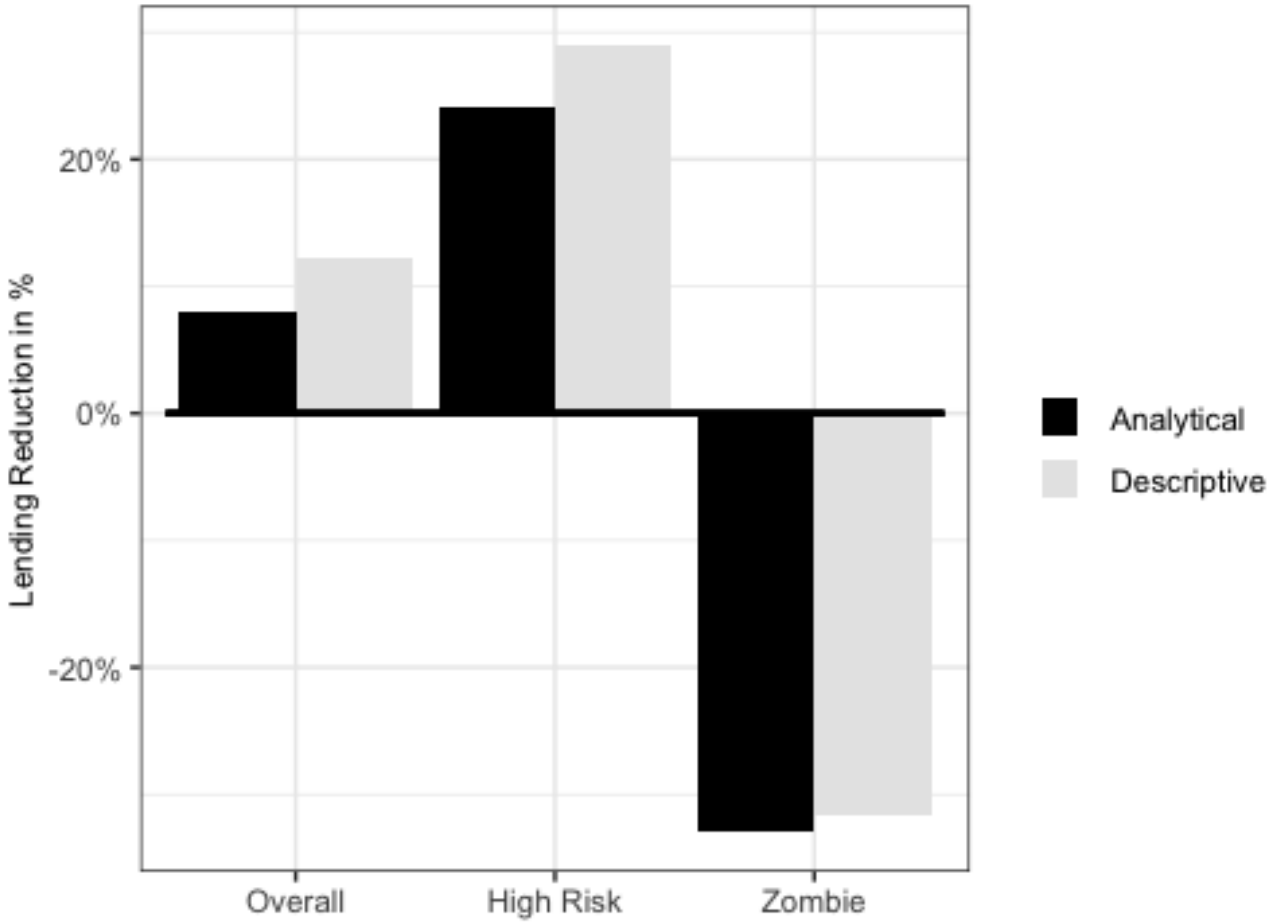


Figure 5: **Evolution of Loans-to-Assets and Securities-to-Assets Ratio for Undercapitalized Banks relative to Better-capitalized Ones**

This graph shows the descriptive differences between the gross loans-to-assets ratio and the debt securities-to-assets ratio at the end of 2012 compared to the end of 2009 on banks' balance sheets.

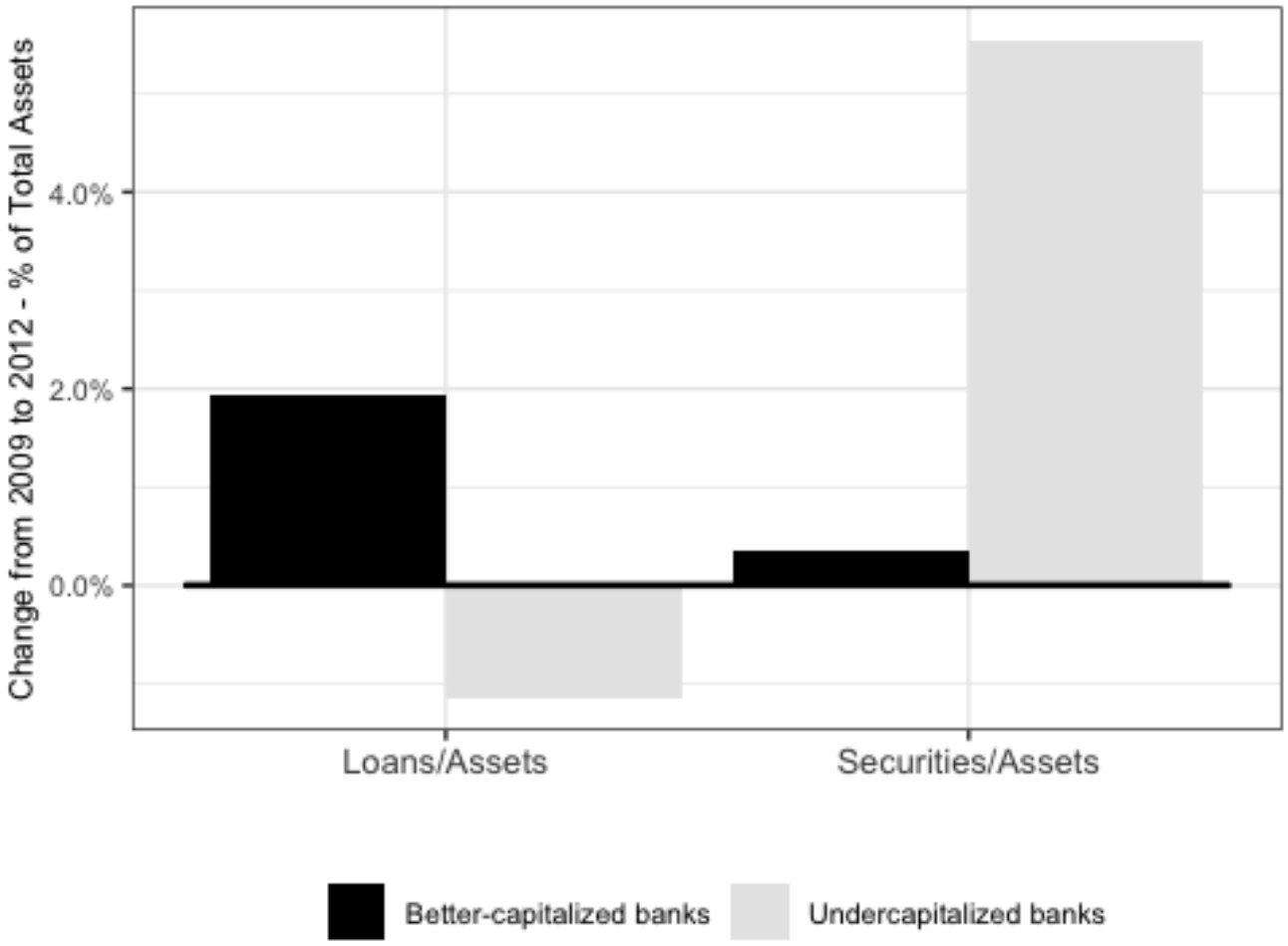
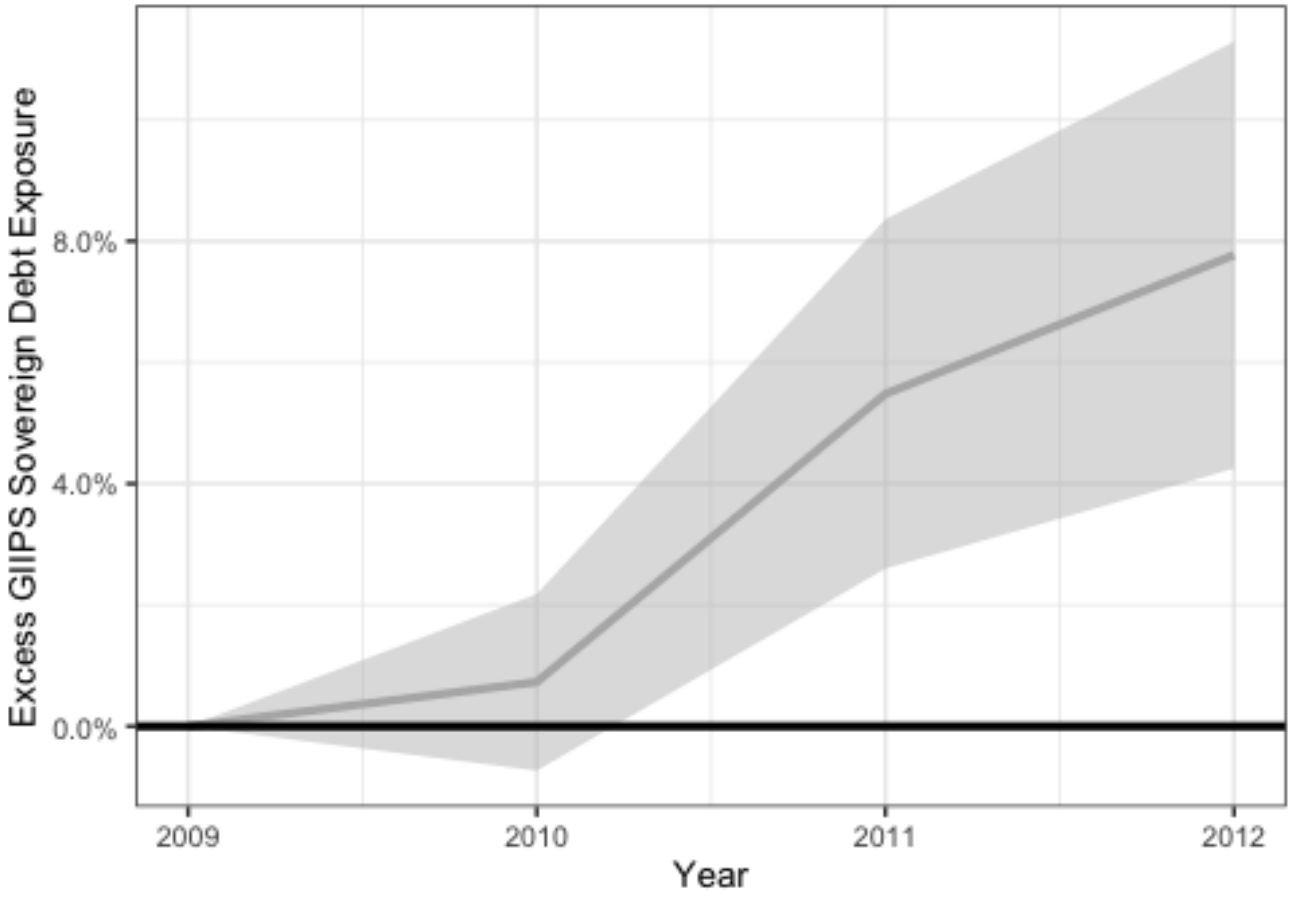


Figure 6: **Evolution of GIIPS government Debt Exposure relative to 2009 for Undercapitalized Banks relative to Better-capitalized Ones**

This graph shows the evolution of the divergence of GIIPS government bond purchases between undercapitalized banks and better-capitalized banks ("excess exposure"). Normalizing the outstanding exposure in 2009 to 1, the graph shows by how much more the GIIPS sovereign debt exposure has risen per year for undercapitalized banks compared to better-capitalized banks.



B Tables

Table 1: **Variable Definitions and Summary Statistics**

The table shows variable definitions and summary statistics for government aid (Panel A), bank-level (Panel B) and macro-level (Panel C) variables. All bank-level and macro-level variables are as of end-2007.

Panel A: Government aid

VARIABLES	Definition	N	Mean	Median	SD	Min	Max
All Aid	Banks that received any type government aid between 2007 and 2009	84					
Recap	Banks that received a recapitalization between 2007 and 2009 (descriptives refer to amounts in % of total assets)	35	2.19	1.23	3.17	0.19	16.77

Panel B: Bank-level variables

VARIABLES	Definition	N	Mean	Median	SD	Min	Max
Total Assets/GDP	Total assets to nominal GDP (%)	830	3.46	0.13	13.33	0.04	128.72
Log Loans	Log gross loans	826	7.83	7.38	1.52	5.53	13.23
Loans/TA	Gross loans to total assets (%)	826	60.91	62.64	18.63	3.16	95.39
Net Int. Margin	Net interest margin (% of total assets)	825	2.19	2.25	0.82	0.13	4.03
Equity/TA	Total equity to total assets (%)	830	6.51	6.03	2.75	0.01	19.76
Tier 1 Ratio	Tier 1 regulatory capital ratio (%)	280	9.42	8.45	3.32	4.51	24.13
LLP/Loans	Loan loss provisions to gross loans (%)	806	0.71	0.54	1.38	-1.29	34.14
NPLs/Loans	Non-performing loans to gross loans (%)	262	3.53	2.72	4.35	0.18	42.58
Log Age	Log time since incorporation	319	3.97	4.41	1.15	0.69	7.50
ROAA	Return on average assets (%)	827	0.51	0.29	0.63	-1.40	7.41
ST funding/TA	Short-term funding to total assets (%). Short-term funding is calculated as Bankscope Global Item 'Deposits & Short-Term Funding' less Bankscope Universal Item 'Total Deposits'.	811	0.97	0.00	3.80	-0.10	47.89
Loans/Deposits	Loans to deposits (%)	799	117.84	99.88	74.72	22.36	598.73
Log z-score	Log z-score (Laeven & Levine, 2009)	721	4.72	4.62	1.27	0.74	7.36
RWA/TA	Risk-weighted assets to total assets (%)	259	67.40	72.70	20.48	10.42	95.37
Securities/TA	Securities to total assets (%)	826	20.83	18.73	14.25	0.05	99.74

Panel C: Macro-level variables

VARIABLES	Definition	N	Mean	Median	SD	Min	Max
Government Revenue	Government revenues (% of nominal GDP)	13	44.16	43.36	4.36	36.20	51.68
Total Debt	Total debt (% of nominal GDP)	13	55.69	63.66	30.77	7.71	103.10
Maturing Debt	Maturing government debt (% of nominal GDP)	13	10.10	11.49	5.06	1.22	18.09
Current Account	Current account balance (% of nominal GDP)	13	-0.95	-0.33	7.35	-14.00	9.92
Avg. Equity Ratio	Banking sector average of 'Equity/TA'	13	6.88	6.83	1.38	4.11	9.07
Avg. Tier 1 Ratio	Banking sector average of 'Tier 1 Ratio'	12	9.35	9.28	1.87	6.41	12.10
Log time to election	Logarithm of time until next election	12	6.72	7.06	0.70	5.23	7.35
Anti/Pro EU	Anti/Pro EU scale of government (0–10)	13	1.82	0.56	2.64	0	8.76

Table 2: **Baseline Cox Regression for Government Interventions**

The table presents the results of Cox regressions for government interventions between September 15, 2008 and December 31, 2009. Banks exit the sample if they receive a government intervention of any type (*any*) or a recapitalization (*recap*). Hazard rates h_{AID}, $AID \in \{any, recap\}$ take the exponential form:

$$h_{AID,i}(t) = h_{AID,0}(t) \cdot \exp(\beta_0 \times X_{i,t-1} + \beta_1 \times b_{c,t-1} + \beta_2 \times m_{c,t-1}).$$

Bank-level variables $X_{i,t-1}$ comprise total assets to domestic GDP (*Total Assets/GDP*), the equity-to-assets ratio (*Equity/TA*), the short-term funding ratio (*ST funding/TA*) and return on average assets (*ROAA*). Banking sector variables $b_{c,t-1}$ comprise the average equity ratio in the domestic banking sector (*Average Equity Ratio*) and the number of banks that already received recapitalization (*Banks with recaps*). Macroeconomic variables $m_{c,t-1}$ comprise the government revenues to GDP (*Government Revenue*), the maturing government debt to GDP (*Maturing Debt*), the current account balance (*CA Balance*), the total government debt to GDP (*Debt/GDP*), real GDP growth (*GDP growth*), GDP per capita ((*GDP*), and household debt over GDP (*HH Debt/GDP*) in the respective country as well as a the logarithm of the time until the next election (*Log Time to Election*). Lastly, we add a control for the pro, respectively anti, EU sentiment in the current government (*Pro EU*). Control variables are not displayed in the table. Tie-breaking follows the Efron rule. Standard errors are robust and adjusted for clustering at the country level. The table reports coefficient estimates. Parentheses contain p-values. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. *NFail* is the number of hazard events, i.e. the number of government interventions of the respective type. The estimation sample contains 832 banks.

Panel A - Recapitalization

VARIABLES	(1)	(2)	(3)	(4)
Government Revenue (%GDP)	0.23***	0.27***	0.22***	0.25***
	(0.00)	(0.00)	(0.00)	(0.00)
Debt/GDP	-0.02			0.05**
	(0.47)			(0.04)
Maturing Debt (%GDP)		-0.23***		-0.43***
		(0.00)		(0.00)
CA Balance			0.03	0.11**
			(0.68)	(0.02)
Observations	18,826	18,826	18,826	18,826
N fail	32	32	32	32
Pseudo-R2	0.39	0.40	0.39	0.40

Panel B - Any aid

VARIABLES	(1)	(2)	(3)	(4)
Government Revenue (%GDP)	-0.03	-0.02	0.01	0.01
	(0.80)	(0.87)	(0.95)	(0.94)
Debt/GDP	-0.01			-0.02
	(0.74)			(0.33)
Maturing Debt (%GDP)		-0.04		0.09
		(0.79)		(0.55)
CA Balance			-0.07	-0.10
			(0.44)	(0.27)
Observations	41,234	41,234	41,234	41,234
N fail	76	76	76	76
Pseudo-R2	0.23	0.23	0.23	0.23
Cluster	country	country	country	country
Tie-break	Efron	Efron	Efron	Efron

Table 3: **Descriptive Statistics of the Sample of Banks by Capitalization**

The table shows the number of banks that are classified as undercapitalized and/or which received aid as well as their split across countries.

Panel A - Any aid vs. recapitalization vs. no aid

	Undercapitalized banks	Better-capitalized banks	Total
Received aid	13	71	84
Received recap.	8	27	35
Received no aid	68	678	746
Total	81	749	830

Panel B - Capitalization status of banking sector by country

Country	Number of undercapitalized banks	Number of better-capitalized banks	Number of banks (total)	Share of undercapitalized banks
NL	0	19	19	0.00%
FR	1	25	26	3.85%
DE	18	437	455	3.96%
BE	1	13	14	7.14%
PT	1	9	10	10.00%
ES	10	69	79	12.66%
AT	6	35	41	14.63%
FI	1	5	6	16.67%
GR	2	10	12	16.67%
LU	1	4	5	20.00%
IT	35	110	145	24.14%
SI	2	6	8	25.00%
IE	3	7	10	30.00%

Notes: AT = Austria, BE = Belgium, DE = Germany, ES = Spain, FI = Finland, FR = France, GR = Greece, IE = Ireland, IT = Italy, LU = Luxembourg, NL = Netherlands, PT = Portugal, SI = Slovenia.

Table 4: **Likelihood of a Bank being Undercapitalized**

The table presents the results of a logit regression with the following specification:

$$Undercap_i = \frac{exp(\beta X_i)}{1 + (exp(\beta X_i)} \text{ where } \beta X_i = \beta_0 \times X_{i,2007} + \beta_1 \times b_{c,2007} + \beta_2 \times m_{c,2007} + \beta_3 \times X_{i,2007} * m_{c,2007}.$$

The variable *Undercap* takes the value 1 if a bank is classified as undercapitalized as defined in the text. Bank-level variables $X_{i,2007}$ comprise total assets to domestic GDP (*Total Assets/GDP*), the equity-to-assets ratio (*Equity/TA*), the short-term funding ratio (*ST funding/TA*) and return on average assets (*ROAA*), as of end-2007. Banking sector variables $b_{c,2007}$ comprise the average equity ratio in the domestic banking sector (*Average Equity Ratio*) and the number of banks that already received recapitalization (*Banks with recaps*). Macroeconomic variables $m_{c,2007}$ comprise the government revenues to GDP (*Government Revenue*), the maturing government debt to GDP (*Maturing Debt*), the current account balance (*CA Balance*), the total government debt to GDP (*Debt/GDP*), real GDP growth (*GDP growth*), GDP per capita ((*GDP*) and household debt over GDP (*HH Debt/GDP*) in the respective country as well as a the logarithm of the time until the next election (*Log Time to Election*). Lastly, we add a control for the pro, respectively anti, EU sentiment in the current government (*Pro EU*). Control variables are not displayed in the table. All non-binary variables are demeaned. Standard errors are robust and adjusted for clustering at the country level. The table reports coefficient estimates. Parentheses contain p-values. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	(1)	(2)	(3)	(4)
Government Revenue (%GDP)	-0.13	-0.12	0.19	0.23**
	(0.58)	(0.14)	(0.18)	(0.04)
Government Revenue (%GDP) × Total Assets/GDP	-0.03***	-0.03***	-0.01	-0.04**
	(0.00)	(0.00)	(0.10)	(0.02)
Government Revenue (%GDP) × Equity/Total Assets	-0.09**	-0.11*	0.07*	0.02
	(0.04)	(0.08)	(0.05)	(0.57)
Government Revenue (%GDP) × ROAA	0.21	0.25	-0.16	-0.11
	(0.11)	(0.24)	(0.34)	(0.30)
Debt/GDP	-0.00			-0.04
	(0.97)			(0.19)
Debt/GDP × Total Assets/GDP	0.00			-0.01
	(0.19)			(0.24)
Debt/GDP × Equity/Total Assets	0.02**			-0.02***
	(0.03)			(0.00)
Debt/GDP × ROAA	-0.04**			-0.25**
	(0.02)			(0.04)
Maturing Debt (%GDP)		14.88*		60.63***
		(0.10)		(0.00)
Maturing Debt (%GDP) × Total Assets/GDP		1.43*		6.89**
		(0.08)		(0.01)
Maturing Debt (%GDP) × Equity/Total Assets		9.03**		18.16***
		(0.03)		(0.00)
Maturing Debt (%GDP) × ROAA		-16.96*		129.98*
		(0.08)		(0.07)
Current Account			-0.26	-0.53***
			(0.20)	(0.00)
Current Account × Total Assets/GDP			-0.00	-0.02**
			(0.55)	(0.05)
Current Account × Equity/Total Assets			-0.07***	-0.12***
			(0.00)	(0.00)
Current Account × ROAA			0.19***	-0.12
			(0.00)	(0.38)
Observations	781	781	781	781
Cluster	country	country	country	country

Table 5: **Impact of being Undercapitalized on Banks' Balance Sheet and Sovereign Crisis Outcomes**

Panel A of the table displays results from a weighted-least squares (WLS) regression of changes in balance sheet characteristics from 2009 to 2012 on the undercapitalization status and a set of control variables. The weighting scheme is obtained from running the regression in Table 4, column 2:

$$\Delta Y_{i,09-12} = \alpha + \beta \times Undercap_i + \gamma \times X_{i,2009} + u_i.$$

Panel B of the table displays results from a weighted-least squares (WLS) regression of bank-level outcomes during the sovereign debt crisis (2010–2013) on the undercapitalization status and a set of control variables. The weighting scheme is the same as above:

$$Y_i = \alpha + \beta \times Undercap_i + \gamma \times X_{i,2009} + v_i.$$

The variable *Undercap* takes the value 1 if a bank is classified as undercapitalized as defined in the text. Bank-level variables $X_{i,2009}$ comprise total assets to domestic GDP (*Total Assets/GDP*), the equity-to-assets ratio (*Equity/TA*), the loans-to-deposits ratio (*Loans/Deposits*) and return on average assets (*ROAA*), as of end-2009. $\Delta Y_{i,09-12}$ is the change from end-of-year 2009 to end-of-year 2012 for one of the following variables: equity-to-assets ratio (*Equity*), Tier 1 capital ratio (*Tier1*), total loans (*Loans*), loan loss provisions over loans (*LLP*), non-performing loans over loans (*NPL*), return on average assets (*ROAA*), net interest margin (*NIM*), risk-weighted assets over total assets (*RWA/TA*). Standard errors are robust and adjusted for clustering at the bank level. The table reports coefficient estimates. Parentheses contain p-values. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A - Balance-sheet outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	$\Delta Equity_{09-12}$	$\Delta Tier1_{09-12}$	$\Delta Loans_{09-12}$	ΔLLP_{09-12}	ΔNPL_{09-12}	$\Delta ROAA_{09-12}$	ΔNIM_{09-12}	$\Delta RWA/TA_{09-12}$
Constant	1.02***	0.70**	0.19***	-1.71***	0.27	1.33***	0.27***	-0.16
	(0.00)	(0.05)	(0.00)	(0.00)	(0.47)	(0.00)	(0.00)	(0.27)
Log Total Assets	-0.05***	-0.03	-0.00	0.06*	-0.00	-0.09**	-0.02**	0.01
	(0.00)	(0.23)	(0.73)	(0.08)	(0.88)	(0.05)	(0.02)	(0.53)
Equity/Total Assets	-0.06***	-0.05***	-0.01**	0.09***	-0.00	-0.08***	-0.02**	0.01
	(0.00)	(0.00)	(0.01)	(0.00)	(0.82)	(0.01)	(0.02)	(0.28)
ROAA	-0.04	0.09*	-0.03	0.69***	0.13	-0.81***	-0.04	-0.03
	(0.30)	(0.07)	(0.16)	(0.00)	(0.12)	(0.00)	(0.17)	(0.54)
Loans/Deposits	-0.00	0.00	-0.00***	0.00	0.00***	0.00	0.00	-0.00
	(0.68)	(0.63)	(0.00)	(0.16)	(0.00)	(0.74)	(0.94)	(0.23)
Undercap	-0.09**	0.21**	-0.04*	0.74***	-0.06	-0.19	-0.04	0.02
	(0.01)	(0.03)	(0.05)	(0.00)	(0.48)	(0.13)	(0.27)	(0.84)
Observations	649	261	651	439	184	554	651	210
R-squared	0.30	0.10	0.15	0.27	0.11	0.20	0.06	0.03
Cluster	bank	bank	bank	bank	bank	bank	bank	bank

Panel B - Sovereign-crisis outcomes

	(1)	(2)	(3)
	Recap	Survival	LTRO
VARIABLES	2010–13	until 2012	Uptake/TA
Constant	-11.03***	3.70***	48.24**
	(0.00)	(0.00)	(0.02)
Log Total Assets	0.71***	-0.25**	-1.83**
	(0.00)	(0.03)	(0.03)
Equity/Total Assets	0.08	0.06	-2.67**
	(0.25)	(0.40)	(0.05)
ROAA	-0.43***	0.63***	9.32***
	(0.00)	(0.01)	(0.00)
Loans/Deposits	0.00	0.00	-0.02
	(0.19)	(0.69)	(0.53)
Undercap	0.08	-0.18	12.06**
	(0.92)	(0.64)	(0.01)
Observations	736	736	57
(Pseudo) R-squared	0.35	0.26	0.37
Cluster	bank	bank	bank

Table 6: **Impact of being Undercapitalized on Banks' Lending Behavior – Overall**

Panel A of the table presents the results of cross-sectional Khwaja and Mian (2008)-type bank lending regressions based on syndicated loan data and estimated with weighted-least squares (WLS):

$$\Delta y_{2009-12,i,c,j} = \beta \times Undercap_i + \gamma' X_{i,2009} + \eta_j + \eta_c + u_{ijc}.$$

Panels B, C and D present the results of identical regressions with the indicator for undercapitalization interacted with dummies for "high-risk", "zombie" or high-interest-paying firms as defined in the main text.
The unit of observation is at the bank-firm level. $y_{2009-12,i,c,j}$ measures the change in loan supply in the 2009 to 2012 period and is defined in the text. The variable *Undercap* takes the value 1 if a bank is classified as undercapitalized as defined in the text. The weighting scheme is obtained from running the regression in Table 4, column 2. Bank-level control variables $X_{i,2009}$ comprise log total assets (*Log Total Assets*), the equity-to-assets ratio (*Equity/Tot Assets*), the return on average assets (*ROAA*), and the non-performing loans to loans ratio (*NPL*), as of end-2009. Standard errors are clustered at the bank level. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. *FE* denotes fixed effects. *IR* stands for paid interest rate.

VARIABLES	(1) Δ Loan	(2) Δ Log Loan	(3) Loan Increase
Panel A - aggregate lending			
Undercap	-0.14***	-0.21***	-0.04**
	(0.01)	(0.01)	(0.05)
Observations	19,943	19,943	19,943
R-squared	0.79	0.75	0.75
Panel B - risky lending			
Undercap	0.05	0.07	0.01
	(0.60)	(0.68)	(0.74)
Undercap × Low Rating	-0.30**	-0.43**	-0.12**
	(0.03)	(0.01)	(0.01)
Observations	3,423	3,423	3,423
R-squared	0.71	0.64	0.67
Panel C - zombie lending			
Undercap	-0.14**	-0.21**	-0.04
	(0.03)	(0.02)	(0.17)
Undercap × Zombie	0.36**	0.40*	0.07
	(0.01)	(0.06)	(0.14)
Observations	3,293	3,293	3,293
R-squared	0.73	0.68	0.69
Panel D - rent-seeking lending			
Undercap	0.39*	0.27	0.22**
	(0.09)	(0.35)	(0.03)
Undercap × Low Rating	-0.46**	-0.52*	-0.38***
	(0.02)	(0.10)	(0.01)
Undercap × High IR	-0.43*	-0.36	-0.30**
	(0.10)	(0.24)	(0.01)
Undercap × Low Rating × High IR	0.25	0.26	0.38**
	(0.29)	(0.49)	(0.04)
Observations	2,931	2,931	2,931
R-squared	0.72	0.66	0.68
Cluster	bank	bank	bank
Firm FE	YES	YES	YES
Country FE	YES	YES	YES
Controls	YES	YES	YES

Table 7: **Impact of being Undercapitalized on Lending Behavior – Intensive vs. Extensive Margin**

Panel A of the table presents the results of cross-sectional Khwaja and Mian (2008)-type bank lending regressions based on syndicated loan data and estimated with weighted-least squares (WLS):

$$\Delta y_{2009-12,i,c,j} = \beta \times Undercap_i + \gamma' X_{i,2009} + \eta_j + \eta_c + u_{ijc}.$$

Panels B, C and D of the table present the results of identical regressions with the indicator for undercapitalization interacted with dummies for "high-risk", "zombie" or high-interest-paying firms as defined in the main text.
$y_{2009-12,i,c,j}$ measures the change in loan supply at the extensive or intensive margin in the 2009 to 2012 period and is defined in the text. The unit of observation is at the bank-firm level. The weighting scheme is obtained from running the regression in Table 4, column 2. The variable *Undercap* takes the value 1 if a bank is classified as undercapitalized as defined in the text. Bank-level control variables $X_{i,2009}$ comprise log total assets (*Log Total Assets*), the equity-to-assets ratio (*Equity/Tot Assets*), the return on average assets (*ROAA*), and the non-performing loans to loans ratio (*NPL*), as of end-2009. Standard errors are clustered at the bank level. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. *FE* denotes fixed effects. *IR* stands for paid interest rate.

VARIABLES	(1) Relationship borrowers	(2) New borrowers
Panel A - aggregate lending		
Undercap	-0.08**	-0.20***
	(0.01)	(0.00)
Observations	14,411	4,891
R-squared	0.74	0.90
Panel B - risky lending		
Undercap	0.05	0.09
	(0.51)	(0.49)
Undercap × Low Rating	-0.24	-0.21
	(0.10)	(0.41)
Observations	2,371	891
R-squared	0.68	0.89
Panel C - zombie lending		
Undercap	-0.05	0.05
	(0.33)	(0.66)
Undercap × Zombie	0.33**	-0.24
	(0.03)	(0.15)
Observations	2,205	950
R-squared	0.69	0.90
Panel D - rent-seeking lending		
Undercap	0.48**	0.16
	(0.01)	(0.19)
Undercap × Low Rating	-0.65***	-0.69**
	(0.00)	(0.05)
Undercap × High IR	-0.54**	-0.14
	(0.02)	(0.46)
Undercap × Low Rating × High IR	0.56***	1.06***
	(0.01)	(0.01)
Observations	1,997	796
R-squared	0.70	0.89
Cluster	bank	bank
Firm FE	YES	YES
Country FE	YES	YES
Controls	YES	YES

Table 8: **Descriptive Statistics of "Zombie" Firms**

The table compares some descriptive statistics of zombie firms borrowing from undercapitalized banks with zombie firms borrowing from better-capitalized banks. The displayed values in Panel A are means of the variables in the year 2009. The displayed values in Panel B are means of the variables in the years 2013 to 2016. The last column shows the p-values of a t-test for differences in means.

Panel A: as of 2009

VARIABLES	Borrowing from undercapitalized banks	Borrowing from better-capitalized banks	p-value of t-test
Interest Coverage Ratio	-2.78	1.94	0.07
EBITDA/Total Assets	0.03	0.03	0.80
ROA	-1.01	0.63	0.25
Cash Flow/Total Assets	0.02	0.03	0.47
Sales/Assets	0.14	0.62	0.00
Tangible Assets/Total Assets	0.98	0.92	0.00
Cash/Total Assets	0.07	0.05	0.53
Liabilities/Total Assets	0.70	0.80	0.02
Log Total Assets	18.96	19.32	0.38

Panel B: as of 2013–2016

VARIABLES	Borrowing from undercapitalized banks	Borrowing from better-capitalized banks	p-value of t-test
Interest Coverage Ratio	-1.87	14.06	0.00
EBITDA/Total Assets	0.03	0.05	0.05
ROA	-1.16	1.51	0.00
Cash Flow/Total Assets	0.02	0.06	0.00
Sales/Assets	0.30	0.72	0.00
Tangible Assets/Total Assets	0.72	0.88	0.00
Cash/Total Assets	0.04	0.06	0.00
Liabilities/Total Assets	0.81	0.69	0.00
Log Total Assets	19.47	19.68	0.22

Table 9: **Impact of being Undercapitalized on Banks' Portfolio Composition**

The table displays results from a weighted-least squares (WLS) regression of changes in asset holdings from 2009 to 2012 on the undercapitalization status and a set of control variables. The weighting scheme is obtained from running the regression in Table 4, column 2:

$$\Delta Y_{i,09-12} = \beta \times X_{i,2009} + \alpha \times Undercap_i.$$

The variable *Undercap* takes the value 1 if a bank is classified as undercapitalized as defined in the text. Bank-level variables $X_{i,2009}$ comprise log total assets (*Log Total Assets*), the equity-to-assets ratio (*Equity/TA*), the NPL-to-loans ratio (*NPL/Loans*) and return on average assets (*ROAA*), as of end-2009. $\Delta Y_{i,09-12}$ is the change from end-of-year 2009 to end-of-year 2012 for one of the following variables: the security-to-loan ratio (*Securities/Loans*), the domestic sovereign bond holdings (*GovBonds Domestic*), and the holdings of sovereign bonds issued by GIIPS countries (*GovBonds GIIPS*). Standard errors are robust and adjusted for clustering at the bank level. The table reports coefficient estimates. Parentheses contain p-values. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	(1) ΔSecurities/ Loans$_{09-12}$	(2) ΔGovBonds Domestic$_{09-12}$	(3) ΔGovBonds GIIPS$_{09-12}$	(4) ΔGovBonds GIIPS$_{09-12}$
Constant	0.00	-0.07	1.50	-0.29
	(0.99)	(0.95)	(0.43)	(0.81)
Log Total Assets	0.01	0.06	-0.10	0.02
	(0.81)	(0.50)	(0.44)	(0.85)
Equity/Total Assets	0.03	-0.05	-0.08	-0.13**
	(0.25)	(0.31)	(0.29)	(0.02)
ROAA	0.21*	-0.07	0.06	-0.07
	(0.08)	(0.60)	(0.80)	(0.69)
NPLs/Loans	-0.01	-0.08**	-0.02	-0.01
	(0.54)	(0.02)	(0.42)	(0.67)
Undercap	0.44***	0.95***	1.11***	0.76**
	(0.00)	(0.01)	(0.00)	(0.02)
GIIPS Bank				1.03***
				(0.00)
Observations	189	39	38	38
R-squared	0.14	0.38	0.31	0.62
Cluster	bank	bank	bank	bank

Appendix

Table A1: **Likelihood of a Bank being Undercapitalized – Robustness**

The table presents the results of a logit regression with the following specification:

$$Undercap_i = \frac{exp(\beta X_i)}{1 + (exp(\beta X_i)} \text{ where } \beta X_i = \beta_0 \times X_{i,2006} + \beta_1 \times b_{c,2006} + \beta_2 \times m_{c,2006} + \beta_3 \times X_{i,2006} * m_{c,2006}.$$

The variable *Undercap* takes the value 1 if a bank is classified as undercapitalized as defined in the text. Bank-level variables $X_{i,2006}$ comprise total assets to domestic GDP (*Total Assets/GDP*), the equity-to-assets ratio (*Equity/TA*), the short-term funding ratio (*ST funding/TA*) and return on average assets (*ROAA*), as of end-2006. Banking sector variables $b_{c,2006}$ comprise the average equity ratio in the domestic banking sector (*Average Equity Ratio*) and the number of banks that already received recapitalization (*Banks with recaps*). Macroeconomic variables $m_{c,2006}$ comprise the government revenues to GDP (*Government Revenue*), the maturing government debt to GDP (*Maturing Debt*), the current account balance (*CA Balance*), the total government debt to GDP (*Debt/GDP*), real GDP growth (*GDP growth*), GDP per capita ((*GDP*) and household debt over GDP (*HH Debt/GDP*) in the respective country as well as a the logarithm of the time until the next election (*Log Time to Election*). Lastly, we add a control for the pro, respectively anti, EU sentiment in the current government (*Pro EU*). Control variables are not displayed in the table. All non-binary variables are demeaned. Standard errors are robust and adjusted for clustering at the country level. The table reports coefficient estimates. Parentheses contain p-values. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	(1)	(2)	(3)	(4)
Government Revenue (%GDP)	-0.37**	-0.32*	0.13	0.34**
	(0.05)	(0.09)	(0.53)	(0.02)
Government Revenue (%GDP) × Total Assets/GDP	-0.02**	-0.02***	-0.02*	-0.04**
	(0.01)	(0.00)	(0.08)	(0.02)
Government Revenue (%GDP) × Equity/Total Assets	-0.08	-0.09	0.09***	0.11***
	(0.27)	(0.18)	(0.00)	(0.00)
Government Revenue (%GDP) × ROAA	0.03	0.08	-0.49**	-0.56**
	(0.84)	(0.54)	(0.03)	(0.02)
Debt/GDP	-0.03**			-0.21***
	(0.04)			(0.00)
Debt/GDP × Total Assets/GDP	0.00			-0.01*
	(0.25)			(0.09)
Debt/GDP × Equity/Total Assets	0.02*			-0.04**
	(0.09)			(0.02)
Debt/GDP × ROAA	-0.05*			-0.06
	(0.07)			(0.12)
Maturing Debt (%GDP)		-1.00		110.81***
		(0.92)		(0.00)
Maturing Debt (%GDP) × Total Assets/GDP		0.64		8.71**
		(0.35)		(0.03)
Maturing Debt (%GDP) × Equity/Total Assets		7.38		26.78***
		(0.13)		(0.00)
Maturing Debt (%GDP) × ROAA		-17.69*		19.54
		(0.08)		(0.24)
Current Account			-0.29*	-0.74***
			(0.06)	(0.00)
Current Account × Total Assets/GDP			-0.00	-0.02**
			(0.92)	(0.04)
Current Account × Equity/Total Assets			-0.11***	-0.16***
			(0.00)	(0.00)
Current Account × ROAA			0.38***	0.32***
			(0.00)	(0.00)
Observations	766	766	766	766
Cluster	country	country	country	country

Table A2: **Impact of being Undercapitalized on Various Measures – Alternative Weights**

The table presents the results of re-running the weighted-least squares (WLS) specifications from Tables 5 to 9 with alternative weighting schemes. The weights are obtained from Table A1, column 2, or are all set to 1, respectively. Standard errors are clustered at the bank level. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A - Balance-sheet variables

VARIABLES	(1) $\Delta Equity_{09-12}$	(2) $\Delta Tier1_{09-12}$	(3) $\Delta Loans_{09-12}$	(4) ΔLLP_{09-12}	(5) ΔNPL_{09-12}	(6) $\Delta ROAA_{09-12}$	(7) ΔNIM_{09-12}	(8) $\Delta RWA/TA_{09-12}$
Panel A.1 - weights from Table A1, column 2								
Undercap	-0.10***	0.22*	-0.04	0.72***	-0.00	-0.13	-0.02	0.03
	(0.01)	(0.07)	(0.11)	(0.00)	(0.98)	(0.31)	(0.55)	(0.75)
Observations	608	247	610	417	177	519	610	199
R-squared	0.30	0.08	0.17	0.27	0.10	0.25	0.08	0.05
Panel A.2 - no weight								
Undercap	-0.13***	0.18*	-0.05**	0.79***	-0.04	-0.10	-0.07	-0.05
	(0.00)	(0.09)	(0.03)	(0.00)	(0.58)	(0.56)	(0.13)	(0.39)
Observations	669	271	671	456	198	564	671	219
R-squared	0.25	0.08	0.13	0.23	0.04	0.16	0.03	0.06

Panel B - Sovereign-crisis performance

VARIABLES	(1) Recap 2010-13	(2) Survival until 2012	(3) LTRO Uptake/TA
Panel B.1 - weights from Table A1, column 2			
Undercap	0.05	-0.33	11.83**
	(0.94)	(0.40)	(0.01)
Observations	689	689	56
R-squared	0.35	0.26	0.36
Panel B.2 - no weight			
Undercap	0.57	-0.40	9.45**
	(0.28)	(0.24)	(0.03)
Observations	758	758	62
R-squared	0.33	0.25	0.29

Panel C - Aggregate lending

VARIABLES	(1) Δ Loan	(2) Δ Log Loan	(3) Loan Increase	(4) Relationship borrowers	(5) New borrowers
Panel C.1 - weights from Table A1, column 2					
Undercap	-0.15**	-0.23**	-0.04**	-0.08**	-0.19***
	(0.01)	(0.01)	(0.05)	(0.05)	(0.00)
Observations	19,632	19,632	19,632	14,169	4,822
R-squared	0.79	0.74	0.75	0.74	0.90
Panel C.2 - no weight					
Undercap	-0.10	-0.18*	-0.02	-0.05	-0.17***
	(0.13)	(0.08)	(0.40)	(0.25)	(0.00)
Observations	20,152	20,152	20,152	14,542	4,961
R-squared	0.78	0.74	0.75	0.73	0.89

Panel D - Risky lending

VARIABLES	(1) Δ Loan	(2) Δ Log Loan	(3) Loan Increase	(4) Relationship borrowers	(5) New borrowers
Panel D.1 - weights from Table A1, column 2					
Undercap	0.03	0.04	0.00	0.04	0.08
	(0.79)	(0.83)	(0.98)	(0.66)	(0.55)
Undercap × Low Rating	-0.28**	-0.39**	-0.11**	-0.21	-0.16
	(0.04)	(0.02)	(0.01)	(0.13)	(0.50)
Observations	2,748	2,748	2,748	2,330	296
R-squared	0.67	0.59	0.62	0.66	0.95
Panel D.2 - no weight					
Undercap	-0.00	0.08	0.01	0.03	0.14
	(0.99)	(0.70)	(0.77)	(0.72)	(0.33)
Undercap × Low Rating	-0.14	-0.32*	-0.09**	-0.11	-0.07
	(0.24)	(0.07)	(0.05)	(0.41)	(0.81)
Observations	3,458	3,458	3,458	2,392	905
R-squared	0.69	0.62	0.66	0.66	0.89

Panel E - Zombie lending

VARIABLES	(1) Δ Loan	(2) Δ Log Loan	(3) Loan Increase	(4) Relationship borrowers	(5) New borrowers
Panel E.1 - weights from Table A1, column 2					
Undercap	-0.14*	-0.19*	-0.05	-0.06	0.05
	(0.05)	(0.07)	(0.12)	(0.32)	(0.66)
Undercap × Zombie	0.35**	0.35	0.07	0.33**	-0.23
	(0.03)	(0.12)	(0.13)	(0.04)	(0.15)
Observations	2,579	2,579	2,579	2,166	306
R-squared	0.70	0.64	0.64	0.69	0.96
Panel E.2 - no weight					
Undercap	-0.12	-0.16	-0.04	-0.04	0.11
	(0.13)	(0.17)	(0.26)	(0.49)	(0.36)
Undercap × Zombie	0.31	0.23	0.11**	0.27	-0.37*
	(0.11)	(0.37)	(0.03)	(0.12)	(0.05)
Observations	3,314	3,314	3,314	2,218	959
R-squared	0.72	0.66	0.68	0.67	0.90

Panel F - Rent-seeking lending

VARIABLES	(1) Δ Loan	(2) Δ Log Loan	(3) Loan Increase	(4) Relationship borrowers	(5) New borrowers
Panel F.1 - weights from Table A1, column 2					
Undercap	0.34	0.24	0.18*	0.44**	0.14
	(0.13)	(0.43)	(0.05)	(0.02)	(0.25)
Undercap × Low Rating	-0.42**	-0.47	-0.34**	-0.64***	-0.64*
	(0.02)	(0.14)	(0.01)	(0.00)	(0.07)
Undercap × High IR	-0.39	-0.33	-0.27**	-0.50**	-0.12
	(0.12)	(0.29)	(0.02)	(0.02)	(0.50)
Undercap × Low Rating × High IR	0.21	0.22	0.34**	0.58***	1.02***
	(0.40)	(0.58)	(0.04)	(0.01)	(0.01)
Observations	2,883	2,883	2,883	1,959	786
R-squared	0.71	0.65	0.67	0.68	0.89
Panel F.2 - no weight					
Undercap	0.06	0.15	0.13	0.14	0.16
	(0.78)	(0.63)	(0.17)	(0.42)	(0.16)
Undercap × Low Rating	-0.14	-0.24	-0.21*	-0.30	-0.51
	(0.52)	(0.45)	(0.08)	(0.19)	(0.30)
Undercap × High IR	-0.11	-0.20	-0.19*	-0.13	-0.07
	(0.63)	(0.53)	(0.10)	(0.56)	(0.71)
Undercap × Low Rating × High IR	0.07	0.05	0.20	0.28	0.80
	(0.80)	(0.90)	(0.21)	(0.29)	(0.12)
Observations	2,957	2,957	2,957	2,014	806
R-squared	0.70	0.64	0.67	0.68	0.89

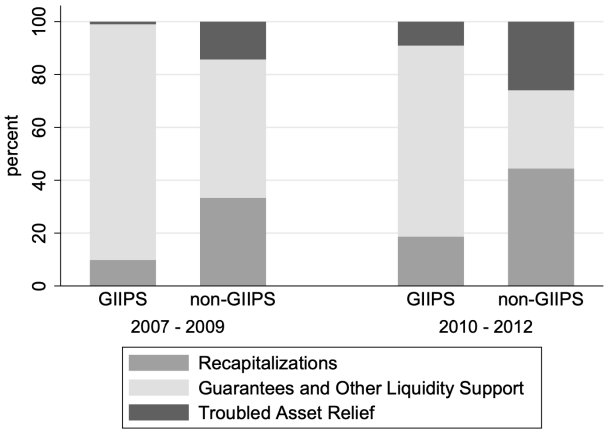
Panel G - Sovereign debt

VARIABLES	(1) ΔSecurities/ Loans_{09-12}	(2) ΔGovBonds Domestic_{09-12}	(3) ΔGovBonds GIIPS_{09-12}	(4) ΔGovBonds GIIPS_{09-12}
Panel G.1 - weights from Table A1, column 2				
Undercap	0.49***	0.92**	1.06***	0.73**
	(0.00)	(0.01)	(0.01)	(0.03)
GIIPS Bank				1.07***
				(0.00)
Observations	180	38	37	37
R-squared	0.16	0.37	0.35	0.62
Panel G.2 - no weight				
Undercap	0.40***	0.89**	0.69	-0.97**
	(0.00)	(0.02)	(0.17)	(0.02)
GIIPS Bank				1.15***
				(0.00)
Undercap × GIIPS				1.54***
				(0.00)
Observations	208	41	39	39
R-squared	0.08	0.26	0.05	0.62

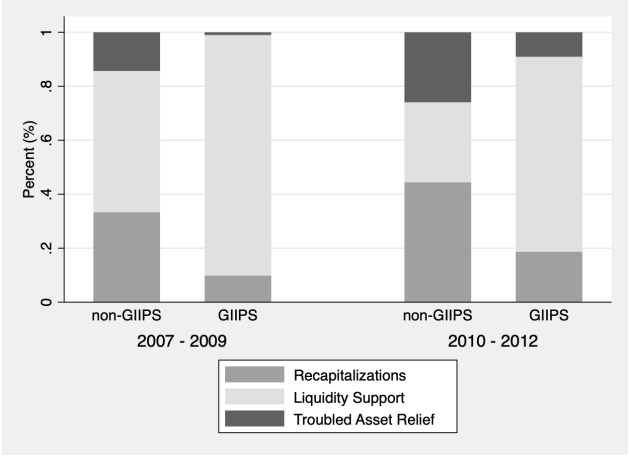
Online Appendix

Figure A1: **Government Interventions: GIIPS vs. non-GIIPS countries**

Figure 1: Government Interventions by Category (in %)



(a) Frequency of Interventions by Categories



(b) Share of Interventions by Categories

Notes: GIIPS refers to Greece, Ireland, Italy, Portugal, and Spain, while non-GIIPS refers to Eurozone countries other than GIIPS.

Table A1: **Overview of State Aid Cases in the EU Financial Sector (Excerpt)**
The table provides an excerpt from the overview of State aid cases in the EU financial sector according to European Commission (2017).

State aid cases - situation as of 31 December

Decisions adopted by the Commission during the period 2008 to 2017[1]. When the Commission applied the Impaired Assets Communication the decision's reference is followed by (*)[2] [3].

Austria

Type of measure / Beneficiary	**Type of Decision**	**Date of adoption**
N557/2008 - Aid scheme for the Austrian financial sector (guarantees, recapitalisation & other)	Decision not to raise objections IP/08/1933	9 December 2008
N352/2009 - Prolongation	EXME/09/0630	30 June 2009
N663/2009 - Second prolongation	EXME/09/1217	17 December 2009
N241/2010 - Extension	IP/10/839	25 June 2010
SA.32018 – Extension	EXME 10/16.12	16 December 2010
N 214/2008 - Recapitalisation of Hypo Tirol	Decision not to raise objections IP/09/928	17 June 2009
N 640/2009 - BAWAG – temporary approval of capital injection and asset guarantee **	Decision not to raise objections IP/09/1989	22 December 2009
N 261/2010 - Restructuring of BAWAG **	Decision not to raise objections IP/10/865	30 June 2010
C 16/2009 and N698/2009 – Emergency aid to Hypo Group Alpe Adria **	Decision not to raise objections IP/09/1998	23 December 2009
SA.32745 - Restructuring of Kommunalkredit **	Decision not to raise objections IP/11/389	31 March 2011
SA.32172 and SA.32554 – Temporary	Decision not to raise	24 May 2011

[1] As a general rule, aid schemes are reviewable six months after approval. Some individual decisions are subject to a review and possible restructuring plan.
[2] If for a particular financial institution the Impaired Assets Communication was applied, this institution appears with the "**" except if the impaired assets measure has been amended.

[3] If for a particular decision not all the conditions of the IAC 2009 were fulfilled, the decision appears only once with the "*"

3

Table A1 (continued): **Overview of State Aid Cases in the EU Financial Sector (Excerpt)**

approval of aid for Hypo Group Alpe Adria [decision replaced – see below]	objections IP/11/636	
SA.32172 and SA.32554 – Replacement decision: Temporary approval of aid for Hypo Group Alpe Adria	Decision not to raise objections	19 July 2011
SA.31883 – Restructuring of Österreichische Volksbanken AG	Decision to open an in-depth procedure IP/11/1522	9 December 2011
SA.31189 – BAWAG Amendment Decision	Decision not to raise objections	19 December 2011
SA.31883 – Restructuring of Österreichische Volksbanken AG	Final decision IP/12/982	19 September 2012
SA.34716 - Recapitalisation of Hypo Tirol	Decision not to raise objections IP/12/1067	4 October 2012
SA.32554 - Temporary approval of an emergency recapitalisation in favour of Hypo Group Alpe Adria	Decision not to raise objections IP/12/1315	5 December 2012
SA.32745 -Run-off plan of Kommunalkredit	Decision not to raise objections EXME/13/19.07	19 July 2013
SA.32554 - Liquidation of Hypo Group Alpe Adria	Final decision IP/13/811	3 September 2013
SA. 31883 (2015/N) – Restructuring of Österreichische Volksbanken AG (OVAG): authorisation for the amended restucturing plan	MEX/15/5303	2 July 2015
SA. 32745 (2017/N) – Sale of parts of Kommunalkredit Austria AG		17 March 2017

Belgium

Belgium/Luxembourg

NN45-49-50/2008 – Guarantee on liabilities of Dexia	Decision not to raise objections IP/08/1745	19 November 2008
Prolongation	IP/09/1662	30 October 2009

Belgium/France/Luxembourg

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Table A2: **State aid N 214/2008 - Recapitalization of Hypo Tirol (Excerpt)**
The table provides an excerpt from State aid case N 214/2008 on the recapitalization of the Austrian bank Hypo Tirol.

EUROPEAN COMMISSION

Brussels, 17.6.2009
C (2009) 4691 final corr.

In the published version of this decision, some information has been omitted, pursuant to articles 24 and 25 of Council Regulation (EC) No 659/1999 of 22 March 1999 laying down detailed rules for the application of Article 93 of the EC Treaty, concerning non-disclosure of information covered by professional secrecy. The omissions are shown thus […].

PUBLIC VERSION

WORKING LANGUAGE

This document is made available for information purposes only.

Subject: **State aid N 214/2009 – Austria**
Aid measures provided to Hypo Tirol Bank AG

Sir,

1. PROCEDURE

(1) Austria informed the Commission of the measure covered by this decision by letter dated 25 February 2009, registered with the Commission on 7 April 2009. Complementary information, necessary for the Commission's assessment of the compatibility of the aid, was submitted by Austria, dated 12 May 2009, 18 May 2009, 20 May 2009, 28 May 2009, 8 June 2009 and 10 June 2009.

2. BACKGROUND AND BENEFICIARY

(2) Hypo Tirol Bank Aktiengesellschaft (in the following "Hypo Tirol") is a credit-institution in the form of a joint stock company. The Austrian federal state (Land) Tirol is, indirectly via the Landes-Hypothekenbank Tirol Anteilsverwaltung, sole owner of the bank.

(3) Hypo Tirol is active in universal banking, insurance broking, in private banking and in the leasing business. Hypo Tirol is active in Tirol, in Italy (focussing on the region of Südtirol), and, as a niche bank, in Zurich, Munich and Vienna.

Dr. Michael SPINDELEGGER
Bundesminister für europäische und internationale Angelegenheiten
Ballhausplatz 2
A - 1014 Wien

Commission européenne, B-1049 Bruxelles – Belgique
Europese Commissie, B-1049 Brussel – België
Telefon: 00 32 (0) 2 299.11.11

Table A2 (continued): **State aid N 214/2008 - Recapitalization of Hypo Tirol (Excerpt)**

(4) In 2008 Hypo Tirol employed in average 786 employees and its balance sheet amounted to approx. EUR 13 billion, with earnings before tax of approx. EUR 16.6 million. While Hypo Tirol is not amongst Austria's largest banks, it is positioned among the important Austrian banks and is, when measured by balance sheet size, the biggest bank in Western Austria.

(5) Due to the financial crisis Hypo Tirol was confronted with losses and downgrades in its credit business, forcing it to reinforce its capital position. Hypo Tirol incurred losses […]' which affected its financial results in a manner that excluded the possibility of an allocation to reserves. As per 13 December 2008 the tier 1 capital ratio amounted to […] which is low compared to similar banks. In order to ensure a sustainable tier 1 capital ratio of above 7% comparable to its peers and […] whilst at the same time preserving its rating and possibilities for refinancing the aid measure described below was notified.

3. THE FINANCIAL SUPPORT MEASURE

(6) Hypo Tirol issues tier 1 hybrid capital (*Partizipationskapital*) in the amount of up to EUR 100 million, corresponding to 1.6% of the risk-weighted assets (RWA). This capital does not confer voting rights and is not cumulative in its payments to the subscribers.

(7) The capital will be issued via financial instruments and will be subscribed by private investors. The financial instruments have a dividend of 5% payable annually provided the bank shows a profit. As from 16 May 2014 the dividend amounts to EURIBOR (12 months) plus 200 basis points payable annually provided the bank shows a profit.

(8) Land Tirol issues a State guarantee for the principal capital amount subscribed by the investors for a period of ten years, which is called in the case of a bankruptcy of Hypo Tirol.

(9) For this guarantee, Hypo Tirol is paying to Land Tirol a progressively increasing guarantee fee, starting with 3.9% in the first three years, and rising to 6.6% in year number ten (see table).

Year	1-3	4	5	6	7	8	9	10
% Guarantee	3,9	4,2	4,5	4,8	5,1	5,6	6,1	6,6

* Confidential information

Table A2 (continued): **State aid N 214/2008 - Recapitalization of Hypo Tirol (Excerpt)**

(10) For the bank, therefore, the total cost of the capital injection amounts to 8.9% in year one, and rises progressively to 9.5% in year five. Thereafter, the total remuneration is comprised of an increasing guarantee fee and a dividend of 12 months Euribor plus 200 basis points.

(11) The financial instruments do not have a fixed maturity. After ten years, i.e. after the expiry of the guarantee, the private investors have a put option towards the Land Tirol, i.e. they can sell the financial instruments to the Land Tirol. Likewise, Land Tirol has a purchase option. It is envisaged that Tirol makes use of the purchase option and that the capital is subsequently redeemed by the bank. In case this does not happen and if Land Tirol were to remain the owner of the capital, Hypo Tirol commits itself to pay a dividend of Euribor (12 months) plus 860 basis points in year 11. In the 12th year the dividend payable to Land Tirol increases by additional 100 basis points to Euribor (12 months) plus 960 basis points. From year 13 onwards the dividend amounts to Euribor (12 months) plus 1000 basis points.

4. AUSTRIA'S POSITION

(12) Austria considers the bank to be fundamentally sound and has provided evidence to that effect.

(13) Austria explained that it was necessary for Hypo Tirol to reinforce its capital position through a measure that would qualify as tier 1 capital under the applicable solvency regulations.

(14) Austria considers that the measure constitutes state aid within the meaning of Article 87(1) EC. Austria believes that the aid is compatible with the common market under Article 87(3)(b) of the EC Treaty in the context of the current crisis.

(15) Austria considers that the measure is not a recapitalisation stricto sensu, as the aid is restricted to guaranteeing the nominal value of the capital provided by private investors, but accepts the application of the Recapitalisation Communication[1]. The measure is not envisaged under the scope of the Austrian scheme N 557/2008.

(16) Austria has provided a letter from the Austrian Financial Supervisory Authority which considers Hypo Tirol due to its size and strong regional position an important element in the Austrian banking sector.

(17) Austria commits to submit a viability plan for the bank after six months. However, if the bank is no longer fundamentally sound, Austria commits to submit a restructuring plan.

[1] Communication from the Commission – "The recapitalisation of financial institutions in the current financial crisis, limitation of aid to the minimum necessary and safeguards against undue distortions of competition", OJ C 10, 15/01/2009, p. 2

Table A3: **Bankscope IDs**
The table provides the Bankscope IDs corresponding to the banks' balance sheet characteristics employed in this study.

Panel A: Bank-level variables	
[t] VARIABLES	Bankscope ID
Total Assets	2025
Loans/TA	2001 divided by 2025
Net Int. Margin	4018
Equity/TA	18165
Tier 1 Ratio	18150
LLP/Loans	4001
NPLs/Loans	4004
ROAA	3024
ST funding/TA	(2003 - 2031)/2025
Loans/Deposits	18245
RWA/TA	30700 divided by 2025