Financial stability and competition in the Euro area

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Abstract

The Euro area, the countries that have adopted the euro, is converging some more towards a banking union. Starting from 2014, the European Central Bank will become the single supervisor of the Euro zone biggest banks calling for a more integrated supervision. Despite the on-going process, there are few studies that focus on the relationship between bank stability and competition specifically for this economic block. Does competition affect the stability of Eurozone banks? Does banks' financial stability increase/decrease in case of higher competition? Does the relationship hold in case of a financial crisis? We assess the dynamic relationship between competition and bank soundness for the Eurozone banks over the period 2002-2012. We find that bank stability increases with competition. Nonetheless, we find that during the 2007-2009 financial crisis, higher market power is associated with higher individual bank soundness.

JEL-Classification: C23, G21

Keywords: Bank stability, Eurozone banks, Competition, Generalized Methods of Moments, Financial crisis.

1 Introduction

The recent regulatory developments toward a more integrated European banking market introduce a single supervisor for Eurozone banks. It comes in response to the 2007-2009 financial turmoil and to break the link between troubled banks and complacent national supervisors. On the one hand the international efforts have been coordinated toward the development of a new regulatory framework to control for systemic risks (e.g., Basel Committee's framework on global systematically important banks). On the other hand, there is an apparent need to strengthen the collaboration between national bank supervisors. This is an area that is not sufficiently covered by the existing literature as little is known about the relationship between bank stability and competition explicitly for Euro zone banks only.

The nexus between competition and stability is paramount in many regards. Higher competition is often related to innovation and better prices for customers. Moreover, under a social welfare perspective, it reduces the deadweight loss induced by market power. On the other hand, competition reduces the “charter value” of banks in that causing a more unstable financial system (Allen and Gale, 2004). In addition, recent cross-country evidence on the relationship shows that other features such as market, regulatory and country characteristics play an important role (Beck et al., 2013). Nonetheless, empirical evidence remains elusive and does not focus explicitly on the Euro zone. This is surprising as the economic block appears to be more homogenous since the countries share the same currency.

We estimate competition using the Lerner Index of Monopoly Power, recently used in various studies (Maudos and De Guevara, 2007; Carbò et al., 2009; Turk Ariss, 2010,

Radic et al., 2011, among many others). Market power is computed at individual bank level. We use panel data techniques and Generalized Methods of Moments (GMM), to control for endogeneity and country-specific effects, in order to test whether changes in competition predict variations in bank risk measures. We also control for the impact that various factors at the bank level have on the competition-risk relationship, such as bank-level fundamentals, herding behaviour, macroeconomic variables and the occurrence of the financial crisis. We also test the significance of the relationship between a measure of market structure in the loan market and bank stability.

The remainder of the paper is structured as follows. Section 2 summarizes the literature review and the research hypotheses. The econometric framework, the data and variables appear in section 3. Section 4 discusses the empirical results and robustness checks and section 5 concludes.

2 Literature review and research hypotheses

We empirically assess if an increase in competition is associated with higher instability of Eurozone banks. This topic is largely covered in commercial banking from both theoretical and empirical standpoints.

From a theoretical perspective, there are two views concerning the impact of competition on financial stability. The ‘competition-fragility’ view (among others, Marcus, 1984; Keeley, 1990; Allen and Gale, 2004; Beck et al., 2006; Matsuoka, 2013) argues that higher competition leads to more risk in banking and to the erosion of bank charter value. On the contrary, various papers support the idea that higher competition may transform the

nature of banking and induce banks to become more relationship-oriented (Boot and Thakor, 2000). As such, the 'competition-stability' view (Boyd and De Nicolò, 2005; De Nicolò and Lucchetta, 2009) contends the negative effects of concentration, claiming that the considerable market power of only few banks will cause them to raise the interest rate on loans, which will induce adverse selection (risky projects are financed) and moral hazard (risk shifting), with a negative impact on the stability of the banking system.

Recently there has been a spurt in empirical studies trying to measure the effects of competition and market power on stability. Several works have tested the relationship between banking market structure and risk focusing on credit risk (Hakenes, and Schnabel, 2010; Fiordelisi et al., 2011), interest rate risk (Delis and Kouretas, 2011) or the broader default risk (Repullo, 2004; Schaeck et al., 2009, Berger et al., 2009; Martinez-Miera and Repullo, 2010; Turk Ariss, 2010) providing mixed evidence. For instance, Boyd et al. (2006) and De Nicolò and Loukoianova (2007) show that financial instability increases in lower competitive markets, while Martinez-Miera and Repullo (2010) find opposite evidence (i.e., risk decreases as bank market power increases). Schaeck et al. (2009) analyse banks operating in 45 nations over 1980–2005 and find that more competitive and more concentrated banking systems are less likely to experience a systemic crisis and increase time to crisis. Berger et al. (2009) analyse a large sample of banks in 23 developed countries and observe that, even if an increase in bank market power lead to riskier portfolios, the effect on stability could be offset by a greater franchise value. In an attempt to reconcile the mixed empirical evidence, Beck et al. (2013) show that greater competition is generally associated with larger impact on banks' risk-taking activities in

countries with stricter activity restrictions, more herding in revenue structure, less concentrated banking markets and more generous deposit insurance.

Our paper contributes to the existing literature in several ways. First, we focus on Eurozone banks. Second, similarly to Beck et al. (2013), we investigate the assumption that competition will have a stronger impact on bank stability in more homogeneous banking system (where herding behaviour is more likely). Third, we analyze whether the fundamental nexus holds in case of severe market turmoil. As such, we use as a natural experiment the occurrence of the 2007-2009 financial crisis and provide empirical evidence on the role of market power during an economic downturn.

3 Empirical approach

3.1 Data sources

Bank financial statements are taken from Bureau van Dijk Bankscope database. We restrict our analysis to banks from the twelve countries that adopted the euro on the 1st January 2002 (i.e., Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal and Spain) over the period 2002-2012. The distribution of the banks by year and country is reported in Table 1.

< INSERT HERE TABLE 1 >

We select all types of depository institutions (commercial banks, savings banks and cooperative banks). To avoid duplication, we consider consolidated data where it is possible and unconsolidated data otherwise. We also delete banks for which relevant

information is not available (e.g., total assets). After data cleaning, our final sample consists of almost 22,700 observations for 2,527 individual banks distributed in the twelve countries. Table 2 reports the sample summary statistics of the main variables included in the analysis.

< INSERT HERE TABLE 2 >

Additional information on economic freedom is retrieved from The Heritage Foundation. Country-level data is collected through Eurostat and the World Bank.

3.2 Measuring competition: the Lerner Index

Following recent studies (Maudos and de Guevara, 2007; Casu and Girardone 2009; Turk Ariss, 2010, among many others), we estimate a non-structural measure of competition using the Lerner index of Monopoly Power (*LER*) to derive individual bank's monopoly power. This Index represents the extent to which market power allows firms to fix a price above marginal cost and it is calculated as follows:

$$LER = \frac{p - MC}{p} \qquad (1)$$

where 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 Q is calculated as total revenues (interest plus non-interest income) divided by total assets. Following some recent papers, we estimate the marginal cost using a translog cost function with two inputs, one single output and a time trend. The final specification is as follows:

$$\ln TC = \alpha_0 + \alpha_1 \ln Q + \frac{\alpha_2}{2} \ln Q^2 + \sum_{j=1}^{2} \beta_j \ln P_j + \frac{1}{2} \sum_{j=1}^{2} \sum_{k=1}^{2} \delta_{jk} \ln P_j \ln P_k +$$
$$\frac{1}{2} \sum_{j=1}^{2} \gamma_j \ln Q \ln P_j + \tau_1 T + \frac{\tau_2}{2} T^2 + \tau_3 T \times \ln Q + \sum_{j=1}^{2} \psi_j T \ln P_j + \varepsilon_{it} \qquad (2)$$

where *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; P_1 and P_2 are the price of the inputs employed in the production process: P_1 is the price of labour (i.e., personnel expenses over total assets), and P_2 is the price of physical capital (i.e., other operating expenses over total fixed assets). $\alpha, \beta, \delta, \gamma, \tau, \psi$ are coefficients to be estimated; ε_{it} is the error term. A panel data regression in a fixed effect model is used considering all 12 countries over 2002-2012.

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

$$MC = \frac{TC}{Q} \left[\alpha_1 + \alpha_2 \ln Q + \sum_{j=1}^{2} \gamma_j \ln P_j + \tau_3 T \right] \qquad (3)$$

We calculated the Funding Adjusted LER, as suggested by Maudos and de Guevara, (2007) and Turk Ariss, (2010): specifically, MC are derived from the estimation of the cost function that omits funding costs as one of the inputs. This enables us to account for market power that may have previously been exercised in the deposit market: specifically, by excluding funding costs, we obtain a clean proxy of pricing power that is not affected by market power which had previously originated in the deposit market while raising funds. Moreover, the Lerner Index is estimated at bank level, therefore the evolution of market power is analysed across banks over time.

3.3 Variables

A comprehensive set of variables is considered in the analysis in order to control for the effect of other determinants on the relationship between competition and risk. These are included in the estimation to take into account both variables that can affect directly the relationship between stability and competition (heterogeneity, market concentration), and other factors that may explain bank financial soundness (bank-level fundamentals and environmental determinants).

We proxy bank stability using the natural logarithm of the Z-Score (as, for instance, in Iannotta et al., 2007; Laeven and Levine, 2009; Beck et al., 2013). We compute the Z-score at bank level as:

$$Z - Score_{i,t} = \frac{ROA_{i,t} + (E_{i,t} / A_{i,t})}{\sigma(ROA_T)} \quad (4)$$

where $ROA_{i,t}$ is the return on assets for bank i in year t, $E_{i,t}/A_{i,t}$ denotes the equity to total assets ratio for bank i in year t, $\sigma(ROA_T)$ is the standard deviation of return on assets over the full sample period (T years). The Z-Score provides a measure of bank soundness as 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-Score implies a higher degree of solvency and therefore it gives a direct measure of bank stability. We consider in the analysis the natural logarithm of Z-score to smooth out higher values of the distribution.

We compute the Herding Measure and the loan market concentration to control for the effects of other factors on the relationship between stability and competition. The Herding

Measure, as in Beck et al. (2013), is built as the within country standard deviation per year of non-interest income (e.g., fee commissions) 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 of this indicator, the more heterogeneous are the sources of revenues of Euro zone banks (i.e., less herding). We also compute a combined measure using the interaction between the herding indicator and the Lerner Index. The Herd-Lerner is estimated as the product of a dummy variable and the Lerner Index. The dummy takes value of one if the banking sector in a country is in the highest third of the Herding measure distribution (i.e., more heterogeneous sources of revenues), zero otherwise.

The Hefindhal-Hirschman Index (HHI) conveys the information on market concentration on loans. The index is computed per year at country level. The higher the value of HHI, the lower is the concentration of the market. We also calculate a combined measure using the Lerner Index. The HHI-Lerner is computed as the product of a dummy and the Lerner Index. The dummy takes value of one if the banking sector in a country is in the highest third of the HHI distribution (i.e., more concentrated markets), zero otherwise.

We consider a set of control variables. The bank level-fundamentals comprehend liquidity, a credit risk measure and size. The liquidity ratio is built as cash and due from banks on total assets. It gives an indication on resources quickly available to cover cash outflows. The ratio of loan-loss provisions over loans provides information on the exposure to credit risk. The size variable, computed as the natural logarithm of bank total assets, accounts for the ability to diversify the business in that reducing the bank overall risk. The influence of the macroeconomic environment is proxied by the inflation rate, by the total

long term unemployment rate (12 months or more) and by the net total government lending. In addition, we employ the overall financial freedom index estimated by the Heritage Foundation. Higher values indicate greater economic freedom. Moreover, an interaction term is introduced to take into account the 2007-2009 financial crisis.

< INSERT HERE TABLE 3 >

3.4 Econometric approach

In order to investigate the inter-temporal relationships between competition and stability, we estimate the following equation:

$$Z_{i,t} = f(LER_{i,t-1}, X_{i,t-1}, K_{i,t-1}) + \varepsilon_{i,t} \quad (5)$$

where the *i* subscript denotes the cross-sectional dimension across banks; *t* denotes the time dimension; $LER_{i,t-1}$ is the Lerner Index for bank *i* expressing bank market power; X_i are factors that we posit to influence the relationship between competition and stability, $K_{i,t-1}$ are control variables (as detailed in Section 3.3) and $\varepsilon_{i,t}$ is the error term.

To tackle potential problems related to endogeneity, we use the Generalized Method of Moments (*GMM*) estimators developed for dynamic panel models (Arellano and Bover, 1995; Blundell and Bond, 1998). Specifically we use the two-step system GMM estimator with Windmeijer (2005) corrected standard error.[1]

[1] The estimated asymptotic standard errors of the efficient two-step GMM estimator are severely downward biased in small samples therefore we correct for this bias using the method proposed by Windmeijer (2005).

4 Results

Panel data regressions are run to investigate the dynamic relationship between financial stability and competition in Eurozone banks. The analysis aims at determining the causal effect of competition on financial stability. In addition, we are interested in understanding if the fundamental relationship has changed during the 2007-2009 financial turmoil. Moreover, it is analysed whether herding behaviour plays a role and if competition is also linked to a measure of market concentration in loans.

We first run our base model considering a one year lag in the Lerner Index. Results, reported in Table 4, show that competition is positively related to individual bank stability, meaning that an increase in the banks' monopoly power decreases bank resilience. This evidence will be in favour of the competition stability view and could potentially have some important policy implications. For instance, as the new recent developments in information technology is allowing new firms to enter the banking market, the single supervisory mechanism (i.e., ECB and national supervisory authorities) may look at ease some of the rules for market entrance. The bank-level fundamentals are strongly and negatively related to bank stability apart from the liquidity ratio. Loan-loss provisions decreases bank stability as high credit risk bites banks' earnings. Interestingly, size is negatively related to bank soundness against the findings of many recent studies (i.e., Beck et al, 2013). This could suggest that the willingness to break up banks "Too-Big-To-Fail" may have empirical foundation in terms of individual bank stability. Inflation rate is positively related with bank stability though it is worth mentioning that the average across the sample for the whole period (1.79%) has been below the ECB target of 2% and there has not been any country or time period where we observe hyperinflation (e.g., inflation

higher than 10%). The coefficients on long term unemployment and government net lending are negatively related to bank stability. Furthermore, the overall financial freedom shows also a negative relationship with individual bank stability.

We run a second regression where we include in the analysis an interaction term to account for the 2007-2009 financial crisis. The negative relationship between market power and bank stability holds. What is more interestingly is that there is a positive relationship between the financial crisis interaction term and individual bank soundness meaning that banks with higher market power withstands the crisis better.

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We run two regressions to investigate the assumption that competition will have a stronger impact on bank stability in more homogeneous banking system (where herding behaviour is more likely). As such, we introduce the Herding measure and a combined measure obtained by interacting the Lerner Index with a dummy capturing the bank herding behaviour. As reported in Table (5), the herding measure is not statistically significant when introduced in the model. The Lerner Index keeps being negatively related to the Z-Score supporting previous results. In Specification (2.2), we introduce the interaction term and find that the Herding Measure is negatively related to bank stability indicating that more homogenous markets (i.e., for low values of the Herding Measure) are related to higher bank soundness. In addition, the combined measure shows that in more homogenous markets with higher competition, financial stability is higher. Although diversification should be carefully considered by policy makers for its impact on the safety and soundness of the overall banking system, more homogenous banking markets seems to be related to

higher individual bank stability. The combined measure is strongly related to bank stability as the coefficient is statistically significant at the 5% level. Moreover, the results of the estimations are in line with previous ones after including in the analysis the herding measure.

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As robustness test, we use a measure of the market structure (loan concentration) to analyse its effect on bank stability over time. The one-year lagged Herfindhal-Hirschman Index is negatively related to bank soundness, implying that bank stability is higher in more concentrated markets: this is consistent with the previous findings suggesting that more competition is likely to happen in more concentrated markets.

< INSERT HERE TABLE 6 >

5 Conclusions

The competition-stability nexus is an unsettled topic in the literature in banking. We provide a cross-country evidence that more competition favours individual bank stability in the EU-12.

We estimate at individual level bank's market power (Lerner Index). We also control for bank-level fundamentals and macroeconomic factors. In addition, we introduce a measure of market structure (Herfindhal-Hirschman Index) to test the robustness of the relationship.

We find that the lower the market power of individual banks, the higher their stability. This relationship seems to be reverted during systemic crises as in the 2007-2009 financial turmoil banks with higher market power were more financially sound. In addition, our results show that although market concentration is detrimental to bank stability, once we account for competition, the more the market power and the concentration in banking market the more the individual bank soundness.

Our findings contribute to the understanding of the banking dynamics in the EU-12 countries. As such, they are an important piece of evidence for the forthcoming European banking union.

References

Allen, F., Gale, D., 2004. Competition and financial stability. *J. Money, Credit, and Banking 36(3)*, 453-480.

Angelini, P., Cetorelli, N., 2003. The effects of regulatory reform on competition in the banking industry. *J. Money, Credit and Banking 35(5)*, 663-684.

Arellano, M., Bover, O., 1995. Another look at the instrumental variables estimation of error components models. *J. Econometrics 68(1)*, 29–51.

Barth, J.R., Caprio, G.J., Levine, R., 2001. The regulation and supervision of banks around the world - a new database. *World Bank Policy Research Working Paper 2588*, World Bank, Washington D.C.

Barth, J., Caprio, G., Levine, R., 2007. Bank regulation and supervision (updated dataset). *World Bank Working paper series 2588*, World Bank, Washington D.C.

Barth, J.R., Caprio, G.J., Levine, R., 2008. Bank regulations are changing: for better or worse ? *World Bank Policy Research Working Paper 4646*, World Bank, Washington D.C.

Beck, T., De Jonghe, O., Schepens, G., 2013. Bank competition and stability: Cross-country heterogeneity. *J. Financial Intermediation 22(2)*, 218–244.

Beck, T., Demirgüç-Kunt, A., Levine, R., 2006. Bank concentration, competition, and crises: First results. *J. Banking & Finance 30* (5), 1581-1603.

Berger, A. N., Klapper, L.F., Turk Arris, R., 2009. Bank competition and financial stability. *J. Financial Services Research 35(2), 99–118*.

Blundell, R., Bond, S.R., 1998. Initial conditions and moment restrictions in dynamic panel data models. *J. Econometrics 87(1)*, 115–43.

Boot, A. W. A. , Thakor, A. V., 2000. Can relationship banking survive competition? *The J. Finance 55 (2)*, 679-713

Boyd, J. H., De Nicolò, G. (2005). The theory of bank risk taking and competition revisited. *The J. Finance, 60(3)*, 1329-1343.

Boyd, J.H., De Nicolò, G., Al Jalal, A., 2006. Bank Risk-Taking and Competition Revisited: New Theory and New Evidence. *IMF Working Papers 297*, International Monetary Fund, Washington. D.C.

Carbó, S., Humphrey, D., Maudos, J., Molyneux, P., 2009. Cross-country comparisons of competition and pricing power in European banking. *J. International Money and Finance 28(1)*, 115-134.

Casu, B., Girardone, C., 2009. Testing the relationship between competition and efficiency in banking: a panel data analysis. *Economics Letters 105(1)*, 134–137.

Delis, M. D., Kouretas, G. P., 2011. Interest rates and bank risk-taking. *J. Banking & Finance 35 (4)*, 840–855.

De Nicoló, G., Loukoianova, E., 2007. Bank ownership, market structure and risk. *IMF Working Paper 215*, International Monetary Fund, Washington. D.C.

De Nicolò, G., Lucchetta M., 2009. Financial intermediation, competition, and risk: a general equilibrium exposition. *IMF Working Paper 105*, International Monetary Fund, Washington. D.C.

Fiordelisi, F., Mare, D.S., 2013. Competition and financial stability in European cooperative banks. *Working paper*.

Fiordelisi, F., Marques-Ibanez, D., Molyneux, P., 2011. Efficiency and risk-taking in European banking. *J. Banking & Finance 35 (5)*, 1315-1326.

Hakenes, H., Schnabel, I., 2010. Credit risk transfer and bank competition. *J. Financial Intermediation 19(3)*, 308–332.

Iannotta, G., Nocera, G., Sironi, A., 2007. Ownership structure, risk and performance in the European banking industry. *J. Banking & Finance 31 (7)*, 2127-2149.

Jiménez, G., Lopez, J. A., Saurina, J., 2013. How does competition affect bank risk-taking? *J. Financial Stability 9(2)*, 185–195.

Keeley, M. C., 1990. Deposit insurance, risk, and market power in banking. *The American Economic Review*, 1183-1200.

Laeven, L., Levine, R., 2009. Bank governance, regulation and risk taking. *J. Financial Economics 93(2)*, 259–275.

Marcus, A,J, 1984. Deregulation and bank financial policy. *J. Banking & Finance 8(4)*, 557-565.

Martinez-Miera, D., Repullo, R., 2010. Does competition reduce the risk of bank failure? *Review Financial Studies 23(10)*, 3638-3664.

Matsuoka, T., 2013. Sunspot bank runs in competitive versus monopolistic banking systems. *Economic Letters 118(2)*, 247-249.

Maudos, J., Fernandez de Guevara, J., 2007. The cost of market power in banking: Social welfare loss vs. cost inefficiency. *J. Banking & Finance 31(7)*, 2103 -2125.

Radić, N., Fiordelisi, F., Girardone, C., 2012. Efficiency and risk-taking in pre-crisis investment banks. *J. Financial Services Research 41(1-2)*, 81-101.

Repullo, R., 2004. Capital requirements, market power, and risk-taking in banking. *J. Financial Intermediation 13(2)*, 156–182.

Schaeck, K., Cihák, M., Wolfe, S., 2009. Are competitive banking systems more stable? *J. Money, Credit and Banking 41(4)*, 711-734.

Turk Ariss, R., 2010. On the implications of market power in banking: Evidence from developing countries. *J. Banking & Finance 34* (4), 765-775.

Windmeijer, F., 2005. A finite sample correction for the variance of linear efficient two-step GMM estimators. *J. Econometrics 126 (1)*, 25-51

Table 1

Distribution of banks

This table presents the distribution of banks by country and year over the sample period (2002-2012).

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Austria	117	156	180	189	201	205	189	192	195	183	110	1,917
Belgium	18	19	19	18	18	16	19	19	18	17	13	194
Finland	0	2	2	1	0	2	2	3	3	2	2	19
France	72	75	76	80	80	82	85	83	87	87	73	880
Germany	1,166	1,137	1,148	1,423	1,446	1,453	1,456	1,451	1,450	1,445	1,080	14,655
Greece	1	1	2	4	4	4	4	4	5	5	3	37
Ireland	0	0	1	1	1	1	1	1	1	2	1	10
Italy	3	0	1	448	458	470	477	479	495	496	389	3,716
Luxembourg	39	39	42	42	46	50	50	51	51	48	30	488
Netherlands	2	3	4	4	4	6	5	5	5	6	4	48
Portugal	2	2	2	7	9	10	13	13	14	13	8	93
Spain	5	5	9	71	75	65	73	82	78	78	64	605
Total	1,425	1,439	1,486	2,288	2,342	2,364	2,374	2,383	2,402	2,382	1,777	22,662

Table 2

Descriptive statistics

This table presents the descriptive statistics of our sample of European banks between 2002 and 2012 for the main variables used in the model. It is at first surprising the Lerner Index is negative for some observations though for 28 banks only. We argue that this could be the case when banks start operations and bear high fixed costs (e.g., for fixed assets).

Variable	Symbol	Obs	Mean	Std. Dev.	Min	Max
Output Price	P	22,662	0.0569	0.0410	-0.0340	2.4074
Marginal Cost	MC	22,662	0.0107	0.0214	0.0000	0.9787
Lerner Index	LER	22,662	0.8231	0.2659	-34.5083	1.0000
Herding measure	HERD	22,662	0.1317	0.1703	0.0000	1.7366
Concentration	HHI LOANS	22,662	0.0246	0.0505	0.0031	1.0000
Z-Score	Z	22,662	4.1788	3.6712	-12.1562	70.8005

Table 3

Variables definition

This table defines the variables used in the paper and the sources of data.

Variables	Symbol	Definition and calculation method	Source
Z-score	Z	The ratio synthesizes a measure of overall banking risk. It is computed as the sum of the return on assets (ROA) and the equity ratio (equity over total assets) divided by the sample standard deviation of ROA.	Own calculations using data from Bankscope.
Lerner Index	LER	It represents the extent to which market power allows the bank to fix a price (P) above its marginal cost (MC).	Own calculations using data from Bankscope.
Output Price	P	Following recent studies (Berger et al 2009 and Turk Ariss 2010) and assuming that banks produce an heterogeneous flow of services that is proportional to their dimension, we use banks' total asset as a proxy of their overall activity (Angelini and Cetorelli, 2003) and we estimate average price as total revenues (interest and non- interest income) on total asset.	Own calculations using data from Bankscope.
Marginal costs	MC	Marginal cost of the product is estimated using a single output translog cost function, firm-fixed effect to handle the average heterogeneity among banks and a technology shift trend to capture the average changing in production technology over the sample period.	Own calculations using data from Bankscope.
Liquidity	LIQ	Liquidity indicator computed as the ratio between cash and due from banks and total assets.	Own calculations using data from Bankscope.
Loan Loss Provisions	LLPTL	Credit risk indicator obtained as the ratio of loan-loss provisions over total loans.	Own calculations using data from Bankscope.
Bank Asset Size	SIZE	It is measured by the natural logarithm of total assets.	Own calculations using data from Bankscope.
Herding measure	HERD	This is a measure of banking industry heterogeneity obtained as the within country standard deviation of the percentage non-interest income (with respect to total assets) as in Beck et al. (2013), per year (t) and per country (i).	Own calculations using data from Bankscope.
Inflation rate	INFL	The annual percentage change in the cost to the average consumer of acquiring a basket of goods and services.	World Bank
Long-term unemployment	LTU	It measures the long-term unemployment (12 months and more) in millions of people looking for a paid job.	Eurostat
Government lending	GOV	Net government lending minus net borrowing as a percentage of GDP. Figures are at general government level.	Eurostat
Overall Freedom	OVERALL	Overall measure of financial freedom.	The Heritage Foundation.
Financial Crisis	LERNFIN	Interaction term obtained by moltiplicating a a dummy variable for the 2007-2009 financial crisis (it takes value of 1 in 2007-2009, 0 otherwise) and the Lerner Index.	Own calculations using data from Bankscope.
Concentration	HHI LOANS	Concentration Index (Herfindhal-Hirschman Index) calculated as the sum of the squares of the market shares (considering loans) of each bank (i) in a specific country (c) in a determined year (t). We consider one observation per year (t) per country (c) (i.e. 60 values).	Own calculations using data from Bankscope.
Herd Lerner	HERD_LERNER	Mixed measure that combines the banks with the highest tendency to herd (i.e. lowest third of the distribution of HERD) with market monopoly power.	Own calculations.
Concentration Lerner	HHI_LERNER	Mixed measure that combines banks' concentration index in the loan market with market monopoly power.	Own calculations.

Table 4

The link between bank stability and competition in Eurozone banks

The Table reports the results from the estimation of equation (5) to disentangle the inter-temporal relationships between bank stability (measured by the Z-score) and competition. We use the two-step *GMM* estimators developed by Blundell and Bond (1998) with Windmeijer (2005) corrected standard error (reported in brackets). We report the Hansen test of over-identifying restrictions for the GMM estimators and the Arellano–Bond test for autocorrelation. In the former, the null hypothesis is that instruments used are not correlated with residuals and so the over-identifying restrictions are valid. In the latter, we test the autocorrelation in first differences (AR1), the null hypothesis being no autocorrelation, and the autocorrelation in levels (AR2), the null hypothesis being again no autocorrelation. All variables are summarized in table 1. The symbols *, **, and *** represent significance levels of 10%, 5% and 1% respectively. The sample includes all the European banks in EU-12 over the period 2002-2012.

	(1.1)		**(1.2)**	
Dependent variable Z: Z-Score	Coef.	Std. Err.	Coef.	Std. Err.
LER_{t-1}	-0.401**	0.188	-0.430**	0.205
LERNFIN			0.050***	0.008
LIQ_{t-1}	0.052	0.367	0.051	0.364
$LLPTL_{t-1}$	-0.015***	0.001	-0.015***	0.001
$SIZE_{t-1}$	-0.114***	0.007	-0.113***	0.007
$INFL_{t-1}$	0.022***	0.004	0.016***	0.004
LTU_{t-1}	-0.056***	0.005	-0.057***	0.005
GOV_{t-1}	-0.004***	0.001	-0.005***	0.001
$OVERALL_{t-1}$	-0.033***	0.002	-0.032***	0.002
Intercept	5.503***	0.209	5.469***	0.214
Observations:	19,998		19,998	
No. of banks	2,512		2,512	
Hansen test, 2nd step, $\chi(2)$, *p-value*	0.693		0.389	
AB test AR(1), *p-value*	0.000		0.000	
AB test AR(2), *p-value*	0.143		0.136	

Table 5

The link between bank stability and competition in EU-12 banks:

the herding behaviour

The Table reports the results from the estimation of equation (5) to disentangle the inter-temporal relationships between bank stability (measured by the Z-score) and competition whilst accounting for banks' herding behaviour. We use the two-step *GMM* estimators developed by Blundell and Bond (1998) with Windmeijer (2005) corrected standard error (reported in brackets). We report the Hansen test of over-identifying restrictions for the GMM estimators and the Arellano–Bond test for autocorrelation. In the former, the null hypothesis is that instruments used are not correlated with residuals and so the over-identifying restrictions are valid. In the latter, we test the autocorrelation in first differences (AR1), the null hypothesis being no autocorrelation, and the autocorrelation in levels (AR2), the null hypothesis being again no autocorrelation. All variables are summarized in table 1. The symbols *, **, and *** represent significance levels of 10%, 5% and 1% respectively. The sample includes all the European banks in EU-12 over the period 2002-2012.

	(2.1)		**(2.2)**	
Dependent variable Z: Z-Score	Coef.	Std. Err.	Coef.	Std. Err.
LER_{t-1}	-0.445**	0.210	-0.391*	0.204
LERNFIN	0.049***	0.008	0.047***	0.008
$HERD_{t-1}$	-0.040	0.028	-0.064**	0.028
$HERD\_LERNER_{t-1}$			-0.060***	0.006
LIQ_{t-1}	0.046	0.366	0.103	0.353
$LLPTL_{t-1}$	-0.015***	0.001	-0.015***	0.001
$SIZE_{t-1}$	-0.113***	0.007	-0.113***	0.007
$INFL_{t-1}$	0.019***	0.004	0.027***	0.004
LTU_{t-1}	-0.058***	0.005	-0.053***	0.005
GOV_{t-1}	-0.005***	0.001	-0.005***	0.001
$OVERALL_{t-1}$	-0.033***	0.002	-0.032***	0.002
Intercept	5.505***	0.215	5.422***	0.214
Observations:	19,998		19,998	
No. of banks	2,512		2,512	
Hansen test, 2^{nd} step, $\chi(2)$, *p-value*	0.382		0.035	
AB test AR(1), *p-value*	0.000		0.000	
AB test AR(2), *p-value*	0.130		0.085	

Table 6

The link between Bank stability and Competition in EU-12 banks: the concentration in the loan market

The Table reports the results from the estimation of equation (5) to disentangle the inter-temporal relationships between bank stability (measured by the Z-score) and competition measured by the concentration in the loan market. We use the two-step GMM estimators developed by Blundell and Bond (1998) with Windmeijer (2005) corrected standard error (reported in brackets). We report the Hansen test of over-identifying restrictions for the GMM estimators and the Arellano–Bond test for autocorrelation. In the former, the null hypothesis is that instruments used are not correlated with residuals and so the over-identifying restrictions are valid. In the latter, we test the autocorrelation in first differences (AR1), the null hypothesis being no autocorrelation, and the autocorrelation in levels (AR2), the null hypothesis being again no autocorrelation. All variables are summarized in table 1. The symbols *, **, and *** represent significance levels of 10%, 5% and 1% respectively. The sample includes all the cooperative banks in EU-12 over the period 2002-2012.

	(3.1)		**(3.2)**	
Dependent variable Z: Z-Score	Coef.	Std. Err.	Coef.	Std. Err.
LER_{t-1}			-1.360***	0.408
HHI LOANSt-1	-1.524	1.307	-12.412**	5.944
HHI_LERNER_{t-1}			17.102***	6.607
LIQ_{t-1}	0.317	0.380	0.627	0.636
$LLPTL_{t-1}$	-0.014***	0.001	-0.014***	0.001
$SIZE_{t-1}$	-0.111***	0.008	-0.130***	0.008
$INFL_{t-1}$	0.029***	0.009	0.009	0.008
LTU_{t-1}	-0.064***	0.009	-0.046***	0.007
GOV_{t-1}	-0.005***	0.001	-0.002	0.001
$OVERALL_{t-1}$	-0.033***	0.002	-0.033***	0.003
Intercept	5.185***	0.166	6.465***	0.515
Observations:	19,998		19,998	
No. of banks	2,512		2,512	
Hansen test, 2^{nd} step, $\chi(2)$, *p-value*	0.039		0.388	
AB test AR(1), *p-value*	0.000		0.000	
AB test AR(2), *p-value*	0.101		0.231	