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CREDIT RISK AND COMPETITIVE BEHAVIOR IN EUROPEAN BANKING DURING 2000-2019

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Abstract: This paper analyzes the determinants of non-performing loans (NPLs) and banking sector stability based on a panel data of 28 European countries during 2000 to 2019. We employ system GMM estimations and find that bank concentration and market power harm credit quality inducing more risk-taking at lower levels of bank competition, lending support for the competition-stability view. By contrast, increased competition reduces credit risk up to a certain threshold beyond which excessive competition again harms credit quality-competition-fragility view. We employ the Lerner index as an indicator of market concentration. Our findings support the existence of a U-shaped relationship between bank competition and credit risk such that there exists an optimal level of bank competition consistent with the minimal level of NPLs. We control for several macroeconomic and bank-specific indicators, and also confirm the dramatic adverse effect of the global crisis on the credit risks of European banks during 2008-2010 period. Our results suggest that regulatory policy may target an optimal degree of bank competition as an additional channel to promote stability in banking.

Keywords: Non-performing loans, Bank competition, Lerner Index, System GMM Estimation

1 Introduction

The purpose of this study is to determine how competition among banks affects credit risk and stability in European banking sectors. In the aftermath of the global financial crisis (2008-2010), European banking sectors were hard hit by a surge in non-performing loans (NPLs), a result of the crisis induced recessions in the region (Pesola, 2010, Figure 1). Daumont *et al*. (2004) define a systemic banking crisis whereby non-performing loans are at least between 5 and 10 percent of total assets and thus with the potential to wipe out most or all the banking system's capital. In emerging Europe, in particular, the NPLs reached over 10-12 percent on average, raising concerns about the health of the banks and risk of system-wide insolvency. Additionally, the region's banks had close financial linkages with foreign banks and because many of these countries experienced a potentially destabilizing credit boom prior to the advent of these crises. Consequently, to ensure a smooth functioning of the banks, capital requirements were tightened, and various macro-prudential regulation regulations were introduced to safeguard banking stability in several European countries. The crisis also paved the way for a more systematic adoption of the advanced internal risk management regimes at the bank level to enhance monitoring of early warning indicators of a possible banking distress due to loan defaults (Erdinç and Gurov, 2016).

In recent years, there has been a growing literature on the relationship between bank competition and stability with two opposing views. According to the "competition-stability view", competition can be associated with more stability in the banking sectors by inducing less risk taking in extending loans while fostering efficiency by way of better monitoring of loans, and lower credit costs. In a nutshell, competition-driven efficiency gains and controlled loan risks result in stability and improve the soundness of the banking industry (Boyd and De Nicoló, 2005; Beck *et al*. 2006; Turk-Ariss, 2010; Schaeck and Cihak, 2014, Berger and DeYoung,

1997). In the opposite scenario, however, more bank competition may encourage greater risk-taking, and hence, may lead to a worsening of credit quality, and eventually can generate solvency problems in banking. This latter effect may be an unintended outcome of enhanced bank competition and can create fragility in the banking sectors. Hence, the proponents of this "competition-fragility view" posit that in markets where banks have market power and face limited competition, there may be greater stability as banks earn higher profits in such concentrated industries (Keeley, 1990; Bordo *et al*. 1995).

There are conflicting predictions on the relationship between competition and stability in the empirical literature as noted by Beck (2008). More recently, a new strand of literature has attempted to reconcile these opposing views and argued that there may be a non-linear relationship between competition and risk, thus supporting both hypotheses in different parts of the distribution. A notable paper by Martinez-Miera and Repullo (2010) derived the theoretical conditions under which a U-shaped relationship between the degree of bank competition and credit risk (hence, risk of risk of bank failure) may be the outcome.

In this paper, we analyze the relationship between the degree of bank competition and the levels of credit risk for a cross-section of European countries to shed light on the potential impact of bank competition on the loan quality or NPL dynamics while controlling for various measures of macroeconomic, and bank-specific factors. Based on a panel data of 36 European countries for the 2000-2019 period, we employ fixed effects, and system GMM methods in our estimations. Specifically, we examine how banking market structure impacts the asset quality of banks while empirically testing for the existence of a non-linear relationship between bank competition and the NPLs as suggested by Martinez-Miera and Repullo (2010). We also assess the role of the global financial crisis on the NPL dynamics.

Our study contributes to the discussion on the bank competition and credit risk nexus in several ways: (i) To our knowledge, there has been no panel study so far that analyzed this issue in the context of European banking using cross-country data. (ii) In this study, we test empirically the implications of the Martinez-Miera and Repullo model based on the dependent variable, NPL as a credit risk measure, and the Lerner index to proxy market power or bank concentration as suggested by their paper to assess whether European banking conforms to a U-shaped relationship between competition and its evolution of NPLs.

Our findings support the theoretical findings of Martinez-Miera and Repullo (2010). Hence, we empirically confirm the existence of an optimal degree of bank competition posited by their model that the regulators need to maintain to minimize the incidence of credit risks in banking and to ensure stability. Our evidence suggests that the level of bank competition can serve as an additional instrument for macro-prudential regulation.

The remainder of the paper proceeds as follows. Section 2 provides a short review of the related literature. Section 3 presents the definitions of the variables, key descriptive statistics. It also describes the empirical model and discusses the key results. Section 4 concludes.

2 A Brief Survey of Related Literature

A large body of theoretical and empirical literature produce conflicting conclusions on the bank competition and credit risk nexus (Keeley, 1990; Salas and Saurina, 2003; Boyd and De Nicolo, 2005; Fungačova and Weill, 2013; Jimenez *et al*. 2013; Beck, 2008, Beck *et al*. 2013). One strand of this literature argues for competition-fragility view: less competitive banking systems are associated with lower credit risk and more stability. High degree of profitability associated with bank concentration provides banks with a better capital and profit cushions against unexpected shocks and reduce incentives for risk-taking (Keeley, 1990). In contrast, another strand of models argue for competition-stability view and predict that more competitive banking systems are more stable (Boyd and de Nicolo, 2005). Higher loan rates in more concentrated systems induce bank borrowers to assume greater risk which results in increased loan defaults. Boyd and de Nicolo (2005) assume that the risk of these loans is increasing in the loan interest rate and a reduction in loan rates due to greater bank competition reduces the loans' probability of default (risk-shifting effect). Hence, they conclude that competition reduces the risk of bank failure.

Another strand of literature reconciles these conflicting results and argue that there may be a non-linear relationship between competition and risk, thus supporting both hypotheses in different parts of the distribution. Martinez-Miera and Repullo (2010), in an influential article, derive the conditions under which more competition with new bank entry reduces the probability of bank failures and hence, can be stabilizing. The key argument of the paper is that there is a U-shaped relationship between bank competition and risk of bank failure. In very concentrated markets, more competition is associated with a reduction in risk-taking in lending and hence, declining probability of bank failure and safer banks. On the other hand, more competition in markets sufficiently competitive, can be harmful and increase the probability of bank failure by inducing excessive risk-taking and riskier banks. They argue that increased competition can lower credit risk via efficiency gains, while excessive competition can cause adverse effects (lower profit margins and increased risk incentives). The crucial insight from this paper is that both low and high degree of competition level may be consistent with bank instability and failure, suggesting that there may an optimal level of bank competition. Therefore, regulators may implement measures to target a moderate level of bank competition to ensure banking stability.

Brei *et al*. (2020), based on 221 banks from 33 countries in Sub-Saharan Africa over the period 2000-2015 find empirical support for the predictions of Martinez-Miera and Repullo (2010). Tabak *et al*. (2012), however, find contrasting evidence of an inverted U-shaped relationship for a cross- section of Latin American countries over the period 2003-2008 whereby high and low competition levels enhance bank stability opposing the predictions of Martinez-Miera and Repullo (2010). Yet, IJtsma *et al*. (2017) do not find any economically significant effect of competition on stability for the European Union banks.

3 Econometric Framework

3.1 Data, Variables and Key Descriptive Statistics

Our study is based on annual aggregated banking data of 36 European countries collected from Global Financial Development Database for the 2000-2019 period. We have created 4 groups of countries based on their underlying characteristics. Group1 corresponds to 16 emerging Central-Southeastern European economies: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czechia, Hungary, Moldova, Romania, Montenegro, Macedonia, Poland, Serbia, Slovakia, Slovenia, Ukraine, and Turkey. Group 2 consists of 12 advanced European economies: Austria, Belgium, France, Germany, Italy, Netherlands, Portugal, Spain, Greece, Cyprus, Switzerland, and Great Britain. Group 3 consists of 9 countries with Baltic states such

as Finland, Norway, Sweden along with Denmark, Latvia, Lithuania, Estonia, Iceland, and Ireland. Group 4 includes Georgia and Belarus.

Figure 1 shows the evolution of the NPL ratios for each group in the sample. As is evident from Figure 1 and Table 1, NPLs are higher on average, almost double the magnitude for the Group 1 countries of emerging Europe despite the efforts of to contain the NPLs prior to the onset of the global financial crisis and the gains in terms of profitability and efficiency in their banking systems. There was a surge in the non-performing loans and a significant drop in profitability as measured by the return on assets (ROA) in this region which registered the highest levels of credit defaults, partly propelled by the rapid credit growth fueled by massive capital inflows largely intermediated by their foreign-dominated banking sectors in their process of financial deepening. Credit risks in Group 2 advanced European countries also increased two-fold from 3.65 percent to 6.54 percent in the post-crisis period despite staying in moderate levels. A three-fold increase was also evident in Group 3 Baltic countries, while the rates stayed at acceptable levels of 6.12 percent on average in the aftermath of the crisis.

Table 1 Main Characteristics of the Banking Sectors, 2000-2019

Groups	NPL (% of Loans)	ROA (%)	Credit to Private (% GDP)	CR5	Credit To Deposit	Lerner	Capital to Risk weighted Assets	Net Interest Margin (NIM)
Group 1								
Pre-2008	10.40	1.52	25.80	78.23	119.72	0.22	18.77	6.04
Post-2008	10.86	0.40	51.73	70.77	103.77	0.24	17.39	4.06
Group 2								
Pre-2008	3.65	0.54	88.51	81.91	120.80	0.17	12.01	1.63
Post-2008	6.54	-0.09	112.89	83.06	119.99	0.16	15.28	1.43
Group 3								
Pre-2008	1.75	1.03	66.05	90.94	141.09	0.17	12.66	2.63
Post-2008	6.12	0.97	106.75	91.66	177.39	0.27	18.93	1.87
Group 4								
Pre-2008	5.22	3.06	9.19	91.29	109.58	0.28	25.42	14.98
Post-2008	4.99	1.31	33.55	81.55	126.26	0.26	18.26	7.14

Note: The numbers are mean values for each group of countries over the period 1999–2019. "CR5" is the concentration ratio of the top 5 banks, "NPL" are non-performing loans (% of Loans), and "ROA" is the return on assets. Net Interest Margin is abbreviated as NIM.
Source: Global Financial Development Database and author's own calculations.

Table 1 also shows that European banking systems display a concentrated market with wide variation across groups in the Lerner indices, CR5 and the net interest margins (NIMs). A banking sector with a Lerner index less than 0.1 is considered a competitive market. However, if the Lerner index is as high as 0.2, this is a concentrated industry. Group 2 along with Group 3 is more competitive as compared to the accession and transition countries in Group 1 and Group 4, latter being the most concentrated. These results are also consistent with the behavior of their NIMs. Group 1 countries are substantially more concentrated than Group 2

and Group 3 in terms of the Lerner index but both Groups 1 and 3 have registered a significant increase in the Lerner index in the post-2008 period which is disturbing (Figure 2). On the other hand, bank capitalization levels remained high for Groups 1 and 3 possibly as a bulwark against potential banking instability that could arise from the surge in their levels of NPLs. Most competitive banks in our data with less than 0.2 Lerner index are those found in Germany, France, Finland, Belgium, Italy, Montenegro, Netherlands, and Portugal.

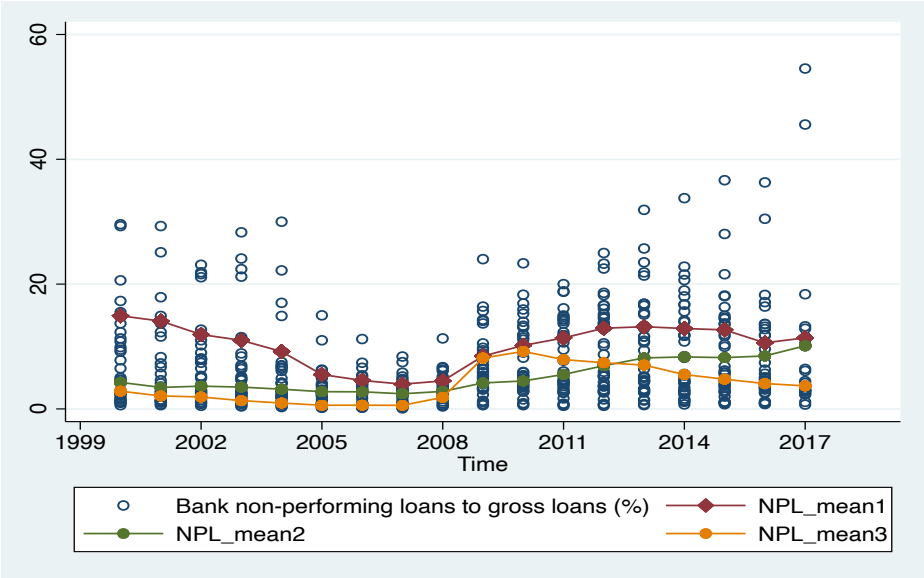

Figure 1 Non-performing Loans (% of Gross Loans) for Group 1, Group 2 and Group 3 countries for the period 2000-2017

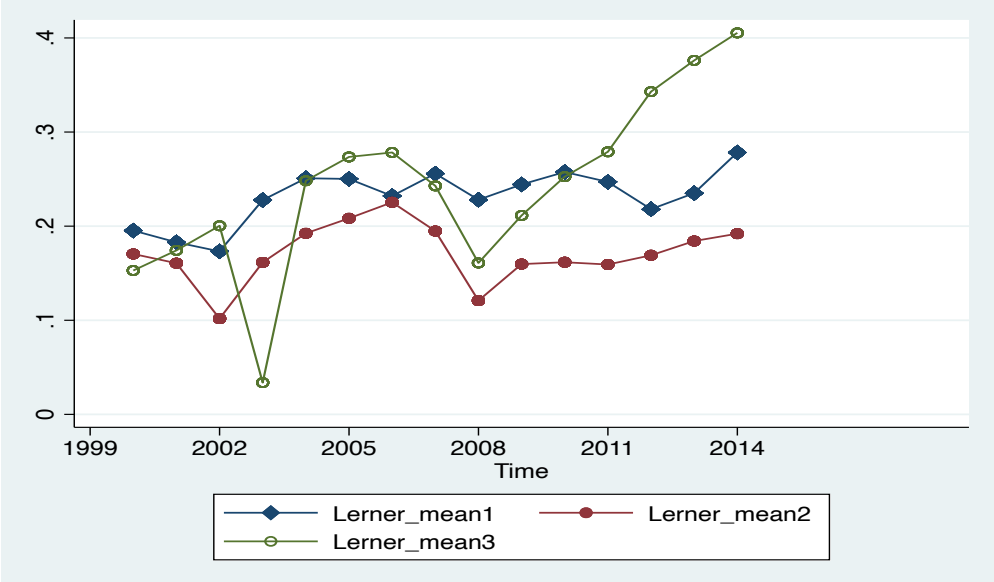

Figure 2 Lerner Indices for Group 1, Group 2 and Group 3 countries for the period 2000-2017

Table 2 Description of the Variables

Key Variables	Description	Expected Sign For NPL
Dependent Variable		
NPL (log)	Ratio of Non-Performing Loans to Gross-Loans	
Independent Variables		
Lerner	Lerner Index, % of markup of price above marginal cost	+
Lerner^2 (Lernersq)	Lerner Index, squared term	-
RGDP_gr	Real GDP growth rate	-
Inflation	Inflation rate	-/+
CR5	Share of top 5 banks' assets in total bank assets	-/+
Credit_Dep	Credit-Deposit Ratio	-/+
Privcred	Private Credit by banks as % of GDP	-
i-spread	Lending-Deposit rate spread	-/+
ROA	Return on Assets	-
For_Banks	Number of foreign banks	-/+
NIM	Bank net interest margin	-
Overhead	Operating Costs to Total Assets	+
dcrisis	Dummy variable for the global crisis with value 1 for 2008-2010	+
CAP	Capital-Assets Ratio	+/-

2.2 Model Specification

We examine the relationship between credit risks (NPLs) and the competition measure (market power), Lerner index, after controlling for bank-specific and macro-economic determinants. Table 2 presents the description of the variables used in the estimations. We consider a dynamic panel regression with the baseline model as specified below:

$$NPL_{it} = \alpha_i + \rho NPL_{it-1} + \varphi Lerner_{it} + \beta X_{it-1} + \delta M_{it} + u_{it} \quad (1)$$

where NPL_{it} denotes the logarithmic transformation of the non-performing loan ratio[1] in country i, in year t and NPL_{it-1} as the lagged dependent variable to capture the persistence of credit risk over time. $Lerner_{it}$ represents the bank concentration indicator (inverse of competition),

[1] The ratio of reserves for impaired loans to total loans is bound by zero and is equal to one. We use its logarithmic transformation so that it spans a wider interval over [−∞; +∞] (see Salas and Saurina, 2002; Espinoza and Prasad, 2010).

X_{it-1} is a vector of bank-specific characteristics, and M_{it} denote the vectors of macroeconomic control variables. Structural, regulatory, and institutional controls have not been added to the regressions due to the existence of similar structures in these countries. But the fixed effect term, α_i captures these possible time-invariant unobserved differences in loan quality across countries. u_{it} is the white-noise error term. Additionally, *dcrisis* is added to the regressions as the dummy variable for the period 2008-2010 to capture the impact of the global financial crisis.

To explore the possibility of a non-linear relationship between bank competition and non-performing loans, we augment our baseline model in (1) with a quadratic term for the competition measure, $Lerner_{it}{}^2$. Martinez-Miera and Repullo (2010) argue that when regressing some measure of bank insolvency such as the NPLs (as a measure of bank risk), a measure of market power such as the level of the Lerner index, , $Lerner_{it}$ should have a positive coefficient and its squared form, $Lerner_{it}{}^2$ must carry a negative coefficient in the estimations to confirm the existence of a U-shaped relationship between bank competition (inverse of Lerner index) and the risk of bank failure (inverse of bank solvency).

2.3 System GMM Estimations

Initially, we specify a dynamic fixed effects regression for the determinants of credit risk (NPLs) using several macroeconomic and bank-specific variables and control for the crisis period. Table 3 shows the system-GMM estimation results for full-sample and for the post-2008 period. Specifications (1) to (3) include the Lerner index and its squared term where we vary the estimation method. In all regressions, lagged NPL is highly significant, suggesting strong persistence in the NPL series. In the presence of lagged dependent variable, it is well-known that the fixed effect estimation suffers from Nickell's bias (Nickell, 1981). We estimate a system GMM (two-step robust) model to avoid this bias associated with the dynamic fixed effect models. We instrument all our bank-specific variables by their lagged values to mitigate any possible endogeneity problem (Roodman, 2009).

We use the two-step system GMM estimator rather than the difference GMM estimator because the former uses more instruments in the level equation, improving efficiency especially when the lagged dependent variable shows significant level of persistence. To avoid the instrument proliferation problem, we attempt to control the number of instruments via the collapse option in Stata and ensure that the size of our instruments is smaller than the number of cross-sections as suggested by Roodman (2009). The variables used in our study do not suffer from non-stationarity issues based on our tests. Additionally, GMM estimation requires a short time and large cross-sectional dimension to avoid issues regarding possible non-stationarity of the variables when data involves large time periods. Hence, we provide estimation results for the full sample as well as the subset of our sample for the period after 2008 (till 2020). We also use the Windmeijer's finite-sample correction to prevent the standard errors to be downward bias in small samples (Windmeijer, 2005).

According to Arellano and Bond (1991) and Arellano and Bover (1995), GMM estimation must not exhibit second order autocorrelation to ensure consistency of the coefficients. First order autocorrelation in the differenced residuals is acceptable and consistent with in the case of white-noise errors in the original dynamic model. But the null hypotheses of no second order autocorrelation should not be rejected to support a well-specified model without serial correlation. Our results conform to these requirements as seen in Table 3.

In all our system-GMM estimations, the Hansen J statistics also confirms that our instruments are valid with p-values greater than 0.25 or with close enough values (Table 3). Roodman (2009) convincingly argues that validity of the instruments should be assessed based on 25 percent rather than standard significance levels of 1 to 10 percent.

Table 3 Two-step System GMM Estimation Results

log(NPL)	(I) Full Sample	(II) Full Sample	(III) Post-2008
LogNPL(-1)	0.860 (0.051) ***	0.857 (0.055) ***	0.860 (0.078) ***
dcrisis	0.121 (0.035) ***	0.115 (0.036) ***	----
RGDP_gr	-0.054 (0.005) ***	-0.051 (0.005) ***	-0.039 (0.004) ***
Lerner	2.043 (0.543) ***	2.275 (0.551) ***	2.454 (0.679) ***
$Lerner^2$	-4.311 (1.106) ***	-4.746 (1.177) ***	-4.752(1.562) ***
ROA	-0.021(0.012) *	-0.020 (0.012) *	-0.024 (0.0108) **
CR5	-0.003 (0.002)	-0.001 (0.003)	-0.004 (0.003) *
Privcred	-0.001 (0.001) *	----	-0.000 (0.000)
Inflation	0.004 (0.002) **	0.005 (0.002) **	----
Credit_Dep	----	-0.000 (0.000)	
No. Obs.	450	436	155
No. Instr.	13	13	15
No. Countries	36	35	35
Time effects	No	No	Yes
AR(1)	0.020	0.020	0.035
AR(2)	0.895	0.900	0.264
Hansen's J stat.(p-value)	0.438	0.428	0.223

Note: Standard errors are in parentheses. The coefficients are significant at 1, 5, and 10% and are indicated with (***), (**) and (*) respectively.
Source: Author's own calculations.

We have employed several specifications of macro and bank- specific variables as controls in addition to the Lerner index and its squared form. The variables we report in Table 3 are those which turn consistently significant in almost all regressions, and this is why we report only these results. In addition, the signs and significance of the variables have been almost identical regardless of the specification, confirming the robustness of our results.

As is evident from Table 3, European NPL dynamics are particularly sensitive to specific macroeconomic variables, most notably, the real GDP growth, (*RGDP_gr*) and inflation (*Inflation*) with expected signs. These are consistent with the findings of numerous studies which show that NPLs are counter-cyclical and adverse macroeconomic shocks worsens credit risk as such conditions affect the ability of borrowers to service bank debt (Salas and Saurina, 2002; Pesola, 2010; Erdinç and Abazi, 2014). The results also show that inflation rate negatively impacts bank asset quality.

Several bank-specific controls have been included in the panel regressions as in the literature (Quagliariello, 2007; Salas and Saurina, 2002; Espinoza and Prasad, 2010). Our results show that *ROA*, as a proxy for profitability, and management quality plays a significant role in constraining loan defaults with a negative and significant sign in all specifications. Jimenez and Saurina (2006) find a positive relationship between rapid credit growth and future NPLs. Brei et al. (2020) find that banks that are more involved in lending report relatively more NPLs. On the other hand, the effect of financial development on loan quality is expected to be favorable. We capture these effects with two measures: *Privcred* (domestic credit to the private sector divided by GDP) to account for financial depth and *Credit_Dep* (Loan to Deposit ratio) as an indicator of aggressive lending via access to foreign funding with the former expected to have a negative and the latter to have a positive effect on the NPLs. *Credit_Dep* has turned

insignificant in most of our estimations, probably because of its diverse variation across countries in a cross-country setting. The coefficient of *Privcred* variable is significant and negative, suggesting that the degree of financial development indeed reduces the incidence of NPLs in the European context.

Time effects and the dummy, *dcrisis*, consistently verify that the loan quality dropped severely in the post-crisis period with significant positive signs, and this underlines the vulnerability of region's banks to the shocks generated by the global crisis as they were transmitted thorough strong trade and financial links to the entire Europe.

Our most notable finding is that the Lerner index has a significant positive effect on NPLs while its squared form has a significant negative sign in all our estimations. In specifications (1)-(3) shown in Table 5, a higher Lerner index (i.e. lower bank competition) is associated with lower loan quality (i.e. higher NPLs), giving support to the competition-stability view. The negative sign of the Lerner squared implies that there is a certain level of bank concentration which is associated with a maximum level of NPLs. Hence, our study confirms the existence of a U-shaped relationship between credit risk (NPLs) and bank competition (inverse of bank concentration) as in Martinez-Miera and Repullo (2010) in the context of European banking. To examine the robustness of our results, we have re-estimated our model based on the inverse of the Lerner index and the squared form of this inverse measure as an indicator of bank competition rather market power. Our estimations consistently have revealed that bank competition measure (inverse of Lerner) has a significant negative sign, and the squared form of the same measure a positive sign. Another measure of bank concentration, *CR5* is found to be negative and weakly significant (in specification 3 only) for NPLs. This finding may suggest that when top 5 banks as leading institutions dominate the banking sectors, there might be a benefit for the sector in terms of improvement in loan quality in banking. A closer investigation of this market dominance channel can be explored further in the context of European banking.

A rich variety of variables have been also considered in different specifications such as capital adequacy ratio, *CAP*, lending-deposit spread, *i-spread*, number of foreign banks, *for_banks*, and overhead expenses, *Overhead*. They do not affect NPLs in a significant manner so they have been dropped from estimations.

4 Conclusions

In this paper, we empirically confirm the existence of a U-shaped relationship between credit risk (NPLs) and competition in the context of the European banking sector with significant policy and regulatory implications. Our findings support the view of Martinez-Miera and Repullo (2010) that there is a threshold level of bank competition which may be consistent with the lowest level of credit risks in banking. An important implication is that too much competition may be at least as detrimental as too much concentration and market power in banking.

Our empirical findings are expected to guide policy decisions to ensure financial system soundness by designing and implementing appropriate countercyclical macro-prudential regulation and maintaining a healthy level of bank competition. Hence, macro-prudential regulation has an additional dimension: targeting bank competition at the optimal level to ensure banking stability.

To mitigate distortions in bank competition, we also support polices to accelerate steps toward the direction of the European banking union and a common bank regulation framework in the euro-area.

Our empirical results also show that accumulation of NPLs as a potential source of instability in banking is significantly affected by the macroeconomic environment, specifically, real GDP growth and inflation. Hence, we stress the importance of effective countercyclical macroeconomic policy measures as a crucial determinant of stable banking systems.

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