State-Aid, Stability and Competition in European Banking

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Abstract

What is the relationship between bank fragility and competition during a period of market turmoil? Does market power in European banking involve extra-gains after discounting for the cost of government intervention? We answer these questions in the context of Eurozone banking over 2005-2012 and show that greater market power increases bank stability implying aggregate extra-gains of 57% of EU12 gross domestic product for the banking sector after discounting for the costs associated with government intervention. The negative influence of competition on bank stability is non-monotonic and reverses for lower degrees of competition. Capital injections, guarantees and asset relief measures elicit greater bank soundness.

JEL-Classification: C23, G21, G28

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1 Introduction

The response to the global financial crisis by governments and central banks was significant and unprecedented in both Europe and the US. Policy measures enacted ranged from initiatives dealing with impaired bank assets, the recapitalizing and/or financial restructuring of troubled banks, and various actions designed to inject liquidity into the banking system.[1] Between the start of 2008 and October 2014 European Union (EU) governments approved state aid to banking systems amounting to 45.8% of GDP comprising €1.49 trillion of capitalization and asset relief programs and €4.3 trillion of guarantees and liquidity measures. Most state authorized aid was in the form of guarantees, some €3.9 trillion in total (most of which was granted at the peak of the crisis during 2008).[2] The scale of government aid provided to the financial sector has prompted concerns about anti-trust implications (White, 2009; Carletti and Vives, 2009; Beck et al., 2010; and CEPS, 2010) and also led some to investigate whether competitively disadvantaged banks should be subsidized (Lyons and Zhu, 2013).

Given anti-trust concerns relating to the state support to banks, the main aim of this paper is to empirically analyse the effect of state-aid on competition as well as bank stability. To investigate the impact of the Global Financial Crisis (GFC) and government intervention on competition and risk we analyse separate banking markets and control for a range of factors including systemic heterogeneity, bank-level fundamentals and macroeconomic features. We

[1] See BIS (2009), Group of Thirty (2009) and Brunnermeier (2009) for detailed perspectives on the causes and consequences of the global financial crisis. For European insights see De Larosière (2009) and Goddard et al. (2009).

[2] Information from the EC State Aid to the banking sector scoreboard: http://ec.europa.eu/competition/state_aid/scoreboard/financial_economic_crisis_aid_en.html.

compute various indicators (at the bank level) capturing overall stability, credit risk and liquidity risk. Competition is estimated using the Lerner Index (Calderon and Schaeck, 2015) which enables us to derive measures at the bank level and over time. Additionally, we include variables to capture different forms of government intervention, business models and the degree of market power. Using various panel techniques we test whether changes in competition are associated to variations in bank risk. We also investigate the impact of the crisis period (2008-2012) and the effect of government intervention on individual bank stability measured using the Z-index. In addition, we estimate the net pecuniary cost/gain of government intervention in the banking sector calculated on a countrywide basis as the difference between aggregate extra-profits associated with enhanced market power and the cost of government intervention computed as expenditures to gross domestic product (Maudos and de Guevara, 2007). To address the usual endogeneity concerns of competition in our baseline regressions and in-line with previous studies (Beck et al., 2013; Anginer et al., 2014; Kick and Prieto, 2014), we employ instrumental variable estimation methods.

We show that market power increases bank stability (consistent with previous literature, including Beck et al. (2013) and Fu et al. (2014)) and this results in a net pecuniary gain (enhanced banking sector profits resulting from increases in market power that exceed the cost of government intervention). This finding is important for policy makers as it highlights the benefits as well as the costs of public support to the banking industry at times of crises. We also show that the positive effect of market power on bank stability is non-monotonic and reverses for high levels of market power. Bank specialization is also found to be significantly and positively related to individual bank stability, namely, that capital injections, guarantees and asset relief measures increase individual bank soundness.[3]

Our paper bridges two strands of the literature: the first investigates the link between competition and stability/fragility in banking; the second examines policy intervention post-global financial crisis. The first strand of literature evaluates the link between competition and bank fragility with a well-established theoretical debate hinging on the trade-off between competition and stability (Marcus, 1984; Keeley, 1990; Boyd and De Nicolò, 2005). Allen and Gale (2004) underline the complexity of this relationship pointing out that though there are benefits from static efficiency, competition can lead to greater instability. Heightened competition, however, can reduce the "charter value" of banks causing instability in the financial system (Allen and Gale, 2004). The empirical evidence on the link between competition and stability is somewhat mixed and largely dependent on the sample, estimation methodology and choice of conditioning variables used (Beck et al., 2013). Schaeck et al. (2009) and Anginer et al. (2014) find that competition is positively related to systemic stability but Beck et al. (2006), Fu et al. (2014) and Diallo (2015) argue that more concentrated banking systems show a lower probability of systemic crises and greater resilience to such events compared with competitive systems. Berger et al. (2009) observe that, even if an increase in bank market power leads to riskier portfolios, the effect on stability could be offset by enhanced bank franchise values. Forssbæck and Shehzad (2014) analyse

[3] Although it would be interesting to investigate if various policy interventions produce a differential impact on market power in the long term, it is problematic to safely assess causality due to severe endogeneity issues.

competition and stability in the deposit and loan market separately and show that in both markets competition is positively linked to greater default and asset risk.

The second strand of literature focuses on the impact of policy interventions during and post-crisis. McAndrews et al. (2008) examine the effectiveness of the Federal Reserve's Term Auction Facility (TAF) in mitigating liquidity problems in the interbank funding market and show that TAF was effective in reducing distress in money markets from December 2007 through April 2008. Baba and Packer (2009) analyse the effect of swap lines among central banks in reducing dollar shortages in the period prior to and after Lehman Brothers failure in September 2008. The authors find that the European Central Bank, Swiss National Bank and Bank of England were successful in ameliorating the problem of dollar funding for non-US financial institutions. Meaning and Zhu (2011) show a significant decrease in government bond yields following the purchases of Treasury securities by the Federal Reserve and of gilts by the Bank of England. A more recent study by Pennathur et al. (2014) examine the market reaction to nine U.S. government interventions in response to the crisis for different categories of financial institutions (banks, savings and loan associations, insurance companies, an real estate investment trusts). The authors find that these measures generally result in an increase in risk and a reduction in firm value. Aït-Sahalia et al. (2012) find that policy announcements, such as fiscal and monetary policy, liquidity support, financial sector policy, and ad-hoc bank failures, are usually associated with reductions in the LIBOR–OIS spreads between June 2007 and March 2009. Fiordelisi and Ricci (2015) investigate the impact of policy announcements (fiscal and monetary policy, liquidity support, financial sector policy, and ad-hoc bank failures) on the stock price of globally systemically important banks (G-SIBs) between June 2007 and June 2012. Typically, monetary policy interventions (whether restrictive or expansionary) have a positive impact on bank stock returns. In contrast, bank failures and bail-outs generate strong negative returns, although this effect is mitigated for various G-SIBs[4] providing evidence of a "too-big-too fail" perception by investors. G-SIBs are not found to be equally responsive to all global policy interventions, but appear to be more sensitive to those announced in their own currency area.

While there is a growing literature on policy actions and bank/financial market behaviour post-financial crises, the impact of government intervention on banking sector competition and the potential net benefits of such actions have (as far as we are aware) yet to be addressed. Specifically, there is no evidence of the effect of Government aid during the crisis on individual bank stability and whether potential benefits relating to greater market power offset the cost of government intervention.

Our study aims to make a significant contribution by focusing on the widespread state intervention in Europe while we account for heterogeneity in the intensity of interventions made by each Government and compare this against outcomes generated by the competitive banking environment of each country. Second, we advance previous research because we explicitly estimate the net pecuniary cost/gain of government interventions. Specifically, we propose an objective function where we compare the pecuniary gains from market power with the expense for stabilizing each country financial sector. A net pecuniary gain indicates

[4] Global Systemically Important Banks (G-SIBs) are banks classified by the Financial Stability Board in the highest buckets of systemic relevance according to an indicator-based measurement approach reflecting size, level of interconnectedness, substitutability, global activity and complexity of a credit institution.

that competition could be hastened as it would not increase the cost of government intervention.[5]

The remainder of the paper is structured as follows. First, we describe the data and variables (section 2), and the empirical design (section 3). Next, we present our results (section 4) and robustness checks (section 5). Conclusions are summarized in section 6.

2 Data and variables

In this section, we outline our data collection process (section 2.1), the estimation process of the variables used to capture competition (section 2.2), bank risk-taking (section 2.3), government aid (section 2.4) and other economic phenomenon that may alter the relationships investigated (section 2.5).

2.1 Data

We analyse banks operating in the twelve countries that adopted the euro on the 1st January 2002. Bank financial statements are taken from Bureau van Dijk Bankscope database. The data span the years 2005 through 2012.[6] We select all types of depository institutions (commercial banks, savings banks and cooperative banks) and only use unconsolidated data. After data cleansing, our final sample consists of around 19,100 observations for 2,621 individual banks distributed in the twelve countries.[7] In 2012, the median total assets of the

[5] In the case of a net pecuniary cost government should contribute additional resources to cover for the overall lack of profitability of the domestic banking sector.
[6] International Accounting Standards (IAS) were introduced across Europe in 2005, causing the dataset before and after 2005 to differ.
[7] In terms of number, cooperative banks are the most represented (61%), followed by savings banks (25%) and commercial banks (14%)

banks included in the sample are approximately Euro 680 million and only five banks have assets larger than Euro 100 billion. Looking at the distribution of banks over time per country, we notice that six countries (Austria, France, Germany, Italy, Luxembourg, and Spain) represent 98% of the sample. In 2012, the Netherlands is the country with the largest banks (with average assets size of Euro 63 billion) and Finland the lowest (Euro 650 million). The distributions of banks by year-specialization and by year-country are reported in Table 1.

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Additional information on country-level data is retrieved from Eurostat, the World Bank, the European Commission and the European Central Bank. The justification for the choice of these variables is provided in section 2.5 describing other variables. All the variables constructed with accounting information are winsorized at the 1st and 99th percentile level of their distribution to mitigate the impact of outliers.

2.2 *Measuring competition: the Lerner Index*

We estimate a non-structural measure of competition using the Lerner Index (*LER*) to derive individual bank's monopoly power. This indicator represents the extent to which firms fix prices above marginal cost, it is computed as follows:

$$LER_{i,t} = \frac{P_{i,t} - MC_{i,t}}{P_{i,t}} \tag{1}$$

where the subscript *i* indicates each individual bank and *t* each individual year; *P* is the price of the output and *MC* is the marginal cost. Higher values of the index imply greater market power.

The price of output P is calculated as total revenues (interest plus non-interest income) divided by total assets. For the estimation of marginal cost, we follow the intermediation approach where bank output is modelled as a stock identified by total assets, and inputs are deposits, labour and physical capital. Following some recent studies (Anginer et al., 2014; Beck et al., 2013), we estimate a pooled OLS regression to derive marginal costs using a translog cost function with three inputs and one single output. We also include binary variables indicating bank's specialization to account for potential differences in business model (namely, commercial, savings and cooperative banks), the cost of borrowing and the nominal value of labour cost index for financial and insurance activities (to control for cross-country heterogeneity) and time fixed effects to capture technical change (year dummy variables). The final specification is as follows:

$$\begin{aligned}\ln TC_{i,t} &= \alpha_0 + \alpha_1 \ln Q_{i,t} + \frac{\alpha_2}{2}\left(\ln Q_{i,t}\right)^2 + \sum_{j=1}^{3}\beta_j \ln w_{j,i,t} + \frac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3}\beta_{j,k} \ln w_{j,i,t} \times \ln w_{k,i,t} + \\ &+ \sum_{j=1}^{3}\gamma_j \ln w_{j,i,t} \times \ln Q_{i,t} + \sum_{j=1}^{2}\omega_j BankSpec_i + \sum_{j=1}^{7}\psi_j Year_t + \sum_{j=1}^{2}\delta_j Macro_{c,t} + \varepsilon_{i,t}\end{aligned} \quad (2)$$

where subscripts *i*, *c* and *t* indicate individual banks, countries and years, respectively; *TC* is total costs (the sum of personnel expenses, other administrative expenses and other operating expenses); *Q* is the banks' single output proxied by total assets; w_j are the price of inputs employed in the production process: *wL* is the price of labour (personnel expenses over total assets), *wK* is the price of physical capital (i.e., other operating expenses over total assets), *wD* is the price of deposits (interest expenses over the sum of total deposits and money market funds). *BankSpec* and *Year* are the dichotomous variables for bank specialization and for each individual year respectively. *Macro* are macroeconomic variables at the country level; ε are robust standard errors clustered at the individual bank level. A pooled OLS regression is used considering all 12 countries over 2005-2012. In addition, we impose the common restrictions of symmetry and homogeneity of degree one in input prices.[8]

From equation (2), marginal costs can be derived as follows:

$$\hat{MC}_{i,t} = \frac{\partial TC_{i,t}}{\partial Q_{i,t}} = \frac{TC_{i,t}}{Q_{i,t}}\left(\hat{\alpha}_1 + \hat{\alpha}_2 \ln Q_{i,t} + \sum_{j=1}^{3} \hat{\gamma}_j \ln w_{j,i,t}\right) \quad (3)$$

Table 2 reports the time-series development of the average Lerner index per country per year. The estimates are in-line with previous studies in terms of trends and magnitude (Buch et al., 2012; Kick and Prieto, 2014; Clerides et al., 2015). Over the period 2005-2012, Austria, Greece, and Spain are the only countries that see a substantial fall in market power. Austria and Spain witness an increase in marginal cost and a coincident decline in the average price charged to customers, while in Greece, although average prices have increased, marginal costs have risen faster. In contrast, in Ireland and Portugal (countries that both experienced substantial banking sector turmoil) we observe an increase in market power. In Ireland, price increased more than marginal cost; in Portugal, both price and marginal costs declined but the latter fell faster. Overall, bank marginal costs have fallen in all countries except for Austria, Greece, Ireland and Spain; prices also generally declined apart from in Greece, Finland and Ireland.

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[8] $\sum_{j=1}^{3} \beta_j = 1$, $\sum_{j=1}^{3} \gamma_j = 0$, and $\forall k \in \{1,3\}: \sum_{j=1}^{3} \beta_{j,k} = 0$

To cross-check the reliability of the Lerner estimates, we estimate the Lerner Index for EU8 countries with at least 80 observations over the period 2005-2012,[9] and compute a separate estimation for EU8 countries over the period 2007-2012 to investigate the dynamics during the crisis period (2008-2012). We also compute an adjusted-Lerner index for credit risk exposure. Namely, we deduct loan impairment charges from total revenues to account for the exposure to credit risk. As further tests of robustness we estimate the efficiency-adjusted Lerner index employed in recent papers (Koetter et al., 2012; Buch et al., 2013). Finally, as in Beck et al. (2013) and Anginer et al. (2014), we employ an instrumental variable approach to deal with potential endogeneity issues associated with estimating the Lerner index.

2.3 Measuring bank risk exposures

We employ multiple measures of bank stability. Our main variable of interest is the overall bank risk of failure computed as the natural logarithm of the Z-Index (Buch et al., 2012; Beck et al., 2013; Forssbæck and Shehzad, 2014). The Z-Index is calculated at the bank level as follows:

$$Z - Index_{i,T} = \frac{ROA_{i,T} + (E_{i,T} / A_{i,T})}{\sigma(ROA_{i,t})} \qquad (4)$$

where subscript *i* indicates individual banks, T the current period and t= {1...T}; *ROA* is the return on assets; *E/A* denotes the equity to total assets ratio; *σ(ROA)* is the standard

[9] Austria, Belgium, France, Germany, Italy, Luxembourg, Portugal and Spain.

deviation of return on assets for bank *i* using a rolling time window.[10] The Z-Index provides a measure of bank soundness because it indicates the number of standard deviations by which returns have to diminish in order to deplete the equity of a bank. A higher Z-Index implies a higher degree of solvency and therefore it gives a direct measure of bank financial stability. We also use the natural logarithm of the Z-index to smooth out higher values of the distribution (Table 3).

< INSERT HERE TABLE 3 >

We also include other risk measures employed in the literature. The liquidity risk measure is constructed as cash and due from banks on total short-term funding. It gives an indication on resources quickly available to cover cash outflows (Gropp et al., 2011). The ratio of loan-loss provisions over total loans provides information on the exposure to credit risk (Jiménez et al., 2013; Kick and Prieto, 2014). The coverage ratio indicates the level of solvency of a bank in terms of available capital compared to non-standard loans. It is constructed as the sum of equity and loan reserves minus non-performing loans, all divided by total assets.

2.4 Measuring government intervention

A number of variables are used to account for the crisis period and government intervention. We first include in the analysis a dummy variable taking the value of 1 for the years 2008

[10] The method employed for the estimation of the standard deviation of return on assets may create autocorrelation. We therefore compute the autocorrelation of the Z-Index at different lags and find that the autocorrelation coefficients show a moderate level of autocorrelation (highest figure is 0.393 for the first lag).

through 2012, 0 otherwise and following Laeven and Valencia (2013) the beginning of the GFC is set as 2008.[11] Moreover, our analysis covers the effects of individual measures undertaken by different governments to safeguard and support troubled banks including capital injections, guarantees, asset relief interventions and liquidity measures using data provided by the European Commission. To avoid comparison problems, we measure the cost of intervention as a percentage of Gross Domestic Product (GDP). Individual government intervention measures are interacted with two dummy variables expressing bank specialization to investigate whether banks with different business models benefited more/or less from various types of state intervention. Moreover, in order to investigate the combined effect of high market power and government intervention over the period 2008-2012, a dummy variable is constructed using the highest decile of the Lerner distribution per year-country in the EU8 countries. In this case, the Lerner index is estimated following Equation (1) for EU8 countries only over the period 2007-2012.[12] The combined effects are explored through the interaction between the government intervention and either this dummy variable or the Lerner index. Table 4 reports the information on the magnitude of the different forms of public intervention to support financial institutions as a percentage of GDP.

< INSERT HERE TABLE 4 >

[11] Laeven and Valencia (2013) do not include Finland within the group of countries that experienced a systemic banking crisis in the period 2007-2011. Nevertheless, we postulate that the period 2008-2012 is systematically different at the European level compared to the previous time period.

[12] To be more specific, the marginal cost is estimated using Equations (2) and (3) for EU8 countries only over the period 2007-2012.

Following Maudos and De Guevara (2007), we estimate a measure of the pecuniary cost/gain of market power in banking. Given that there could be a positive impact of market power for individual bank stability, we posit that the cost of government intervention may be offset by aggregate price mark-ups for various banks or across banking systems. We therefore calculate the following:

$$\frac{Adjusted\ Cost\ /\ Gain_{c,t}}{GDP_{c,t}} = \frac{1}{GDP_{c,t}}\left\{\left[\sum_{i=1}^{n}\left(P^{c}{}_{i,t} - MC^{c}{}_{i,t}\right)\times Q^{c}{}_{i,t}\right] - CostOfGov_{c,t}\right\} \qquad (5)$$

where subscript i, c and t indicate individual banks, countries and years, respectively; GDP is the gross domestic product in a country in a year; n is the total number of individual banks in a country in a year; P is the price of output for each individual bank computed as total revenues over total assets; MC is the Marginal Cost for the individual bank computed as per expression (3); Q is the bank single output (total assets); *CostOfGov* is the total expenditure in millions of euros born by a specific country in a year. Equation (5) summarises the net pecuniary costs/gains that arise due to market power changes at banks compared with the cost of government intervention. Using Equation (5) we are able first to estimate the resources left on the table for the banking sector due to market power. We then compute the net pecuniary gain after discounting the cost of government intervention. A negative value indicates that it is likely that government expenditures are higher in the case of state bailout.

2.5 Other variables

An additional set of variables are considered to investigate the potential effects of the influence of other determinants on the relationship between competition and risk, such as bank-level fundamentals, systemic heterogeneity and environmental determinants.

The bank level-fundamentals relate to financial leverage and size. We endogenise the decision on the level of financial leverage as the liability structure has a crucial effect on the relationship between insolvency risk and banking market power (Freixas and Ma, 2014). The ratio is built as total liabilities to total equity. The size variable is computed as the natural logarithm of bank total assets.

As in Beck et al. (2013), a 'herding' measure is built as the within country standard deviation per year of non-interest income as a share of total assets. It takes into consideration the possible incentives for banks to increase their risk-taking following an increase in competition. The higher the value the more heterogeneous the sources of bank revenue (namely, less herding). In addition, we control for the influence of the macroeconomic environment using the GDP growth rate and the total long term unemployment rate (Jimenez et al, 2013; Forssbæck and Shehzad, 2014). The complete list of variables, data sources and definitions appear in Table 5.

< INSERT HERE TABLE 5 >

Table 6 reports the summary descriptive statistics of the sample and the correlation matrix for the relevant variables only. The Lerner index takes on negative values when marginal costs are higher than average prices, whilst the other variables are positively defined. The Z-index shows a highly right-skewed distribution therefore supporting our decision to take the natural logarithm to smooth the data. It is also worth noting that there exists low correlation between all the pairs of variables.

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3 Identification strategy

Following a standard approach adopted in papers linking bank-fragility and competition (Gropp et al., 2011; Anginer et al., 2014; Forssbæck et al., 2014), we model bank risk taking as a function of bank-, industry- and country- level determinants as described below:

$$Risk_{i,t} = f(Comp_{i,t}, X_{i,c,t}, Gov_{c,t}, K_{i,t}, M_{c,t}) \quad (6)$$

where the subscripts *i*, *c*, *t* denote individual bank, country and time dimensions respectively; *Risk* is a bank risk-taking variable; *COMP* refers to banking competition; *X* are variables of interest to test our additional assumptions (namely the financial crisis period, bank's specialization and market power); *GOV* relates to various types of government intervention; *K* are controls for bank-level fundamentals; and *M* are controls for macroeconomic conditions.

Our identification strategy involves three steps. First, we analyse the relationship among a set of risk measures, market power and a dichotomous variable for the crisis period (taking the value of 1 between 2008 and 2012, 0 otherwise) over the period 2005-2012. Specifically, we analyse the extent of the relationship between financial stability, competition and the crisis period by using the following panel fixed-effects model, in line with the methodology adopted by Forssbæck et al. (2014):

$$Risk_{i,t} = \alpha_i + \beta_1 Comp_{i,t-1} + \beta_2 Crisis_{t-1} + \sum_{j=1}^{2} \delta_j K_{i,t-1}^{j} + \sum_{j=1}^{3} \varphi_j M_{c,t-1}^{j} + \varepsilon_{i,t} \quad (7)$$

where *Risk* are different risk measures (the natural logarithm of the Z-index; liquidity risk; credit risk; and the coverage ratio); *COMP* is the competition indicator measured using the Lerner index; *Crisis* is the dummy variable for the crisis period; *K* are controls for bank-level fundamentals (financial leverage and bank asset size). *M* are controls for macroeconomic conditions (herding measure, GDP growth and the long-term unemployment rate). α_i is the time invariant component of the error. ε indicates robust standard errors clustered at the individual bank level. β, δ and φ are parameters to be estimated. All the regressors are lagged one-year to lessen any simultaneity problems. We estimate the parameters of interest using a within-fixed effects estimator that allows the regressors to be correlated with α_i. The explanatory variables are calculated over the period 2004-2011 to allow for estimation of the lagged relationship. We also run the Hausman's specification test to verify whether the random effects model provides more efficient estimates compared to the fixed effects model.

The second stage of our analysis focuses only on the crisis period (2008-2012) by considering whether government intervention had a differential impact of various bank types (commercial banks, savings banks, cooperative banks). Similar to Beck et al. (2013) and Anginer et al. (2014), we use a pooled OLS model to allow for the introduction of time-invariant variables and specifically bank specialization. Country dummy variables are included to avoid biases caused by omitted country-specific regressors while time dichotomous variables account for time specific effects. The model specification is as follows:

$$Risk_{i,t} = \alpha + \beta_1 Comp_{i,t-1} + \sum_{j=1}^{2} \omega_j BankSpec_i^j + \sum_{w=1}^{4} \lambda_w GovInt_{c,t-1}^w + \\ + \sum_{j=1}^{2}\sum_{w=1}^{4} \zeta_{j,w} BankSpec_i^j \times GovInt_{c,t-1}^w + \sum_{j=1}^{2} \delta_j K_{i,t-1}^j + \gamma_t + \theta_c + \varepsilon_{i,t} \quad (8)$$

where *Risk* is the natural logarithm of the Z-index; *COMP* is the Lerner index; *BankSpec* are two dichotomous variables for bank specialization; *GovInt* indicate the four forms of government intervention: capital injections, guarantees, asset relief and liquidity provision. *K* are controls for bank-level fundamentals; γ are time fixed effects; θ are country fixed effects; ε indicates the robust standard errors clustered at the individual bank level. α, β, ω, λ, ζ, δ are parameters to be estimated. In the pooled OLS framework, the error term is uncorrelated with explanatory variables. These are calculated over the period 2007-2011 to allow for the estimation of lagged relationships.

The third stage of our analysis focuses on competition by analysing whether banks with the highest market power have benefited more from government intervention. In view of the theoretical predictions of Martinez-Miera and Repullo (2010), we include a dummy variable for banks with the highest market power in a specific country in a specific year to investigate the possibility of non-linearity between competition to bank stability. The pooled-OLS model specification is as follows:

$$Risk_{i,t} = \alpha + \beta_1 Comp_{i,t-1} + \beta_2 HighMp_{i,t-1} + \left[\sum_{j=1}^{4} \left(\lambda_j + \zeta_j HighMp_{i,t-1} \right) \times GovInt_{c,t-1}^j \right] + \\ + \sum_{j=1}^{2} \delta_j K_{i,t-1}^j + \gamma_t + \theta_c + \varepsilon_{i,t} \quad (9)$$

where *Risk* is the natural logarithm of the Z-index; *COMP* is the Lerner index; *HighMP* is a dummy variable for the banks with the highest market power; *GovInt* are the four forms of government intervention; *K* are controls for bank-level fundamentals; γ are time fixed effects; θ are country fixed effects; ε indicates robust standard errors clustered at the individual bank level; α, β, λ, ζ, δ are parameters to be estimated. The explanatory variables are calculated for EU8 countries over the period 2007-2012 to allow for the estimation of the lagged relationship.

4 Results

Using panel fixed effects and pooled OLS models we investigate the relationship between individual bank stability, competition and government intervention. First, we relate a set of risk measures to the Lerner index and a dummy variable for the crisis period. We then introduce government intervention and bank's specialization. We further explore whether banks with the highest market power have benefited more from the support of national governments and estimate the country net pecuniary gain/loss.

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Table 7 shows the results of our base regressions. Market power is positively associated with bank stability (Z-score and the coverage ratio) and negatively linked to liquidity and credit risk exposures. This finding is of particular interest to regulators and policy makers in the light of the unprecedented government intervention witnessed in Europe during the financial crisis. Competition is associated with higher liquidity risk: when the mark-up over marginal cost is higher, the opportunity-cost of liquid assets is also higher. In contrast with the theoretical predictions of Boyd and de Nicolò (2005) and in-line with earlier empirical work (Demsetz et al., 1996; Salas and Saurina, 2003), we find that higher market power is associated with lower levels of provisioning and higher coverage ratios for non-performing loans. As expected, over the crisis period, banks experienced an increase in their overall risk of insolvency compared to the previous period (2005-2007) as denoted by the negative value in the dummy variable for the crisis (Table 7, Column 1). There is also a fall in the level of provisioning and the liquidity positions of banks.

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In the second step, we turn to bank specialization and measures of the impact of government intervention (Table 8). Between 2008 and 2012 cooperative and savings banks are relatively safer compared to commercial banks and asset relief has been effective in shoring up individual bank stability. The estimations provide other interesting results. First, we find negative statistical significance for liquidity measures (Column 5, Table 8). This suggests that liquidity injections do not improve overall solvency problems. Second, only savings banks appear to benefit from enhanced stability due to the extension of guarantees whereas evidence is inconclusive for cooperative banks and all banks in general. Asset relief measures overall have a positive effect on individual bank stability and for savings and cooperative banks the impact was higher, while for commercial banks asset relief appears to increase fragility.

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Results from the estimation including a dummy variable for banks with the highest market power show consistently greater risks (Table 9). Across all the estimations we find a negative sign for the coefficient of the high market power variable and strong statistical significance. Recapitalisation measures, guarantees and asset relief measures are all positively and generally significantly related to bank stability. Moreover, liquidity aid is negatively associated to overall bank solvency. Nonetheless, when we consider the combined effect with market power (Table 9, Column 4 and 9), the effect is positive suggesting that government intervention through liquidity provision should be targeted at banks with greater market power.

To confirm the non-monotonic relationship existing between market power and individual bank stability, we use quantile regression to discern the conditional value of individual bank stability given bank market power. Results reported in Table 10 show that the conditional quantile treatment effects of market power on stability are statistically significant and positive up to the 6^{th} decile; it then turns statistically insignificant for the 7^{th} decile and switches sign for the highest Z-index deciles.[13] These findings, together with the results in Table 9, have important policy implications because they implicitly recognize that market power is beneficial for bank stability up to a point – namely up until the sixth decile (value of the Z-Index between 95 and 140) of the Z-index distribution.

< INSERT HERE TABLE 10 >

[13] We turn to the distribution of the Z-index as we are interested in the threshold value that it would be difficult to discern using the logarithmic transformation. Nevertheless, we run the same analysis using the natural logarithm of the Z-Index and the results, available upon request from the authors, remain qualitatively the same.

We compute the net pecuniary cost/gains using Equation (5) and the results show that over the period 2008-2012 in all the countries banks enjoy a positive aggregate mark-up (Table 11, Panel A). When we account for the cost of bailing-out the banking sector, countries such as Ireland and Greece experience a negative cost/gain in some years meaning that the surplus associated with enhanced market power are outweighed by the cost of government interventions (Table 11, Panel B). This is true also if we consider the cumulative differential over the period 2008- 2012). [14]

< INSERT HERE TABLE 11 >

We also perform various robustness checks.[15] First we investigate whether Equations (7-9) are subject to misspecification or measurement errors. An unbalanced panel data sample may suffer from survivorship bias and so we estimate Equations (7-9) using two different samples: a balanced sample with all the banks with all observations per year and a second sample with banks that survived until 2012 only. This allows us to rule out the alternative that only the safest banks survived or that government intervention is effective as we are considering only institutions that survived. Moreover, because Germany is the most represented country in terms of the number of banks in the sample (62%) and recent literature has shown a positive relationship between risk and competition in German banking (Buch et

[14] The gains associated with increases in market power are likely to be understated in our analysis due to the low number of sample banks in some countries. Second, since government intervention is often at a point in time (contingent and not protracted over time), gains from market power are garnered over time, an accurate measurement of the trade-off should take into consideration at least the time window between two subsequent banking crises.

[15] Results are available from the authors upon request.

al., 2013), the results may be driven by German data. We therefore estimate the Lerner index by excluding German banks and obtain the results for Equations (7-9) using this sub-sample.

We also consider alternative approaches to compute the Lerner and the Z-indexes. We follow the approach proposed by Koetter et al. (2012) and compute a Lerner index adjusted for efficiency scores. In addition, we also estimate an adjusted Lerner index to account for the credit risk exposure of each individual bank. As noted in Forssbæck and Shehzad (2014) for lending rates, asset quality is not reflected in the calculation of the average price of the output therefore the risk premium is not considered in the computation of the market power. We therefore estimate Equation (1) by subtracting from the numerator credit provisions. Finally, we compute the Z-index following Yeyati and Micco (2007) where in Equation (4) average ROA[16] is substituted for current ROA.

The results of the robustness checks support our previous findings providing stronger evidence for the relationship among bank soundness, competition, market turmoil and government intervention.

5 Controlling for Endogeneity

We control for endogeneity concerns arising from reverse causality. In the context of the research design used in this paper, we argue that it is not reasonable to assume a feedback effect going from risk-taking to competition. This is because competition estimates predate banks' risk-taking for years: it is rational to expect that banks' can control and fix their own

[16] The average ROA is computed using all the available information up to the current period, i.e. t= {1…T}.

asset allocation decisions (so their risk exposure) based on various factors, including the degree of competition in the industry experienced in the past.

Endogeneity arising from omitted variables, however, could be a problem. We argue that this may potentiality exist, despite including a number of control variables in our main regressions and, especially, firm-fixed effects (Equation 7). As such, we employ an instrumental variable approach using the GMM estimator to address potential endogeneity problems. Following Anginer et al. (2014) and Beck et al. (2013), we use three different instruments. First, we instrument competition by using the two-year lagged Lerner Index. Second, we use one year lagged credit growth because the lagged year-on-year growth in net loans is likely to be correlated to competitive conditions but not to current risk-taking decisions. Third we employ the cost-income ratio in a typical setting where bank concentration, hence competition, is endogenously driven by bank efficiency (Demsetz, 1973; Peltzman, 1977) but does not obviously relate to risk decisions.

< INSERT HERE TABLE 12 >

We report in Table 12 the results from the first and the second stage regressions when all the instruments are concurrently used in the first-stage regression.[17] Columns (1), (3), (5), (7), (9), and (11) report the results from the first-stage estimations, whilst columns (2), (4), (6), (8), (10) and (12) the estimations from the second stage regression. Overall, the results lend support to our major findings regarding the effects of competition and government aid on bank fragility.

[17] In our estimation approach, we first test in the case of exactly identified Lerner index and then test the results in case of overidentified Lerner index. We report in Table 12 the estimations for the latter, those from the former are available from the authors upon request.

6 Conclusions

Understanding the competition-stability nexus is important in terms of gauging the resilience of banking sectors. This is particularly true at times of crisis when tax-payers money is used to rescue and stabilise distressed credit institutions.

We investigate the extent of the relationship between market power and stability in Eurozone countries (EU12) over the period 2005-2012 and find a positive relationship between market power and financial stability (up to a certain level of market power) and also that bank's specialization is significantly related to individual bank stability. Capital injections, guarantees and asset relief measures increase individual bank soundness. Liquidity measures appear to decrease bank stability but this effect is reversed when liquidity aid is combined with market power.

We compute an adjusted gain/loss function where we explicitly compare the cost of bailouts against the systemic gains associated with increased price-marginal cost makups (higher market power). We advocate that a cost-benefit approach to gauge the impact of state intervention in the banking sector should take into account the extra-profits associated with increased market power as well as the cost of government intervention. High market power may be justified if it is associated with extra-capital buffers to absorb systemic shocks. The gains from increased market power may lower or compensate for the expenditures of government intervention. The policy target should be close or around zero to allow for a safety buffer in case of systemic banking crises. We find that this is not the case for all EU12 countries where the mark-up is positive over the crisis period (except for Greece and Ireland).

Our results have various limitations that are meaningful starting points for future research. First, different factors should be considered to find the right balance between allowing a moderate mark-up in the banking sector and the likelihood that bailouts should be of increased magnitude. Second, further work should consider the broader costs associated with banking crises as the immediate bailout expenses are likely to understates total societal costs (Boyd et al., 2005; Laeven and Valencia, 2013). Third, reductions in outputs associated with enhanced market power are not considered in our analysis and this could influence the pecuniary gains/losses associated with the crises. All the aforementioned areas are worthy of future investigation.

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Table 1

PANEL A: Distribution of banks by specialization and calendar year

This table presents the distribution of banks by specialization and year over the sample period (2005-2012). Cooperative banks represent 61% of the sample observations, savings banks 25% and commercial banks 14%. Source: Data from Bankscope after data cleansing.

Specialization	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Commercial Banks	294	313	324	326	353	358	380	361	2,709
Cooperative Bank	1,446	1,473	1,474	1,464	1,457	1,469	1,478	1,469	11,730
Savings Bank	524	530	542	551	597	633	656	641	4,674
Total	2,264	2,316	2,340	2,341	2,407	2,460	2,514	2,471	19,113

PANEL B: Distribution of banks by country and calendar year

This table presents the distribution of banks by country and year over the sample period (2005-2012). Note the lower frequency of the sample data over the period 2005-2004. Moreover, there are four countries (Finland, Greece, Ireland and the Netherlands) with very few bank-year observations. Banks in Austria, Germany and Italy account for 89% of the sample. Source: Data from Bankscope.

Country	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Austria	193	205	206	192	195	198	199	192	1,580
Belgium	19	19	17	19	20	20	19	16	149
Finland	1	0	2	2	3	5	8	8	29
France	89	88	90	91	88	97	106	98	747
Germany	1,401	1,425	1,439	1,439	1,483	1,517	1,554	1,548	11,806
Greece	3	3	3	3	3	3	3	3	24
Ireland	1	1	1	1	2	4	4	3	17
Italy	426	434	445	450	452	465	472	462	3,606
Luxembourg	42	46	51	51	51	50	51	48	390
Netherlands	4	4	7	7	10	11	11	12	66
Portugal	7	10	12	13	13	14	13	13	95
Spain	78	81	67	73	87	76	74	68	604
Total	2,264	2,316	2,340	2,341	2,407	2,460	2,514	2,471	19,113

Table 2

Time-series evolution of the Lerner Index

This table reports the time-series development of the average Lerner Index per country per year. The last two columns summarise the difference between the average Lerner Index in year 2012 and reference years 2005 and 2007, respectively. *, **, and *** represent statistical significance in the mean values of Lerner Index in the two years at 10%, 5%, and 1% two tailed level, respectively. Source: Own calculation using data from Bankscope.

Country	2005	2006	2007	2008	2009	2010	2011	2012	2012-2005	2012-2007
Austria	0.225	0.221	0.209	0.175	0.197	0.215	0.227	0.187	-0.039 **	-0.023 *
Belgium	0.227	0.229	0.182	0.185	0.281	0.277	0.247	0.259	0.032	0.077
Finland	-0.196	.	0.170	0.093	0.287	0.256	0.241	0.246	0.442	0.076
France	0.235	0.243	0.239	0.204	0.261	0.284	0.243	0.248	0.013	0.009
Germany	0.193	0.230	0.179	0.170	0.210	0.248	0.250	0.241	0.049 ***	0.062 ***
Greece	0.277	0.319	0.324	0.267	0.332	0.299	0.172	0.132	-0.145	-0.192
Ireland	0.325	0.150	0.160	0.172	0.332	0.483	0.454	0.422	0.096	0.261
Italy	0.217	0.256	0.251	0.221	0.220	0.198	0.229	0.287	0.070 ***	0.036 ***
Luxembourg	0.246	0.235	0.213	0.201	0.270	0.307	0.285	0.296	0.050	0.084 **
Netherlands	0.172	0.131	0.117	0.172	0.204	0.361	0.244	0.236	0.063	0.119
Portugal	0.166	0.220	0.278	0.187	0.243	0.224	0.202	0.267	0.100	-0.011
Spain	0.295	0.301	0.288	0.254	0.283	0.215	0.202	0.185	-0.110 ***	-0.102 ***
EU12	0.206	0.237	0.202	0.185	0.218	0.238	0.243	0.246	0.039 ***	0.044 ***

Table 3

Time-series evolution of the Z-Index

This table reports the time-series development of the average Z-Index per country per year computed as the sum of the mean Return On Assets in a country at time *t*, and the mean Capital To Assets in country at time *t*, all divided by the standard deviation of the Return On Assets in a country at time *t* (see the World Bank Global Financial Development database for a detailed explanation of the method). The last two columns summarise the difference between the average Z-Index in year 2012 and reference years 2005 and 2007, respectively. In this case we do not run the test of difference in means because we compute the Z-Score using country-level aggregates hence we should compute and integrate the test for the difference in means using the elementary components. Source: Own calculation using data from Bankscope.

Country	2005	2006	2007	2008	2009	2010	2011	2012	2012-2005	2012-2007
Austria	5.288	8.032	12.203	7.054	2.537	1.757	3.937	3.072	-2.216	-9.131
Belgium	3.839	10.032	16.998	4.947	6.205	7.570	3.353	8.343	4.503	-8.656
Finland	-14.235	.	12.637	69.169	17.389	21.132	45.257	26.880	41.115	14.243
France	10.010	9.078	11.644	7.457	8.902	0.970	9.038	9.391	-0.619	-2.253
Germany	6.017	17.780	18.962	6.978	5.305	8.388	11.108	12.457	6.440	-6.505
Greece	18.720	29.484	27.647	24.176	39.823	16.267	14.024	7.195	-11.525	-20.452
Ireland	37.467	28.683	34.621	150.185	164.319	73.162	6.761	9.304	-28.162	-25.317
Italy	22.081	24.175	18.049	24.186	21.395	7.791	6.459	17.132	-4.949	-0.917
Luxembourg	7.423	3.353	3.445	9.670	5.563	12.078	7.965	11.246	3.823	7.801
Netherlands	11.006	2.834	8.672	2.518	3.409	10.463	3.611	3.221	-7.785	-5.451
Portugal	12.296	16.977	20.987	6.810	12.489	8.912	6.979	22.348	10.052	1.362
Spain	15.308	4.596	26.483	18.528	5.660	10.136	32.181	3.241	-12.066	-23.242
EU12	9.512	16.964	17.767	10.835	8.481	7.724	10.129	12.220	2.708	-5.547

Table 4

Government intervention measures as percentage of national GDP

This table reports the data on the different forms of public intervention as a percentage of national Gross Domestic Product. Source: European Commission, DG Competition, State Aid Scoreboard available at http://ec.europa.eu/competition/state_aid/scoreboard/financial_economic_crisis_aid_en.html.

	Recapitalisation measures					Guarantees					Asset relief					Liquidity measures other than guarantees				
Country	**2008**	**2009**	**2010**	**2011**	**2012**	**2008**	**2009**	**2010**	**2011**	**2012**	**2008**	**2009**	**2010**	**2011**	**2012**	**2008**	**2009**	**2010**	**2011**	**2012**
Austria	1.00%	2.13%	0.21%	0.00%	0.64%	0.86%	5.58%	6.80%	5.69%	3.82%	0.00%	0.14%	0.00%	0.00%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%
Belgium	4.86%	1.04%	0.00%	0.00%	0.77%	2.60%	13.87%	9.29%	7.17%	12.17%	0.00%	2.29%	0.00%	0.00%	2.50%	0.00%	0.00%	0.00%	0.00%	0.00%
Finland	0.00%	0.00%	0.00%	0.00%	0.00%	0.06%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
France	1.36%	0.49%	0.00%	0.00%	0.13%	0.44%	4.86%	4.74%	3.59%	2.63%	0.00%	0.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Germany	1.48%	1.37%	0.27%	0.14%	0.04%	0.75%	5.61%	5.28%	1.35%	0.38%	0.39%	1.03%	1.80%	0.00%	0.02%	0.14%	0.00%	0.19%	0.00%	0.00%
Greece	0.00%	1.59%	0.00%	1.20%	15.97%	0.00%	0.63%	11.59%	26.17%	32.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.19%	1.79%	3.00%	3.09%	1.42%
Ireland	0.00%	6.73%	22.91%	10.55%	0.00%	97.05%	173.81%	127.49%	70.64%	51.04%	0.00%	0.00%	1.69%	0.00%	0.00%	0.00%	0.00%	0.00%	0.05%	0.43%
Italy	0.00%	0.27%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.69%	5.47%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Luxembourg	7.50%	0.26%	0.00%	0.00%	0.00%	1.21%	4.36%	3.41%	2.78%	4.34%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.36%	0.34%	0.18%	0.12%
Netherlands	3.04%	0.00%	0.82%	0.00%	0.00%	0.14%	6.31%	6.91%	5.51%	3.22%	0.00%	0.88%	0.00%	0.00%	0.00%	2.22%	5.33%	1.34%	0.62%	0.27%
Portugal	0.00%	0.00%	0.00%	0.00%	4.08%	0.71%	3.12%	2.89%	5.00%	10.04%	0.00%	0.00%	1.80%	0.00%	0.00%	0.63%	2.23%	2.21%	1.45%	0.11%
Spain	0.00%	0.12%	0.89%	0.79%	3.85%	0.00%	3.44%	5.25%	5.75%	6.86%	0.00%	0.00%	0.27%	0.00%	2.43%	0.21%	1.84%	1.78%	1.26%	0.33%
EU12	1.25%	1.11%	0.25%	0.13%	0.25%	0.64%	4.58%	4.55%	2.03%	2.19%	0.24%	0.67%	1.13%	0.00%	0.10%	0.10%	0.11%	0.20%	0.05%	0.02%

Table 5

Variables definition

This table defines the variables included in the analysis.

Variables	Symbol	Definition and calculation method
Dependent variables		
Z-index	ZSCORE	Computed as the sum of the current period t return on assets (ROA) and the equity ratio (equity over total assets) divided by the standard deviation of ROA computed for each individual institution (i) using a rolling time window with all the available information up to the current year.
Coverage ratio	CovRatio	Sum of equity and loan reserves minus non-performing loans, all divided by total assets.
Credit risk ratio	LLPTL	Loan-loss provision to total loans.
Liquidity ratio	LIQ	Cash and due from other banks to short-term funding.
Explanatory variables		
Lerner Index	LER	Extent to which market power allows the bank to fix a price (P) above its marginal cost (MC).
High market power	HighMP	Dummy variable that takes the value of one if the bank is in the highest decile of the distribution of the Lerner Index in a country (c) in a year (t). The dummy variable is computed for countries that have more than ten observations in every year over the period 2007-2012.
Crisis period	CRISIS	Dummy variable for the crisis period that takes value of 1 in years 2008-2012, 0 otherwise.
Capital injections	RM	Amount of government recapitalisation measures as percentage of country gross domestic product.
Guarantees	GUAR	Amount of government guarantees measures as percentage of country gross domestic product.
Asset relief	AR	Amount of government asset relief measures as percentage of country gross domestic product.
Liquidity provision	LM	Amount of government liquidity provision measures as percentage of country gross domestic product.
Control variables		
Size	ln_TOTA	Natural logarithm of total assets.
Financial leverage	FL	Total liabilities to total equity.
Herding measure	HERD	This is a measure of banking industry heterogeneity computed as the within country standard deviation of the percentage non-interest income (with respect to total assets) per year (t) and per country (c).
Macroeconomic indicators	MACRO CONTROLS	Set of macroeconomic indicators: annual percentage change in Gross Domestic Product (GDP_gro); long-term unemployment (12 months and more) in millions of people looking for a paid job (Lt_unemp).

Table 6

PANEL A: Descriptive statistics of the main variables of interest

Panel A presents the descriptive statistics of the main variables of interest included in the estimation. Panel B presents the univariate correlation statistics between the main variables of interest. * represents 10% statistical significance level.

Variable	**Symbol**	**Obs**	**Mean**	**Std. Dev.**	**Median**	**p10**	**p90**	**Min**	**Max**
Z-Score	ZSCORE	19,113	207.367	490.950	65.018	16.050	442.137	2.926	4,315.308
Coverage ratio	CovRatio	19,113	0.082	0.073	0.067	0.042	0.120	0.004	0.607
Credit Risk	LLPTL	19,113	0.006	0.011	0.006	-0.001	0.016	-0.037	0.047
Liquidity Risk	LIQ	19,113	0.048	0.050	0.040	0.009	0.084	0.000	0.403
Lerner Index	LER	19,113	0.222	0.107	0.226	0.110	0.338	-0.245	0.513
Financial leverage	FL	19,113	13.431	6.522	12.757	6.502	20.311	0.529	44.968
Size	ln_TOTA	19,113	13.361	1.442	13.314	11.579	15.208	6.105	20.996

PANEL B: Correlation matrix of the main variables of interest

Variable	**ZSCORE**	**CovRatio**	**LLPTL**	**LIQ**	**LER**	**FL**	**ln_TOTA**
Z-Score	1.000						
Coverage ratio	-0.0342*	1.000					
Credit Risk	0.0391*	0.006	1.000				
Liquidity Risk	0.0619*	0.1194*	0.0399*	1.000			
Lerner Index	-0.0360*	-0.0005	0.0600*	-0.1051*	1.000		
Financial leverage	0.0451*	-0.5556*	0.0535*	0.0588*	-0.1000*	1.000	
Size	-0.0456*	-0.3145*	-0.0508*	-0.0390*	0.3923*	0.4079*	1.000

Table 7

Link between bank stability, competition and the crisis period (2008-2012) in Eurozone banks

This table reports the results from the estimation of Equation (7). We use a panel fixed effects model with robust standard errors clustered at the individual bank level. The sample includes European banks in EU12 over the period 2005-2012. Notice that the total number of observations (17,874) reflects the unbalanced nature of the data set ($T_i \neq T$ for some banks). We report the p-value of the Hausman test (row Hausman test - p-value), in which the null hypothesis is that the random effects estimator is both efficient and consistent. Rho is the intraclass correlation; the higher the better is the fitting of the model. *, **, and *** represent statistical significance at 10%, 5%, and 1% two tailed level, respectively. Standard errors appear in parentheses.

VARIABLES	**(1) lnZ**	**(2) CovRatio**	**(3) LLPTL**	**(4) LIQ**
LER_{t-1}	0.800***	0.020*	-0.006***	-0.027***
	(0.105)	(0.011)	(0.002)	(0.010)
$CRISIS_{t-1}$	-0.443***	0.000	-0.003***	-0.009***
	(0.020)	(0.002)	(0.000)	(0.001)
ln_TOTA_{t-1}	-0.405***	-0.025***	0.001	-0.000
	(0.050)	(0.005)	(0.001)	(0.002)
FL_{t-1}	-0.006*	-0.002***	0.000*	0.000
	(0.003)	(0.000)	(0.000)	(0.000)
$HERD_{t-1}$	-0.002	-0.000*	-0.000***	-0.000
	(0.004)	(0.000)	(0.000)	(0.000)
GDP_gro_{t-1}	-0.018***	-0.000***	-0.000***	-0.000
	(0.001)	(0.000)	(0.000)	(0.000)
$Unemp\_all_{t-1}$	-0.023***	-0.002***	0.001***	0.001***
	(0.006)	(0.001)	(0.000)	(0.000)
Constant	10.100***	0.457***	-0.009	0.048
	(0.663)	(0.071)	(0.009)	(0.032)
Bank FE	Yes	Yes	Yes	Yes
Observations	17,874	17,874	17,874	17,874
Hansen test (p-value)	0.000	0.000	0.000	0.000
rho	0.837	0.876	0.431	0.692
Number of banks	2,621	2,621	2,621	2,621

Table 8

Link between bank stability, competition, business model and government intervention in Eurozone banks

This table reports the results from the estimation of Equation (8). We use a pooled ordinary least squares regression with robust standard errors clustered at the individual bank level. We control for country and time fixed effects. Bank controls include size and financial leverage. The sample comprises European banks in EU12 over the period 2008-2012. Notice that the total number of observation (11,874) reflects the unbalanced nature of the data set ($T_i \neq T$ for some banks). *, **, and *** represent statistical significance at 10%, 5%, and 1% two tailed level, respectively. Standard errors appear in parentheses.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	**lnZ**	**lnZ**	**lnZ**	**lnZ**	**lnZ**
LER_{t-1}	1.209***	1.185***	1.178***	1.196***	1.170***
	(0.180)	(0.181)	(0.183)	(0.180)	(0.182)
Cooperative	0.552***	0.546***	0.527***	0.570***	0.561***
	(0.068)	(0.071)	(0.067)	(0.071)	(0.070)
Savings	1.002***	0.874***	0.891***	1.021***	1.017***
	(0.073)	(0.077)	(0.071)	(0.075)	(0.074)
RM_{t-1}	0.010				0.009
	(0.012)				(0.011)
Cooperative_RM_{t-1}	0.018				
	(0.021)				
Savings_RM_{t-1}	0.031				
	(0.024)				
$GUAR_{t-1}$		0.003			0.006
		(0.006)			(0.006)
Cooperative_$GUAR_{t-1}$		0.004			
		(0.008)			
Savings_$GUAR_{t-1}$		0.052***			
		(0.009)			
AR_{t-1}			-0.126**		0.056***
			(0.056)		(0.019)
Cooperative_AR_{t-1}			0.153**		
			(0.060)		
Savings_AR_{t-1}			0.331***		
			(0.062)		
LM_{t-1}				-0.043	-0.092***
				(0.063)	(0.033)
Cooperative_LM_{t-1}				-0.101	
				(0.100)	
Savings_LM_{t-1}				-0.024	
				(0.101)	
Constant	3.213***	3.170***	3.264***	3.321***	3.290***
	(0.222)	(0.223)	(0.221)	(0.228)	(0.224)
Country FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes
Observations	11,874	11,874	11,874	11,874	11,874
R-squared	0.288	0.290	0.291	0.288	0.288
Number of Banks	2579	2579	2579	2579	2579

Table 9

Link between bank stability, competition and government intervention in Eurozone banks

This table reports the results from the estimation of Equation (9). We use a pooled ordinary least squares regression with robust standard errors clustered at the individual bank level. Equation (9) is estimated for EU8 over the period 2007-2012. We control for country and time fixed effects. Bank controls include size and financial leverage. The sample comprises European banks in EU8 over the period 2008-2012. Notice that the total number of observation (11,786) reflects the unbalanced nature of the data set ($T_i \neq T$ for some banks). *, **, and *** represent statistical significance at 10%, 5%, and 1% two tailed level, respectively. Standard errors appear in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	**lnZ**	**lnZ**	**lnZ**	**lnZ**	**lnZ**	**lnZ**	**lnZ**	**lnZ**	**lnZ**
LER_{t-1}	1.699***	1.666***	1.657***	1.679***	1.659***	1.263***	1.234***	1.245***	1.140***
	(0.204)	(0.206)	(0.207)	(0.204)	(0.208)	(0.194)	(0.214)	(0.196)	(0.206)
$HighMP_{t-1}$	-0.372***	-0.354***	-0.362***	-0.392***	-0.377***				
	(0.061)	(0.062)	(0.058)	(0.062)	(0.061)				
RM_{t-1}	0.030**				0.023**	0.032			
	(0.012)				(0.012)	(0.024)			
$HighMP\_RM_{t-1}$	-0.016								
	(0.040)								
$GUAR_{t-1}$		0.023***			0.017**		0.026**		
		(0.005)			(0.007)		(0.010)		
$HighMP\_GUAR_{t-1}$		-0.010							
		(0.012)							
AR_{t-1}			0.067***		0.027			0.126***	
			(0.015)		(0.023)			(0.048)	
$HighMP\_AR_{t-1}$			-0.031						
			(0.048)						
LM_{t-1}				-0.114***	-0.114***				-0.242***
				(0.043)	(0.042)				(0.085)
$HighMP\_LM_{t-1}$				0.222*					
				(0.129)					
Ler_RM_{t-1}						-0.060			
						(0.099)			
Ler_GUAR_{t-1}							-0.011		
							(0.042)		
Ler_AR_{t-1}								-0.225	
								(0.187)	
Ler_LM_{t-1}									0.559*
									(0.295)
Constant	3.044***	2.982***	3.059***	3.142***	2.430***	3.218***	3.154***	3.210***	3.340***
	(0.203)	(0.204)	(0.203)	(0.204)	(0.306)	(0.207)	(0.209)	(0.206)	(0.208)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,786	11,786	11,786	11,786	11,786	11,786	11,786	11,785	11,786
R-squared	0.237	0.238	0.237	0.237	0.238	0.230	0.230	0.231	0.230
Number of Banks	2552	2552	2552	2552	2552	2552	2552	2552	2552

Table 10

Conditional quantile treatment effects of market power on individual bank stability

This table presents the results of the quantile regression that expresses the quantiles of the conditional distribution of the natural logarithm of the Z-Index as linear functions of the Lerner Index. *, **, and *** represent statistical significance at 10%, 5%, and 1% two tailed level, respectively. Standard errors, on the basis of 100 bootstrap replications, appear in parentheses.

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Z-Index	**q10**	**q20**	**q30**	**q40**	**q50**	**q60**	**q70**	**q80**	**q90**
LER	25.663***	27.386***	30.875***	30.381***	34.808***	24.234**	21.720	-66.213*	-445.513***
	(1.226)	(3.180)	(3.788)	(4.281)	(6.925)	(11.809)	(17.234)	(38.528)	(124.589)
Constant	10.626***	21.091***	30.729***	42.793***	57.295***	83.101***	124.133***	225.502***	546.032***
	(0.360)	(0.781)	(0.967)	(1.017)	(1.556)	(2.690)	(3.881)	(8.965)	(31.451)
Observations	19,113	19,113	19,113	19,113	19,113	19,113	19,113	19,113	19,113

Table 11

PANEL A: Time series development of the pecuniary cost/gain of market power in banking (% GDP)

Panel A reports the time series development at country level of the cost/gain defined in Equation (5) as percentage of country GDP for EU12 over the period 2008-2012.

Year	Austria	Belgium	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	EU12
2008	5.91%	2.01%	3.17%	12.66%	0.26%	2.45%	5.93%	1.08%	1.58%	2.25%	12.09%
2009	6.05%	2.05%	3.25%	13.19%	0.26%	2.72%	6.14%	1.12%	1.61%	2.33%	12.52%
2010	5.86%	1.96%	3.16%	12.55%	0.27%	2.79%	6.02%	1.10%	1.57%	2.34%	11.76%
2011	5.59%	1.89%	3.06%	12.00%	0.29%	2.71%	5.91%	1.07%	1.58%	2.33%	11.25%
2012	5.45%	1.86%	3.02%	11.74%	0.31%	2.69%	5.96%	1.07%	1.64%	2.37%	11.02%

PANEL B: Time series development of the net pecuniary cost/gain of market power in banking (% GDP)

Panel B reports the time series development at country level of the net pecuniary cost of market power in banking defined in Equation (5) as percentage of country GDP. Notice that the cumulative net pecuniary cost the period 2008-2012 is negative for Ireland and Greece only.

Year	Austria	Belgium	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	EU12
2008	5.91%	1.98%	3.17%	12.48%	0.26%	2.39%	5.93%	1.01%	1.57%	2.24%	11.97%
2009	5.96%	1.85%	3.24%	12.95%	0.23%	-0.15%	6.14%	0.31%	1.58%	2.31%	12.35%
2010	5.17%	1.78%	3.16%	11.00%	0.23%	-18.38%	6.01%	0.64%	0.22%	2.28%	10.70%
2011	5.26%	1.55%	3.06%	11.63%	0.05%	-2.54%	5.90%	0.84%	1.02%	1.81%	10.96%
2012	4.45%	0.88%	2.89%	11.34%	-4.68%	2.10%	5.95%	0.88%	0.75%	-1.47%	10.55%
2012-2008	26.76%	8.05%	15.53%	59.40%	-3.91%	-16.58%	29.93%	3.68%	5.13%	7.18%	56.54%

Table 12

Instrumental variable regressions

This table presents the results of the instrumental variable regression. For the sake of space, we report the results for the estimations of a limited number of specifications, specifically Column (1) in Table 7, Column (5) in Table 8 and Columns (6) to (9) in Table 9. Following Anginer et al. (2014) and Beck et al. (2013), we employ as instruments for the Lerner Index the two-year lagged Lerner index, one-year lagged loan growth and one-year lagged cost-income ratio. Results from the first-stage regression appear in Columns (1), (3), (5), (7), (9), and (11). The row Ler_{t-1} reports the coefficients for the fitted values of the Lerner Index obtained from the first-stage regression. Results from the second-stage regression appear in Columns (2), (4), (6), (8), (10), and (12). Estimates are obtained using the generalized method of moments (GMM) estimator with robust standard errors clustered at the individual bank level. In Columns (6), (8), (10) and (12) the instrumented variables are the Lerner Index and the interactions between the Lerner Index and capital injections, guarantees, asset relief and liquidity provision, respectively. Columns (5), (7), (9) and (11) presents the first-stage results for the Lerner Index only. For the sake of space, we do not present the results of first-stage regressions for the interactions. The row Adjusted R-squared presents the result of the goodness-of-fit of the instrumental variables in the first-stage regression. The higher the better are the instruments in explaining the Lerner Index. The row C (difference-in-Sargan) presents the results of the test of endogeneity of the instruments. Under the null hypothesis the instruments are exogenous. Robust F presents the results of the F statistic. The higher the value the better the goodness-of-fit. Hansen's J presents the results for Hansen's J statistic. Under the null hypothesis, the over-identifying restrictions are valid.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	**LER_{t-1}**	**lnZ**	**LER_{t-1}**	**lnZ**	**LER_{t-1}**	**lnZ**	**LER_{t-1}**	**lnZ**	**LER_{t-1}**	**lnZ**	**LER_{t-1}**	**lnZ**
LER_{t-1}		0.697**		1.325***		1.322***		1.418***		1.584***		1.196***
		(0.309)		(0.283)		(0.247)		(0.270)		(0.239)		(0.332)
$CRISIS_{t-1}$	0.009***	-0.093***										
	(0.001)	(0.021)										
Cooperative			-0.003	0.616***								
			(0.004)	(0.071)								
Savings			-0.002	1.010***								
			(0.003)	(0.075)								
RM_{t-1}			-0.000	0.006	0.079	-0.015						
			(0.001)	(0.008)	(0.053)	(0.030)						
$GUAR_{t-1}$			0.001**	0.002			0.033*	-0.003				
			(0.000)	(0.003)			(0.017)	(0.012)				
AR_{t-1}			0.028***	0.065***					0.080	0.231		
			(0.003)	(0.016)					(0.065)	(0.262)		
LM_{t-1}			-0.010**	-0.081**							0.140	-0.268**
			(0.005)	(0.035)							(0.094)	(0.104)
Ler_RM_{t-1}						0.089						
						(0.146)						
Ler_GUAR_{t-1}								0.093*				

VARIABLES	(1) LER$_{t-1}$	(2) lnZ	(3) LER$_{t-1}$	(4) lnZ	(5) LER$_{t-1}$	(6) lnZ	(7) LER$_{t-1}$	(8) lnZ	(9) LER$_{t-1}$	(10) lnZ	(11) LER$_{t-1}$	(12) lnZ
								(0.052)				
Ler_AR$_{t-1}$										0.003		
										(0.067)		
Ler_LM$_{t-1}$												0.662*
												(0.395)
Constant	0.034	4.146***	0.028	3.049***	-0.017	3.070***	-0.056	3.118***	0.005	3.224***	0.010	3.149***
	(0.051)	(0.222)	(0.045)	(0.229)	(0.052)	(0.211)	(0.059)	(0.215)	(0.056)	(0.207)	(0.048)	(0.217)
LER$_{t-2}$	0.527***	-	0.560***	-	0.567***	-	0.583***	-	0.566***	-	0.556***	-
	(0.067)	-	(0.059)	-	(0.054)	-	(0.053)	-	(0.058)	-	(0.059)	-
CostIncome$_{t-1}$	-0.148**	-	-0.118*	-	-0.099	-	-0.075	-	-0.108	-	-0.113*	-
	(0.075)	-	(0.061)	-	(0.065)	-	(0.071)	-	(0.070)	-	(0.066)	-
LoanGrowth$_{t-1}$	0.015**	-	0.012	-	0.025***	-	0.018**	-	0.015**	-	0.005	-
	(0.006)	-	(0.009)	-	(0.008)	-	(0.008)	-	(0.007)	-	(0.007)	-
Country FE	-	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	-	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	No	No	No	No	No	No	No	No	No	No
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.656	-	0.689	-	0.542	-	0.551	-	0.557	-	0.536	-
C (difference-in-Sargan)	0.067	-	0.154	-	0.636	-	0.023	-	0.011	-	0.095	-
Robust F	757.734	-	633.660	-	-	-	-	-	-	-	-	-
Hansen's J	0.000	-	0.004	-	0.000	-	0.000	-	0.000	-	0.000	-
Observations	15,194	15,194	11,516	11,516	11,370	11,370	11,370	11,370	11,370	11,370	11,370	11,370
Number of banks	2,513	2,513	2,477	2,477	2,440	2,440	2,440	2,440	2,440	2,440	2,440	2,440