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Competition and stability in the European Union banking sector

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Abstract

This paper empirically tests the two competing hypotheses regarding the relationship between competition and stability: the competition-fragility hypothesis and the competition-stability hypothesis. The banking sector stability is first proxied by the estimated Z-score that provides a measure of overall bank stability. Further, the paper separately considers some specific constituent components of the Z-score measure to analyse different aspects of the bank stability: bank profitability and bank capitalisation. Two different measures are used to represent bank competition: the Herfindahl-Hirschman Index (a specific measure of market concentration), and the Boone indicator (which measures competition from an efficiency perspective). Using data sourced from the Moody's Analytics BankFocus database, the paper applies panel estimations to a relatively large panel including 784 relevant banks of all the 27 European Union countries, between 2006 and 2021. The main findings overall confirm the validity of the competition-fragility hypothesis. Moreover, the results obtained for two specific EU countries: Germany and France, highlight some specific differences in particular regarding the effects of bank market concentration, and the responses to the crises that affected the EU banking institutions over the considered period. The findings of this paper reinforce the relevance of the policy makers' role and give room to some recommendations.

Keywords: Bank stability: bank competition; Z-score; Herfindahl-Hirschman Index; Boone indicator; EU banking sector.

JEL Classification: C33; D53 ; F36 ; G21.

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1. Introduction

The main aim of this paper is to empirically test the validity of the two competing hypotheses regarding the relationship between competition and stability: the competition-fragility hypothesis considering that market competition reduces stability, and the competition-stability hypothesis supporting that market competition increases stability.

Economic theory often supports the view that perfect information and market competition are associated with good performance, while concentration of market power is usually synonym of weak competition and bad performance.

Competition in the banking markets is also many times supposed to benefit the banks' clients, because it increases the available choices, and contributes to the lowering of the borrowing rates and the raising of the deposit rates. In addition, it is recognised that the increasing globalization and liberalisation of financial markets, together with the technological changes across the world, have changed the functional and competitive environment of the banking institutions.

On the other hand, and particularly in the aftermath of the subprime crisis, special attention was paid to the consequences of asymmetric information in financial markets. In order to prevent adverse selection and moral hazard problems, it is often recommended to increase transparency and trust, namely through the establishment of long-lasting relationships between the banking institutions and their clients. These lasting

relationships based on trust are usually associated to bank market power and may also be considered as a necessary condition to bank market stability.

In the European Union (EU), the global process of liberalization was accompanied with the efforts to establish the single European financial market, based on the belief that market competition would increase bank performance. The subprime crisis has hit hard the European banking sector and many EU banks faced serious losses and were able to survive mainly due to the exceptional financial support from their national governments and monetary authorities. Shortly after the global financial crisis some EU countries were also affected by the Euro area sovereign debt crisis, when troubled banks reduced their funding to governments, raising sovereign borrowing costs. The way to overcome the crises included the increase of the process of restructuring and consolidation of the EU banking sector, raising questions about the possibility of guaranteeing the stability of the banking institutions, accompanied with (or supported by) healthy competition in the banking market.

Using a relatively large panel of 784 relevant banks of all the EU member states, over the years 2006-2021, this paper empirically tests the validity of the competition-fragility hypothesis or of the competition-stability hypothesis and .contributes to the literature, providing answers to the following questions:

1) How does bank market competition affect bank market stability in the considered sample of EU banks?
2) Do the results depend on the concrete proxies used to measure competition and stability?
3) Are the results obtained for the whole panel of EU banks in line with the results obtained separately for the sub-panels of the German and the French banks?

4) How did the different crisis periods that affected the EU banking sector during the considered period influence bank stability?
5) Is it possible to identify other factors (besides competition measures and crisis dummies) that contributed to the stability of the EU banking sector over the years 2006-2021?

Overall, the results obtained in the paper are consistent with the competition-fragility hypothesis, but they also reveal that the results depend on the proxies used to measure the stability and the competition of the EU banking sector as well as on potential country specific performance and different reactions namely to the crises that affected the EU banks during the considered period.

The main empirical findings clearly confirm the validity of the competition-fragility hypothesis when bank competition is measured with the Boone indicator. In the cases when bank competition is proxied with the Herfindahl-Hirschman Index the results are not statistically so robust but it is still possible to conclude that the increase of bank market concentration enhances the stability of the German banks included in the sample. The effects of the dummies reflecting the years of the crises that affected the EU during the considered period (2006-2021) also reveal that the subprime crises had a strong negative effect on the sample including all EU banks as well as on the sub-samples including only the German or the French banks. These results are overall confirmed for the dummies representing the other two crises, but also highlighting some specific country differences. Regarding the effects of the dummy representing the sovereign debt crisis, for the panel including only the German banks, there is convincing evidence that the stability of these German banks increased with this crisis. Moreover, although not so

evidently, it looks like that for the sub-panel including only French banks, the dummy representing the recent pandemic crisis had a positive effect on bank stability.

The rest of the paper is structured as follows. Section 2 provides a brief literature review. Section 3 describes the data and the methodology used in the empirical estimations. Section 4 presents the results. Section 5 presents the main conclusions and policy recommendations.

2. Brief literature review

Economic literature on the relationship between bank market competition and stability is far from consensus regarding the relationship between competition and stability. Two main competing hypotheses are identified: on one hand, the competition-fragility hypothesis considering that competition reduces stability, because it encourages banks to increase risk and operate with low capital buffers, highlighting the potential trade-off between competition and stability. On the other hand, the competition-stability hypothesis, which considers that financial consolidation improves stability, namely through higher capital buffers and a greater degree of diversification.

Supporting the competition-fragility view are, for example, Hellman et al (2000) underlying the inconsistency of interest-rate liberalization and prudential bank behaviour, namely because financial-market liberalization increases competition, eroding profits and contributing to the increase of moral-hazard problems. Marquez (2002) highlighted the relevance of access to information, considering that with a high number of competing banks in the market, each bank becomes less informed and potentially less efficient. Dam and Zendejas-Castillo (2006) also found that a higher level of competition induces banks

to invest in risky assets, confirming that risks and potential fragility are associated with competition. Beck et al (2006) analysed the relationship between the market structure of the banking industry and bank fragility, mainly concluding that crises are less likely in economies with more concentrated banking systems.

Beck et al (2013) test the relationship between bank competition and bank stability with cross-country analysis exploring market, regulatory and institutional features. The results obtained are overall consistent with the competition-fragility hypothesis, but they clearly reveal a large cross-country variation, suggesting that an increase in competition is associated with a larger rise in banks' fragility mainly in countries with stricter activity restrictions, lower systemic fragility, better developed stock exchanges, more generous deposit insurance and more effective systems of credit information sharing.

Horvath et al (2016) analysed the relationship between bank competition and bank liquidity creation, concluding that increased bank competition reduces liquidity creation, and they interpreted this result in terms of the effect of competition in increasing bank fragility. Ahnert and Martinez-Miera (2021) present a model to evaluate how different developments in the banking industry, such as changes in competitive intensity or opacity, affect bank fragility, the competitive structure, and welfare. The findings are also in favour of the competition-fragility view, as shocks that increase bank competition or bank transparency contribute to increasing deposit rates, costly withdrawals, and thus bank fragility.

The competition-stability view is supported among others by Boyd and De Nicoló (2005) concluding that as competition in bank markets increases, lending rates reduce as well as the probability of borrower default, and this improves banks' profitability and stability. The same kind of conclusions were obtained in Boyd et al (2009) as well as in De Nicoló

and Turk-Ariss (2010), overall supporting the non-existence of an evident trade-off between competition and stability.

Schaeck et al (2009) also found that more competitive banking systems are less prone to experience systemic crisis; in addition, they considered that economic policies promoting bank market competition, if well executed, have potential to promote stability.

Schaeck and Cihák (2014) examined the effect of market competition on bank stability with the belief that competition incentivizes banks to enhance cost efficiency, increasing reallocation from unsuccessful (inefficient) banks to successful. They confirmed that competition robustly improves stability through the increase of efficiency, concluding also that bank capital and profitability benefit from increased competition. But their results are heterogenous and there is clear evidence that fragile banks benefit less from competition. In favour of the competition-stability view is also Goetz (2018) suggesting that less barriers to entry significantly increases bank stability in the United States, because more competition boosts banks' profits and leads to the reduction of individual banks' shares of non-performing loans.

Martinez-Miera and Repullo (2010) developed Boyd De Nicoló (2005) model, but took into account the degree of market competition, suggesting a U-shaped relationship between competition and the risk of bank failure. They also highlighted the dominant risk-shifting effect of increased competition in highly concentrated markets: more competition leads to lower loan rates, which in turn leads to lower probabilities of loan default, thus corroborating the Boyd De Nicoló (2005) conclusions.

Moreover, Martinez-Miera and Repullo (2010) identified another effect of increased competition, the margin effect, dominating in competitive markets: lower rates reduces the banks' revenues from performing loans, decreasing bank profitability and stability. The same kind of conclusion were obtained by Claessens (2009) considering that

competition in financial services is unambiguously good, but its effect on bank stability clearly depends on the degree of competition; excessive competition can compromise financial stability.

Several works support that the two competing hypotheses (competition-fragility versus competition-stability) do not necessarily lead to opposite effects of competition and market power on bank stability. For example, Berger et al (2009) consider that even if market power in the loan market results in riskier loan portfolios, the overall risks may not increase if banks adopt some appropriate risk-mitigating techniques. Their empirical results are consistent with the competition-stability view, since banks with a higher degree of market power have increased loan portfolio risk; but they also found that banks with a higher degree of market power have less overall risk exposure, therefore supporting the competition-fragility view.

Tabak et al (2012) also found evidence that the two competing hypotheses can hold simultaneously. They analysed the effects of bank competition on the bank risk-taking using data from 10 Latin American countries between 2003 and 2008, concluding that competition affects risk-taking behaviour in a non-linear way as both high and low competition levels enhance financial stability, but there is an opposite effect for average competition. Moreover, the paper highlights the relevance of bank size and capitalization, suggesting that banks in competitive markets look like less vulnerable, especially the larger banks, since banks with a larger capital ratio are more stable.

Liu and Wilson (2013) test the relationship between competition and stability, concluding that it depends on the initial risk of the considered banks. More precisely, they found that banks with high risks tend to avoid more risk, protecting their franchise values when competition increases, which is consistent with the competition-stability hypothesis. On

the other hand, competition has a positive impact on the risk of banks with lower levels of risk, which is in line with the competition-fragility hypothesis.

Analysing the effects of competition on bank stability in the United Kingdom over the period 1994-2013 de-Ramon et al (2018) concluded that on average, the competition-fragility hypothesis holds, as higher levels of competition tend to lower bank-level stability. However, the results are not homogenous and they are highly dependent on the underlying financial strength of the banks. More precisely, there is evidence that financial weak banks clearly benefit from greater levels of competition, and their bank profitability and capitalisation increase as a result of accelerated competition, which is consistent with the competition-stability hypothesis.

Soedarmono et al (2013) also analyse the influence of competition on stability, but focusing on some Asian emerging markets and taking into account the effects of crisis periods (over the years 1994-2009). Overall, the conclusions suggest the competition-fragility view, as they show that a higher degree of market power in the banking market is associated with higher capital ratios, higher income volatility and higher insolvency risk of banks. However, the paper also concludes that market power in banking had a stabilizing impact during the crisis, in particular during the 1997 Asian crisis. Moreover, the paper suggests that the findings are dependent on the size of the largest banks as well as on the "too-big-to-fail" policies of the considered countries.

Brei et al (2020) test the relationship between bank competition and stability in 33 countries of Sub-Saharan Africa over the years 2000-2015, concluding that there is a U-shaped relationship between bank competition and credit risk: up to a certain point higher levels of bank competition are associated with lower credit risks, and beyond this point more competition increases credit risks. Their findings also suggest that increased competition should be accompanied by policies specifically targeted to financial stability,

and that policy makers should encourage bank competition when the banking sector is relatively concentrated but only up to a certain limit.

The same kind of conclusions were obtained by Cuestas et al (2020), confirming the existence of a U-shaped relationship between competition and financial stability in a sample of commercial banks in the Baltic countries over the period 2000–2014. This paper also highlights that the way how the structure of the banking industry evolves is of critical importance for financial stability, suggesting that policy makers should encourage mergers and acquisitions, when competition is fierce; but in contrast, they should prevent augmenting concentration, in the already highly concentrated banking markets.

Leroy and Lucotte (2017) empirically investigate the relationship between competition and bank risk across a large sample of European listed banks over the years 2004–2013 considering both individual and systemic dimensions of risk. The findings provide support for the two competing hypotheses. On one hand, competition looks like to increase individual risk, as banks stressed by competition take more risks, in line with the competition-fragility view. But on the other hand, an increase in market power is associated with more systemic risk, and with an increased contribution of financial institutions to the deterioration of the system, which supports the competition-stability view.

IJtsma et al (2017) empirically test the effect of concentration in the 25 European Union (EU) countries, during the 1998–2014 period, considering both the bank-level and the country-level of financial stability. They concluded that concentration hardly affects stability at both levels, suggesting that in these EU countries, neither supervisory restructuring, nor normal market-driven mergers, are likely to be substantially harmful to financial stability.

3. Data and Methodology

Using panel estimates this paper tests the influence of competition on bank stability considering a relatively large panel including 784 relevant banks of all the 27 European Union (EU) countries between 2006 and 2021.

The banking sector stability is first proxied by the estimated Z-score[2]. Following the usual procedure, Z-score of bank *i* in the year *t* ($Z_{i,t}$) is computed with the expression:

$$Z_{i,t} = \frac{ROA_{i,t} + \left(\frac{E}{TA}\right)_{i,t}}{\sigma ROA_{i,t}} \qquad (1)$$

Where:

$ROA_{i,t}$ = return on average assets (%)

$\left(\frac{E}{TA}\right)_{i,t}$ = equity / total assets (%) = capital ratio

$\sigma ROA_{i,t}$ = standard deviation of the return on average assets

Besides the Z-score, the paper also considers two specific constituent components of the Z-score measure in order to analyse different aspects of the bank stability: the bank profitability and the bank capitalization. Bank profitability is measured with the return on average assets (ROA). Bank capitalization is the capital ratio, that is, the equity to total assets ratio, which also provides a relevant indication of bank risks (the higher is the equity to asset ratio the less risky is the bank).

[2] Used and well-discussed, among others, in Boyd et al (2009), Schaeck and Cihák (2014), de-Ramon et al (2018), IJtsma et al (2017).

Two different measures are used to represent bank competition[3]: the Boone indicator (which measures competition from an efficiency perspective), and the Herfindahl-Hirschman Index (a specific measure of market concentration).

Following, among others, Dutta and Saha (2021), and taking into consideration the intermediation function of the banking institutions, two Boone indicators are computed: one for the banks' loans (B_{loans}) and the other for the banks' deposits ($B_{deposits}$). As the considered sample includes a different number of banks from each of the 27 EU countries and the banking markets of these countries are not homogeneous, the market share of bank *i*, is related to the sub-sample of the banks of its own country (and not the whole sample of 784 banks), in the year *t*. The Boone indicators are the values of the coefficients β that are obtained through the estimation of the following linear equations:

B_{loans}:

$$ln(Market\ share\ of\ the\ loans)_{i,t} = \alpha + \beta\ ln(Average\ variable\ cost)_{i,t} \quad (2)$$

$B_{depositss}$:

$$ln(Market\ share\ of\ the\ deposits)_{i,t} = \alpha + \beta\ ln(Average\ variable\ cost)_{i,t} \quad (3)$$

Where the average variable cost is proxied by the sum of the interest expense and the non-interest expense to the total loans (in the case of B_{loans}) or to the total customer deposits (for $B_{deposits}$).

The Herfindahl-Hirschman Index (HHI) also considers the market share of bank *i*, in relation to the sub-sample of the banks of its own country. Therefore, the HHI indicates the level of bank market concentration in each of the 27 EU countries, and it is also

[3] The advantages and disadvantages of the use of these and other proxies of bank competition (such as the Lerner index) are well-discussed, for example, in Schaeck and Cihák (2014), Leon (2015), de-Ramon et al (2018), Dutta and Saha (2021).

computed separately for the market share of the banks' loans and the banks' deposits, following the usual definition:

$$HHI_{loans} = \sum_{i=1}^{N} (Market\ share\ of\ the\ loans)_{i,t}^{\ 2} \quad (4)$$

$$HHI_{deposits} = \sum_{i=1}^{N} (Market\ share\ of\ the\ deposits)_{i,t}^{\ 2} \quad (5)$$

All data reporting banks' performance are sourced from the Moody's Analytics BankFocus database in December 2022. The choice of the banks took into consideration not only the availability of de data for the period 2006-2021 but also the size of the banks. Overall, banks with less than 2 billion Euros of total assets in 2021 were excluded from the sample. However, for the EU countries with few banks with a high amount of total assets, the sample includes banks with less than 2 billion Euros of total assets (but not far from 1 billion Euros in 2021). Annex I specifies the number of the banks for each of the 27 EU countries included in the sample, and their representatives not only in terms of the percentage of the total number of the banks included in the whole sample, but also in terms of their percentages of the total loans and the total deposits to costumers. The information provided in Annex I clearly highlights the specific situations of two EU countries: France and Germany. More precisely, the French banks included in this sample, represent around 16% of the total number of banks, but collect 31% of the deposits and provide 33% of the deposits; on the other hand, the German banks represent 41% of the banks included in the sample, but they represent only 27% of the collected deposits and 26% of the provided loans.

Additionally, two control variables are included in the estimations: the ratio of the net loans to total assets (%), and the natural logarithm of the real per capita Gross Domestic

Product (GDP). Like all the other variables related to bank performance, the ratio of the net loans to total assets was sourced from the Moody's Analytics BankFocus database. The values of the GDP were sourced in November 2022 from the World Bank database "Global Financial Development", freely available at Global Financial Development Database (worldbank.org)

The net loans to total assets ratio gives an indication of the bank liquidity situation, more precisely of how much of the bank assets are tied into liquid (or illiquid) loans; and the growth of the real GDP per capita is a proxy of the countries' macroeconomic conditions. Moreover, as the paper aims to test the effects on the bank market stability of the crises that affected the EU countries during the period 2005-2021, three dummies were included for the years of the main crisis: the global subprime financial crisis, D_1 (for the years 2008-2010), the sovereign debt crisis, D_2 (for 2011-2013), and the pandemic crisis, D_3 (for 2020 and 2021). The estimated model is basically the following:

$$bank\ stability_{i,t} = \alpha_0 + \alpha_1\ bank\ competition_{i,t} + \alpha_2\ net\ loans\ to\ total\ assets\ ratio_{i,t} + \alpha_3\ GDP_{j,t} + \alpha_4\ D_1\ + \alpha_5\ D_2 + \alpha_6\ D_3 + \varepsilon_{i.t} \quad (6)$$

Where, the stability of bank *i* (*i= 1, …784*), in year *t* (*t = 2006, …, 2021*), is first proxied with the natural logarithm of the Z-score, and then with two of its components: the return on average assets, and the equity to total assets ratio; bank market competition is measured with one of the mentioned competition indicators: B_{loans}, $B_{deposits}$, HHI_{loans}, HHIdeposits; GDP is the real domestic product of the EU country *j* (*j = 1, …27*); D_1, D_2, and D_3 are the crisis dummies; and $\varepsilon_{i,t}$ is the error term (Annex II presents the descriptive statistics and the pairwise correlations between the variables included in the estimations).

Equation (6) is estimated for each of the three dependent variables, proxies of bank stability (Z-score, bank profitability, and bank capitalization) first applying fixed and random effects estimations, and using the values of the Hausman test to determine, in each situation, whether the fixed effects model or the random effects model is more appropriate.

As clearly explained, for example in Wooldridge (2010) and in Green (2018) fixed effects estimations allow to overcome one important concern in cross-sectional studies: the potential omission of relevant control variables. Fixed effects regressions control for any time-invariant cross-sectional variable and are particularly appropriate to analyse the impact of variables that vary over the time. Fixed effects explore very well the relationship between the explanatory variables and the outcome within each cross unit. A random effects model assumes that explanatory variables have fixed relationships with the response variable across all observations, and that these fixed effects may vary from one observation to another, although usually following a normal distribution. An estimation of random effects provides inference about the specific levels (similar to a fixed effect), but also population level information.

The robustness of the results obtained with fixed and random effects is tested in this paper using also dynamic one-step system GMM (Generalized Method of Moments) estimations. GMM deal well with another concern in the context of the considered model: the potential existence of endogenous regressors. Dynamic GMM panel estimations not only address the endogeneity problems, but also reduce the potential bias of the estimated coefficients. The GMM method proposed, among others by Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998, uses cross-country information and jointly estimates the equations in first difference and in levels, with first differences

instrumented by lagged levels of the dependent and independent variables and levels instrumented by first differences of the regressors.

4. Empirical results

The basic model is estimated for each of the three proxies of bank stability (Z-score, bank profitability, and bank capitalization), with four equations for each dependent variable, all using the same sample of control variables, but separately including one of the proxies for bank competition: B_{loans}, $B_{deposits}$, HHI_{loans}, HHIdeposits.

The paper first presents the results obtained over the years 2006-2021 for the whole panel of the 784 banks from the 27 EU countries that are considered in the estimations. Then it separately presents the results obtained for the 322 German banks and for the 129 French banks. Finally, there is a brief summary of the results obtained for all the considered panels when the Z-score is the chosen variable to represent bank stability.

4.1.Results obtained for the whole panel of the considered EU banks

Table 1A presents the results obtained for the whole panel of the 784 EU banks using either fixed or random effects (following the indications of the Hausman test values). The values of the F or Wald statistics provide evidence of the overall robustness of the reported results.

There is robust statistical evidence that the increase of bank market competition (proxied with the Boone indicator, which measures competition from an efficiency perspective) is not in favour of bank market stability.

More precisely, the increase of the country's market competition, either in the banks' loans (B_{loans}) or in the banks' deposits ($B_{deposits}$), clearly contributes to the decrease not

only of the bank stability (measured with the Z-score) but also to the decrease of other two relevant aspects bank stability: bank profitability and bank capitalization. These results are clearly consistent with the competition-fragility hypothesis.

Overall, the results obtained for the concentration measure both for bank loans (HHI_{loans}) and for bank deposits ($HHI_{deposits}$) are not statistically robust, and do not allow very relevant conclusions about the influence of the country's bank market concentration on bank stability.

Table 1A around here

Still according to the results presented in Table 1A, the contribution of the banks' liquidity situation (indicating how much of the banks' assets are tied into liquid loans) to banks' stability is always statistically robust. More precisely, there is very convincing evidence that banks' liquidity contributes to the increase of the banks' Z-scores as well as to the increase of one aspect of bank stability: bank capitalization (the equity to total assets ratio) meaning also that the increase of banks' liquidity contributes to less risky banks. However, the banks' liquidity situation has a clear negative influence on the other aspect of bank stability: bank profitability, which is measured with the return on average assets. The influence of the growth rate of the real GDP per capita on bank stability is also not fully unanimous, probably reflecting the differences in the individual macroeconomic conditions of the EU countries. Overall, the results for the real GDP growth are in line with the results obtained for the other control variable (the bank liquidity situation) as there is again convincing evidence that the increase of real per capita GDP growth positively contributes to bank stability measured with the Z-score and bank capitalization. But the results regarding the influence of the real GDP growth on bank profitability are not sufficiently robust to allow credible conclusions.

Not surprisingly, Table 1A indicates that all the included crisis dummies have a clear and statistically robust negative influence on all the three proxies of bank stability. The only exception are the results regarding the pandemic crisis (2020-2021) but only when bank stability is provide with bank profitability (more precisely, the Return on average assets).

The results obtained for the same regressions, still considering the panel with the 784 EU banks, but now using dynamic one-step system GMM estimations, are reported in Table 1B. The overall robustness of these results is confirmed with the values of the Wald tests and to some extend also with the tests proposed by Arellano and Bond (1991), which are used to test autocorrelation, that is, the assumption that the error term is not serially correlated using the differenced error term. The validity of the instruments is also assured with the values of the Sargan statistic, which is supposed to be robust to heteroskedasticity and autocorrelation.

Table 1B around here

Despite the few exceptions, the results obtained with GMM estimations are generally in line with the results obtained with random and fixed effects estimations, namely regarding the validity of the competition-fragility hypothesis, when bank competition is measured with the two Boone indicators (B_{loans} and $B_{deposits}$).

The few exceptions are related namely to the influence of the bank market concentration measures: now there is clear evidence that the increase of both the HHI_{loans} and the $HHI_{deposits}$ have positive contributions to bank stability when it is measured with the Z-score. The HHI_{loans} also looks like contributing to the increase of bank profitability but the results regarding the contribution of the HHI_{loans} to bank capitalization raise doubts about the positive (or negative) influence of the banks' loans concentration to the equity to total assets ratio (and to banks' risks).

The influence of the banks' liquidity situation to stability is again statistically very robust, and corroborating the previous results, there is clear demonstration that bank liquidity has a positive effect on the banks' Z-scores. However, the results obtained with GMM estimations for the other two considered aspects of bank stability: bank profitability and bank capitalization, are not clearly in line with the ones obtained with random and fixed effects estimations, making difficult to conclude whether the banks' liquidity situation has a positive or negative influence on bank profitability and bank capitalization.

The results regarding the influence of the real GDP growth on bank stability are again not fully homogenous. Looking only to the statistically robust results that were obtained with GMM estimations, it is possible to confirm that a higher growth of real per capita GDP has a positive influence on bank capitalisation. But regarding the other two dependent variables (Z-score and bank profitability) the results indicate that the growth of the real GDP is not promoting bank stability, particularly in the two regressions where market competition is represented with the B_{loans} indicator. Also, when the regressions include HHI_{loans} or $HHI_{deposits}$ as proxies of market competition, the real GDP growth looks like having a negative influence on the Z-score indicator of bank stability. These non-unanimous results probably reflect not only the different macroeconomic conditions of the individual EU countries, but they can also be related to the heterogeneities of their market competition conditions and to the appropriateness (or not) of the considered bank market competition measures.

The results obtained with GMM estimations regarding the influence of the crisis dummies on bank stability are fully in line with those obtained with fixed and random effects estimations when stability is measured with the Z-score or with the equity to total assets ratio, confirming that the three crisis dummies have a clear and statistically robust negative influence on these two proxies of bank stability. But the results regarding the

effects on bank profitability of the crisis dummies, particularly of those reflecting the years 2008-2010 and 2020 and 2021, raise doubts about their potential positive contribution to bank stability of the considered panel of EU banks.

4.2.Results obtained for the sub-panel including the 322 German banks

Table 2A reports the results obtained following the previous methodology and using panel fixed or random effects (following the indications of the Hausman test) but now considering the sub-panel including only the 322 German banks.

Overall, the values of the F statistics and almost all the results obtained with the estimations of the four regressions when bank stability is represented with bank profitability (more precisely, the return on assets) in this case are not sufficiently robust to allow valid conclusions.

The results are statistically more robust when bank capitalisation (the equity to total assets ratio) is the dependent variable, e.g. the proxy of bank stability. They clearly confirm the validity of the competition-fragility hypothesis when competition is represented with the two estimated Boone indicators. Moreover, it is possible to conclude that one of the control variables: the net loans to total assets ratio (measuring the bank's liquidity situation) has a positive effect on bank stability. The other relevant results in this case are related to the influence of the crisis dummies. As expected, the stability of the German banks included in our sample, was negatively affected by the dummies representing the subprime crisis (2008-2010) and the Covid-19 crisis (2020-2021) but not significantly influenced by the dummy representing the sovereign debt crisis.

Table 2A around here

Still according to the results presented in Table 2A, it is possible to conclude that the estimations are statistically much more robust when stability is represented with the Z-

score. Now there is not only very convincing evidence of the validity of the competition-fragility hypothesis (when competition is measured either with the B_{loans} or with the $B_{deposits}$ indicators) but also that the other two proxies of market competition: HHI_{loans} and $HHI_{deposits}$, are relevant to explain the stability of the German banks included in the sample. More precisely, in this case, it is possible to conclude that the increase of the concentration of the German bank market (both in terms of loans and deposits) has a positive influence on bank market stability. Moreover, it is possible to confirm that the net loans to total assets ratio has a positive effect on bank stability; and in line with the two previous situations, the results regarding the effect of the real GDP growth on the Z-score are not sufficiently robust to allow valid conclusions.

The results reported in Table 2A clearly highlight the differences in the effects of the considered crisis dummies on the stability (measured with the Z-score) of the German banks: while the dummies representing the subprime and the pandemic crises affected negatively the banks' stability, the dummy representing the years of the sovereign debt looks like having a positive influence on the stability of the German banks.

Table 2B provides the results obtained using dynamic one-step system GMM estimations for the sub-sample including only the German banks. The overall statistical robustness of these results is well demonstrated, not only with the values of the Wald and the Sargan tests, but also with the much more clear evidence that there is autocorrelation of first order, AR(1), but not of second order AR(2).

The results obtained with GMM estimations when the dependent variable is the Z-score are very similar to those obtained with fixed effects, clearly validating the previous conclusions about the effects on the stability of the German banks of the competition proxies, the control variables, and the crisis dummies.

As to the results obtained for the other two proxies of bank stability, it is worth noting that now the real GDP growth looks like having statistically robust positive effects both on bank profitability and on bank capitalization, while the net loans to total assets ratio goes on having a positive effect on bank stability (but here only when it is represented with equity to total assets ratio). However, now the results related to the crisis dummies are not convincing enough to allow credible conclusions.

Table 2B around here

4.3.Results obtained for the panel including the 129 French banks

Still following the same estimations procedures, but now for the sub-sample of the 129 French banks, Table 3A presents the results obtained with random effects estimations (which according to the Hausman test values were more appropriate than the fixed effects estimations). In all situations the values of the F statistics do not raise doubts about the overall robustness of these estimations.

There is still overall evidence of the validity of the competition-fragility hypothesis, although now not so strongly. The results are statistically robust only when competition is proxied with the Boone indicators, particularly with the $B_{deposits}$, and when the Z-score or the equity to total assets are the depend variables.

In line with all the other situations, the control variable representing the bank liquidity situation, e.g. the increase of the ratio net loans to total asset, positively contributes to bank stability, but again, only when it is proxied with the Z-score or the equity to total assets. The results regarding the other dependent variable are still statistically robust but indicate that the higher are the return on assets, the less stable are the French banks included in the panel.

The results reflecting the effects of the real per capita GDP growth are still mixed and not particularly robust; nevertheless, now there is credible evidence that a higher macroeconomic growth positively contributes to the increase of the French banks' profitability.

Moreover, the results reflecting the effects of the crisis dummies on the sub-sample of the French banks are fully in line with those obtained for the whole panel including banks from all the 27 EU countries. There is again statistically robust evidence that the dummies representing the three considered crises had a negative influence on the stability of the French banks (with the already mentioned exception of the no evident effect of the Covid crisis but only when bank stability is proxied with the return on assets).

Table 3A around here

The same equations are again estimated for the sub-panel of the French banks using dynamic one-step system GMM estimations. The results are provided in Table 3B and now very clearly confirm the validity of the competition-fragility hypothesis, but only when stability is proxied with the Z-score or the equity to total assets.

The influence of the control variable representing the bank liquidity situation is fully in line with the results obtained with random effects estimations. Moreover, it is still hard to define the kind of influence that the real GDP growth has on the stability of the French banks, except when stability is proxied with the return on assets, confirming the previous conclusion that a higher economic growth positively contributes to the increase of the French banks' profitability.

The results regarding the influence of the crisis dummies are also fully consistent with the ones that were obtained with random effects estimations. The only relevant exception are the statistically robust results reporting the effects of the dummy representing the

pandemic crisis that now looks like having a positive influence on the return on average assets of the French banks.

Table 3B around here

4.4. Summary of the results obtained for all panels when bank stability is represented with the Z-score

The results of the estimated equations were overall much more robust when the bank stability was proxied with the estimated Z-score which combines the other aspects of bank stability (bank capitalization and bank profitability), as well as the volatility of the bank profitability.

The summary of the results obtained with fixed or random effects estimations as well as with dynamic one-step system GMM estimations is presented in Table 4 and indicate that:

- There is convincing evidence that in all reported situations, when bank market competition is represented with the Boone indicator (which measures competition from an efficiency perspective), the increase of competition has a very robust negative effect on bank stability, clearly validating the competition-fragility hypothesis. This conclusion is valid both for the B_{loans} and the $B_{deposits}$ indicators.
- The results obtained are not so unanimous when competition is represented with the Herfindahl-Hirschman Index (HHI). Nevertheless, there is still statistical very robust evidence that a higher level of bank market concentration, both in terms of the loans (HHI_{loans}) and the deposits ($HHI_{deposits}$) contributes to the increase of the stability of the German banks included in the sample. This conclusion is also valid for the whole panel of all the 784 EU banks, mostly when the regressions are performed using dynamic GMM estimations. On the other hand, the mixed results

obtained for the sub-sample of the French banks point to the overall conclusion that the increase of bank market concentration is not an appropriate way to contribute to the stability of the French banks.

- A clear and relevant conclusion is that in all situations, the higher is the net loans to total assets ratio (a control variable included in all performed estimations, that provides an indication of the bank liquidity situation) the more stable will be the considered EU banks.
- The results obtained regarding the influence of the crisis dummy associated with the subprime crisis (years 2008-2010) very clearly demonstrate that it had a robust negative impact in the stability of the EU banks included in the estimations.
- The same negative effect on bank stability is evidently demonstrated for the sovereign debt crisis (2011-2013) dummy, both for the whole sample of the 784 EU banks included in the sample, and for the sub-panel including only the 129 French banks. On the other hand, there is an opposite effect for the sub-panel including the 322 German banks: now this crisis dummy has a very clear positive impact on the stability of the German banks.
- The results obtained for the dummy representing the pandemic crisis (2020-2021) reveal that it had a clear negative impact for both the panel of all EU banks and for the sub-panel of the German banks. However, the results are not so unanimous in the case of the French banks and, at least when using GMM estimations, it is possible to conclude that the stability of the France banks increased with the pandemic crisis.

Table 4 around here

5. Main conclusions and policy recommendations

This paper contributes to the literature analysing the relationship between bank market competition and stability in the EU banking sector, over the period 2006-2021. It considers first a panel including 784 banks from all the 27 EU member states and then two sub-panels: one including only the 322 German banks and the other only with the 129 French banks.

The results obtained using panel fixed and random effects estimations as well as dynamic one-step system GMM estimations, allow the following conclusions:

1) There is overall demonstration of the validity of the competition-fragility hypothesis, as a higher bank market competition does not contribute to the increase of bank stability in the considered panels of EU banks. This conclusion reveals that the stability of the EU banking sector will not benefit from the increase of market competition, probably because there is already a high level of bank market competition, due not only to the global process of liberalization but also to the specific process of economic and financial integration, namely associated to the establishment of the single European financial market.

2) The results obtained clearly depend on the concrete proxies that were used to measure bank competition and stability. The findings are much more unanimous when competition is proxied with the Boone indicators, which measure competition from an efficiency perspective, without relevant differences in the results obtained when competition is measured in the loans (B_{loans}) or in the deposits market ($B_{deposits}$). This conclusion is in line, for example, with Schaeck

and Cihák (2014), and Dutta et al (2021), who discuss and support the advantages of using Boone indicators to measure bank competition. Moreover, the empirical results of this paper are also much more consistent when bank stability is measured with the computed Z-score, than when it is proxied with two of its components: bank profitability (the returns on assets) or bank capitalisation (the equity to total assets ratio). But there is also evidence that the different measures of market competition may have specific effects on one of the distinct components of the Z-score (overall supporting the findings of, among others, de-Ramon et al, 2018). These conclusions clearly underline the relevance of discussing the results obtained taking into due consideration the specific aspects of the used measures and indicators.

3) The results obtained for the whole panel including the considered 784 banks from the 27 EU countries are overall in line with those obtained for the sub-panels including either only the 322 German banks or the 129 French banks. Nevertheless, it is still possible to identify some country specific results, namely regarding the relevance of the measure of bank market concentration, the Herfindahl-Hirschman Index, for the stability of the German banks. More precisely, there is very clear evidence that the increase of concentration in the German's loans (HHI_{loans}) and deposits ($HHI_{deposits}$) markets has a robust positive effect on the stability of the considered German banks. This specific result reveals that despite the relevant process of European economic and financial integration, and the fact that the German banks represent more than 41% of all banks considered in this paper, the behaviour of the German banks does not clearly represent the behaviour of the whole panel.

4) There is overall evidence that the identified crises had a negative effect on the stability of the EU banking sector. But it is still possible to identify differences in the effects associated to specific crisis dummies as well as to the concrete sub-panels. It is particularly evident that, contrary to the results obtained for the whole panel of 784 EU banks and to the sub-panel of the French banks, there is very robust evidence that the dummy representing the years of the sovereign debt crisis (2011-2013) has a positive effect on the German's bank stability. This result confirms that the German banks were not negatively affected by this specific crisis as Germany was not one of the EU countries facing the problems associated with too high sovereign debts. The finding of this paper also reveal some differences in the effects associated to the dummy representing the pandemic crisis, namely in the sub-panel including only the French banks as, at least when using GMM estimations, the results indicate that the stability of the French banking sector increased with this crisis.

5) The results regarding the effects of the two considered control variables overall reveal that increasing the growth of the real GDP per capita is not the most appropriate way to assure bank stability. On the other hand, in all considered panels, there is very convincing demonstration that the increase of the net loans to total assets ratio, indicating improved bank liquidity situation, has a strong positive effect on stability of the EU banking sector.

The findings of this paper reinforce the relevance of the policy makers' role and give room to some recommendations. Bank market competition in the EU is probably already sufficiently high, and it should not be reinforced as, overall, the increase of bank

competition looks like detrimental to the stability of the EU banking institutions (at least of the most relevant ones, in terms of their total assets in 2021).

The findings also highlight that overall, the policies fomenting bank merging and acquisitions, increasing bank market concentration, are not the best way to assure the stability of the EU banking sector. However, the results obtained also reveal some country specific characteristics. For example, when considering only the sub-sample of the German banks, a higher bank market concentration is strongly recommended to increasing the stability of the German's banking sector.

The results obtained with the dummies representing the crises that affected the EU countries over the years 2006-2021, also recommend particular attention to some cross-country differences. Despite the process of economic and financial integration in the EU, the member states and their banking institutions still have some individual characteristics that should be taken into account, and do not always recommend the adoption of "one size fits all " policies.

Further research should also be encouraged, in this field, namely exploring the impact of the different policies as well as some relevant exogenous shocks on the banking systems, namely the consequences of the current high inflation rates, the overall instability, and the new challenges that the whole world and particularly Europe is facing in these turbulent years.

Table 1A – Results obtained with panel fixed and random effects estimations – whole sample of 784 EU banks (N = 12544 observations)

784 EU banks	Z-SCORE				Return on average assets				Equity to total assets ratio			
	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$
	FE	FE	FE	FE	RE	RE	RE	RE	FE	FE	FE	FE
B_{loans}	-.0221*** (-5.59)				-.0499** (-2.04)				-.1147*** (-2.66)			
$B_{deposits}$		-.0236*** -6.21				-.0427* (-1.78)				-.1606*** (-3.87)		
HHI_{loans}			2.52e-10 (0.70)				6.77e-10 (0.27)				1.46e-09 (0.37)	
$HHI_{deposits}$				2.74e-08 (1.24)				7.82e-09 (0.05)				2.18e-07 (0.91)
Net loans to total assets ratio	.0046*** (14.54)	.0045*** (14.38)	.0046*** (14.62)	.0046*** (14.62)	-.0032** (-2.24)	-.0034** (-2.33)	-.0034** (-2.34)	-.0034** (-2.34)	.0226*** (6.58)	.0222*** (6.47)	.0227*** (6.63)	.0228*** (6.63)
GDP per capita	.7714*** (15.28)	.7618*** (15.11)	.7580*** (15.01)	.7584*** (15.02)	-.0716 (-0.94)	-.0743 (-0.97)	-.0968 (-1.29)	-.0967 (-1.28)	5.509*** (10.01)	5.465*** (9.94)	5.439*** (9.89)	5.442*** (9.90)
$D1_{(2008-210)}$	-.0739*** (-9.48)	-.0774*** (-9.92)	-.0743*** (-9.52)	-.0743*** (-9.53)	-.1192** (-2.14)	-.1255** (-2.25)	-.1110** (-2.15)	-.1202** (-2.16)	-.3838*** (-4.52)	-.4072*** (-4.78)	-.3859*** (-4.54)	-.3861*** (-4.54)
$D2_{(2011-2013)}$	-.0293*** (-4.16)	-.0251*** (-3.60)	-.0236*** (-3.38)	-.0236*** (-3.38)	-.2234*** (-4.45)	-.2129*** (-4.28)	-.2104*** (-4.23)	-.2105*** (-4.23)	-.1376* (-1.79)	-.1181 (-1.56)	-.1080*** (-1.42)	-.1079*** (-1.42)
$D3_{(2020-2021)}$	-.0919*** (-9.71)	-.0962*** (-10.21)	-.0969*** (-10.26)	-.0967*** (-10.25)	-.0680 (-1.01)	-.0775 (-1.16)	-.0794 (-1.19)	-.0793 (-1.18)	-.7406*** (-7.17)	-.7622*** (-7.42)	-.7663*** (-7.45)	-.7653*** (-7.44)
Const	-34.93*** (-22.26)	-34.36 (-21.83)	-35.29*** (-22.47)	-35.26*** (-22.46)	24.53** (2.22)	25.52** (2.31)	23.64** (2.14)	23.70** (2.15)	-238.5*** (-13.94)	-234.1*** (-13.64)	-240.4*** (-14.06)	-240.2*** (-14.05)
Hausman test (Prob > chi2)	252.43 (0.0000)	240.68 (0.0000)	241.30 (0.0000)	241.57 (0.0000)	7.58 (0.3715)	9.15 (0.2419)	6.84 (0.3358)	6.85 (0.3350)	120.75 (0.0000)	114.55 (0.0000)	106.64 (0.0000)	106.73 (0.0000)
R-squared within	0.1616	0.1621	0.1594	0.1595	0.0025	0.0028	0.0024	0.0024	0.0613	0.0558	0.0608	0.0608
F or Wald test (Prob > F) or (Prob > chi2)	323.68 (0.0000)	324.92 (0.0000)	318.45 (0.0000)	318.63 (0.0000)	33.96 (0.0000)	32.97 (0.0000)	29.87 (0.0001)	29.81 (0.0001)	109.70 (0.0000)	687.78 (0.0000)	108.64 (0.0000)	108.75 (0.0000)

This table presents the results of the author's estimations, using panel fixed and random effects estimations, considering as dependent variables the proxies for bank stability, the natural logarithm of the computed Z-score as well as two components of the Z-score: the return on assets (representing bank profitability) and the equity to total assets (representing bank capitalization). Separate equations are estimated for each of the computed measures of bank competition in the loan and deposit markets: Boone indicators (Bloans, Bdeposits,) and Herfindahl-Hirschman Indices (HHIloans and HHIdeposits). All equations include two control variables: the ratio of the net loans to total assets, and the natural logarithm of the real per capita GDP, as well as the three dummies representing the years of the crises that affected the EU banking sector over the period 2006-2021. ***significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 1B – Results obtained with dynamic one-step system GMM estimations – whole sample of 784 EU banks
(N = 12544 observations)

784 EU banks	Z-SCORE				Return on average assets				Equity to total assets ratio			
	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$
B_{loans}	-.1470*** (-11.95)				-1.864*** (-6.37)				-.0476 (-0.45)			
$B_{deposits}$		-.6845*** (-16.27)				1.111*** (3.12)				-9.652*** (-16.28)		
HHI_{loans}			4.6e-08*** (3.58)				4.42e-07* (1.75)				-4.57e07*** (-3.07)	
$HHI_{deposits}$				1.12e-06** (2.19)				.00008 (1.42)				5.84e-06 (1.48)
Net loans to total assets ratio	.0377*** (34.25)	.0498*** (23.95)	.0362*** (18.84)	.0359*** (29.82)	.3177*** (15.07)	.2358*** (11.96)	.2645*** (9.06)	.2872*** (3.71)	-.1595*** (-14.85)	-.0847*** (2.92)	-.1500*** (-6.42)	-.1592*** (-13.97)
GDP per capita	-.5391*** (-8.50)	.1850 (1.53)	-.7470*** (-6.78)	-.6859*** (-9.97)	-2.17*** (-2.80)	.3926 (0.57)	-.3449 (-0.32)	-.6799 (-0.24)	5.947*** (11.89)	21.03*** (12.89)	6.053*** (5.59)	5.9570*** (11.17)
D1(2008-210)	-.0900*** (-12.61)	-.1782*** (-13.17)	-.0713*** (-5.22)	-.0889*** (-11.21)	2.953*** (10.40)	2.394*** (10.34)	2.595*** (6.07)	2.397** (2.31)	-.2624 (-4.31)	-1.302*** (-7.34)	-.4371 (-3.01)	-.2509*** (-3.80)
D2(2011-2013)	-.0792*** (-11.42)	-.0660*** (-6.06)	-.0294** (-2.55)	-.0397*** (-5.71)	-.1911 (-0.80)	-.2005 (-0.94)	.1318 (0.36)	.1406 (0.15)	-.6295*** (-10.80)	-.8101 (-5.78)	-.7280*** (-6.16)	-.6040*** (-10.77)
D3(2020-2021)	-.0309*** (-3.48)	-.0127 (-0.85)	-.0726*** (-4.86)	-.0604*** (-6.33)	2.184*** (8.88)	1.064*** (5.37)	1.192*** (3.75)	1.504*** (1.85)	-.6937 (-10.03)	-.1481 (-0.82)	-.6293*** (-4.34)	-.6788*** (-9.39)
Const	-25.49*** (-15.93)	3.385 (1.01)	-33.20*** (-10.54)	-27.37*** (-15.41)	905.7*** (20.25)	721.7*** (17.23)	718.0*** (9.69)	817.5*** (5.09)	157.2*** (12.76)	550.5*** (13.36)	199.7*** (6.59)	159.7*** (11.93)
Wald chi2(8) test (Prob > chi2)	375296.70 (0.000)	124225.84 (0.000)	121011.04 (0.000)	306997.61 (0.000)	1224.74 (0.000)	1587.18 (0.000)	534.59 (0.000)	79.96 (0.000)	300580.32 (0.000)	40923.56 (0.000)	62519.79 (0.000)	258339.50 (0.000)
AB AR(1) z (Pr > z)	-23.91 (0.000)	-15.05 (0.000)	-4.21 (0.000)	-4.76 (0.000)	-20.76 (0.000)	-31.78 (0.000)	-2.38 (0.018)	-1.47 (0.141)	-14.91 (0.000)	-12.28 (0.000)	-3.31 (0.001)	-3.91 (0.000)
AB AR(2) z (Pr > z)	3.97 (0.000)	-5.67 (0.000)	0.56 (0.575)	1.98 (0.048)	4.26 (0.000)	0.06 (0.952)	0.07 (0.945)	-0.02 (0.986)	3.14 (0.002)	-8.60 (0.000)	0.61 (0.543)	2.93 (0.003)
Sargan test chi2 (Prob > chi2)	3372.36 (0.000)	896.71 (0.000)	1120.97 (0.000)	2871.75 (0.000)	5604.64 (0.000)	7510.28 (0.000)	2530.98 (0.000)	369.56 (0.000)	13522.75 (0.000)	1564.08 (0.000)	2802.88 (0.000)	11620.28 (0.000)

This table presents the results of the author's estimations, using dynamic one-step system GMM estimations, considering as dependent variables the proxies for bank stability, the natural logarithm of the computed Z-score as well as two components of the Z-score: the return on assets (representing bank profitability) and the equity to total assets (representing bank capitalization). Separate equations are estimated for each of the computed measures of bank competition in the loan and deposit markets: Boone indicators (Bloans, Bdeposits,) and Herfindahl-Hirschman Indices (HHIloans and HHIdeposits). All equations include two control variables: the ratio of the net loans to total assets, and the natural logarithm of the real per capita GDP, as well as the three dummies representing the years of the crises that affected the EU banking sector over the period 2006-2021. ***significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 2A – Results obtained with panel fixed and random effects estimations – 322 German banks (N = 5152 observations)

322 German banks	Z-SCORE				Return on average assets				Equity to total assets ratio			
	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$
	FE	FE	FE	FE	RE	RE	RE	RE	FE	FE	FE	FE
B_{loans}	-.0629*** (-5.40)				-.0442 (-0.25)				-.2468*** (-2.01)			
$B_{deposits}$		-.2808*** (-5.26)				-.1281 (-0.16)				-1.443*** (-2.57)		
HHI_{loans}			.0012*** (4.76)				.0005 (0.28)				.0041 (1.56)	
$HHI_{deposits}$				.0007*** (3.37)				.0008 (0.42)				.0023 (1.01)
Net loans to total assets ratio	.0100*** (19.46)	.0100*** (19.50)	.0101*** (19.58)	.0101*** (19.62)	.0019 (0.73)	.0019 (0.73)	.0019 (0.73)	.0019 (0.72)	.0797*** (14.73)	.0797*** (14.73)	.0800*** (14.78)	.0801*** (14.80)
GDP per capita	-1.172*** (-4.69)	.3257 (1.42)	.2687 (1.17)	-.1985 (-1.01)	5.608 (1.56)	6.427** (1.98)	6.407** (2.16)	6.309** (2.21)	-3.033 (-1.15)	3.626 (1.51)	2.344 (0.97)	.6983 (0.34)
D1(2008-210)	-.0971*** (-10.12)	-.0901*** (-9.43)	-.0697*** (-6.55)	-.1044*** (-10.18)	.3232** (2.24)	.3263** (2.27)	.3352** (2.27)	.3132** (2.13)	-.4779*** (-4.73)	-.4480*** (-4.46)	-.3807*** (-3.40)	-.4970*** (-4.61)
D2(2011-2013)	.0408*** (5.49)	.0408*** (5.47)	.0279*** (3.85)	.0292*** (4.03)	-.0247 (-0.22)	-.0262 (-0.23)	-.0323 (-0.30)	-.0332 (-0.30)	.0463 (0.59)	.0582 (0.74)	-.0030 (-0.04)	.0018 (0.02)
D3(2020-2021)	-.1884*** (-12.05)	-.1352*** (-9.51)	-.0891 (-4.70)	-.1132*** (-6.37)	.3002 (1.32)	.3295 (1.58)	.3498 (1.56)	.3642 (1.61)	-1.066*** (-6.48)	-.8391*** (-5.61)	-.7051*** (-3.54)	-.7989*** (-4.28)
Const	-92.06*** (-23.73)	-60.12*** (-12.30)	-81.20*** (-25.70)	-88.41*** (-21.80)	100.5* (1.81)	116.9* (1.69)	107.71** (2.35)	99.63** (1.98)	-570.7*** (-13.98)	-421.4*** (-8.20)	-527.3*** (-15.87)	.2695*** (9.60)
Hausman test (Prob > chi2)	16.74 (0.0191)	15.13 (0.0344)	19.58 (0.0066)	18.58 (0.0096)	0.24 (1.0000)	0.35 (0.9998)	0.29 (0.9995)	0.29 (0.9996)	24.10 (0.0011)	23.36 (0.0015)	24.85 (0.0008)	25.29 (0.0007)
R-squared within	0.5594	0.5593	0.5588	0.5578	0.0022	0.0022	0.0022	0.0022	0.3600	0.3603	0.3598	0.3596
F or Wald test (Prob > F) or (Prob > chi2)	874.84 (0.0000)	874.36 (0.0000)	872.75 (0.0000)	869.11 (0.0000)	11.06 (0.1359)	11.03 (0.1375)	11.08 (0.1353)	11.18 (0.1310)	387.58 (0.0000)	388.15 (0.0000)	387.22 (0.0000)	386.90 (0.0000)

This table presents the results of the author's estimations, using panel fixed and random effects estimations, considering as dependent variables the proxies for bank stability, the natural logarithm of the computed Z-score as well as two components of the Z-score: the return on assets (representing bank profitability) and the equity to total assets (representing bank capitalization). Separate equations are estimated for each of the computed measures of bank competition in the loan and deposit markets: Boone indicators (Bloans, Bdeposits,) and Herfindahl-Hirschman Indices (HHIloans and HHIdeposits). All equations include two control variables: the ratio of the net loans to total assets, and the natural logarithm of the real per capita GDP, as well as the three dummies representing the years of the crises that affected the EU banking sector over the period 2006-2021. ***significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 2B – Results obtained with dynamic one-step system GMM estimations – 322 German banks (N = 5152 observations)

322 German banks	Z-SCORE				Return on average assets				Equity to total assets ratio			
	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$
B_{loans}	-.0320*** (-3.88)				.5873* (1.71)				.5306*** (7.33)			
$B_{deposits}$		-.1731*** (-4.63)				-.1298 (-0.09)				-.7856** (-2.49)		
HHI_{loans}			.0010*** (5.13)				-.0211** (-2.36)				-.0030* (-1.75)	
$HHI_{deposits}$				.0007*** (4.38)				-.0071 (-1.03)				-.0028** (-1.96)
Net loans to total assets ratio	.0306*** (34.58)	.0308*** (34.79)	.0308*** (34.72)	.0310*** (34.94)	-.0161 (-0.48)	-.0155 (-0.46)	-.0281 (-0.82)	-.0146 (-0.43)	.3453*** (47.31)	.3353*** (47.07)	.3385*** (47.26)	.3375*** (47.47)
GDP per capita	-.3282* (-1.82)	.5250*** (3.15)	.6312*** (3.63)	.2242 (1.56)	58.12*** (7.39)	50.15*** (6.74)	39.52*** (5.22)	49.25*** (7.93)	11.11*** 7.10	5.768*** 4.08	2.386 (1.62)	3.4890*** (2.87)
D1(2008-210)	-.0341*** (-4.72)	-.0294*** (-4.08)	-.0115 (-1.41)	-.0431*** (-5.56)	3.319*** (10.61)	3.269*** (10.41)	2.904*** (8.36)	3.375*** (10.26)	-.0216 (-0.34)	-.0851 (-1.39)	-.1436*** (-2.10)	-.0414 (-0.63)
D2(2011-2013)	.0300*** (5.73)	.0308*** (5.88)	.0220*** (4.31)	.0235*** (4.61)	-.0321 (-0.16)	.0838 (0.42)	.1397 (0.73)	.0612 (0.32)	-.4350*** (-9.62)	-.3157*** (-7.14)	-.3370*** (-7.83)	-.3401*** (-7.93)
D3(2020-2021)	-.0750*** (-6.51)	-.0447*** (-4.26)	-.0010 (-0.07)	-.0175 (-1.31)	1.527** (2.47)	1.211** (1.97)	-.1650 (-0.20)	.8612 (1.28)	.5844*** (5.80)	.2766*** (3.11)	.0851 (0.69)	.0999 (0.90)
Const	-57.08*** (-19.64)	-38.23*** (-10.68)	-51.86*** (-21.63)	-59.36*** (-19.03)	789.5*** (6.05)	682.4*** (4.10)	670.0*** (6.03)	768.1*** (5.30)	-29.94 (-1.14)	-88.98*** (-2.95)	-137.9*** (-6.51)	-108.3*** (-3.94)
Wald chi2(8) test (Prob > chi2)	491368.2 (0.000)	489150.7 (0.000)	488217.7 (0.000)	486771.5 (0.000)	230.80 (0.000)	227.08 (0.000)	232.47 (0.000)	228.52 (0.000)	291305.4 (0.000)	301232.8 (0.000)	299503.7 (0.000)	299883.1 (0.000)
AB AR(1) z (Pr > z)	-16.41 (0.000)	-16.35 (0.000)	-16.48 (0.000)	-16.42 (0.000)	-30.12 (0.000)	-26.90 (0.000)	-23.38 (0.000)	-28.42 (0.000)	-0.76 (0.446)	-0.30 (0.768)	-0.29 (0.769)	-0.33 (0.741)
AB AR(2) z (Pr > z)	1.37 (0.170)	1.09 (0.278)	1.11 (0.266)	1.04 (0.298)	-0.01 (0.995)	0.47 (0.638)	-0.09 (0.925)	0.22 (0.825)	-0.55 (0.582)	-0.84 (0.402)	-0.66 (0.511)	-0.71 (0.475)
Sargan test chi2 (Prob > chi2)	2952.96 (0.000)	2933.20 (0.000)	2922.6 (0.000)	2921.10 (0.000)	4286.39 (0.000)	4274.50 (0.000)	4265.28 (0.000)	4280.68 (0.000)	7325.04 (0.000)	7625.18 (0.000)	7584.62 (0.000)	7593.43 (0.000)

This table presents the results of the author's estimations, using dynamic one-step system GMM estimations, considering as dependent variables the proxies for bank stability, the natural logarithm of the computed Z-score as well as two components of the Z-score: the return on assets (representing bank profitability) and the equity to total assets (representing bank capitalization). Separate equations are estimated for each of the computed measures of bank competition in the loan and deposit markets: Boone indicators (Bloans, Bdeposits,) and Herfindahl-Hirschman Indices (HHIloans and HHIdeposits). All equations include two control variables: the ratio of the net loans to total assets, and the natural logarithm of the real per capita GDP, as well as the three dummies representing the years of the crises that affected the EU banking sector over the period 2006-2021. ***significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 3A – Results obtained with panel random effects estimations – 129 French banks (N = 2064 observations)

129 French banks	Z-SCORE				Return on average assets				Equity to total assets ratio			
	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$
	RE	**RE**	**RE**	**RE**	**RE**	**RE**	**RE**	**RE**	**RE**	**RE**	**FE**	**FE**
B_{loans}	-.0172 (-0.75)				-.1202* (-1.70)				-.0417 (-0.16)			
$B_{deposits}$		-.2088*** (-3.01)				-.2317 (-1.09)				-2.637*** (-3.26)		
HHI_{loans}			-2.94e-10 (-1.15)				-2.64e-10 (-0.34)				-1.99e-09 (-0.67)	
$HHI_{deposits}$				7.58e-06 (0.22)				-.00001 (-0.12)				.00003 (0.08)
Net loans to total assets ratio	.0027*** (5.03)	.0027*** (5.02)	.0027*** (4.99)	.0027*** (5.01)	-.0038** (-2.42)	-.0039** (-2.47)	-.0039** (-2.47)	-.0039** (-2.47)	.0163*** (2.65)	.01623*** (2.66)	.0162*** (2.64)	.0163*** (2.65)
GDP per capita	-.1607 (-0.41)	-.0166 (-0.06)	-.3593 (-1.30)	-.3609 (-1.30)	2.846*** (2.39)	1.810*** (1.97)	1.429* (1.68)	1.420* (1.67)	-3.691 (-0.81)	.2034 (0.06)	-4.153 (-1.28)	-4.172 (-1.29)
$D1_{(2008-210)}$	-.1146*** (-7.11)	-.1651*** (-7.0)	-.1096*** (-7.64)	-.1095*** (-7.55)	-.2245*** (-4.55)	-.2482*** (-3.44)	-.1865*** (-4.25)	-.1852*** (-4.18)	-1.216*** (-6.47)	-1.910*** (-6.98)	-1.206*** (-7.22)	-1.205*** (-7.13)
$D2_{(2011-2013)}$	-.0629*** (-4.07)	-.1012*** (-5.17)	-.0567*** (-4.46)	-.0565*** (-4.44)	-.2156*** (-4.56)	-.2195*** (-3.65)	-.1700*** (-4.36)	-.1695*** (-4.35)	-.6996*** (-3.88)	-1.250*** (-5.47)	-.6858*** (-4.62)	-.6842*** (-4.61)
$D3_{(2020-2021)}$	-.0895*** (-4.18)	-.0827*** (-4.27)	-.0968*** (-5.15)	-.0968*** (-5.12)	.0304 (0.46)	-.0071 (-0.12)	-.0227 (-0.39)	-.0237 (-0.41)	-.7514*** (-3.01)	-.5875*** (-2.60)	-.7673*** (-3.50)	-.7684*** (-3.49)
Const	9.229*** (3.16)	16.03*** (4.33)	8.569*** (3.16)	8.357*** (3.06)	77.66*** (8.70)	80.47*** (7.08)	72.16*** (8.69)	72.14*** (8.65)	57.20* (1.68)	151.3*** (3.50)	56.22* (1.78)	54.98* (1.73)
Hausman test (Prob > chi2)	4.42 (0.7298)	4.45 (0.7271)	4.42 (0.6206)	5.45 (0.6054)	1.47 (0.9834)	1.42 (0.9850)	1.44 (0.9631)	1.87 (0.9669)	1.62 (0.9780)	1.62 (0.9779)	1.60 (0.9527)	2.88 (0.8960)
R-squared within	0.0595	0.0636	0.0599	0.0594	0.0326	0.0668	0.0663	0.0662	0.0378	0.0431	0.0380	0.0379
Wald test (Prob > chi2)	128.13 (0.0000)	137.14 (0.0000)	129.19 (0.0000)	127.60 (0.0000)	142.89 (0.0000)	141.04 (0.0000)	139.92 (0.0000)	139.82 (0.0000)	78.57 (0.0000)	89.56 (0.0000)	79.01 (0.0000)	78.55 (0.0000)

This table presents the results of the author's estimations, using panel fixed and random effects estimations, considering as dependent variables the proxies for bank stability, the natural logarithm of the computed Z-score as well as two components of the Z-score: the return on assets (representing bank profitability) and the equity to total assets (representing bank capitalization). Separate equations are estimated for each of the computed measures of bank competition in the loan and deposit markets: Boone indicators (Bloans, Bdeposits,) and Herfindahl-Hirschman Indices (HHIloans and HHIdeposits). All equations include two control variables: the ratio of the net loans to total assets, and the natural logarithm of the real per capita GDP, as well as the three dummies representing the years of the crises that affected the EU banking sector over the period 2006-2021. ***significant at 1% level; ** significant at 5% level; * significant at 10% level

Table 3B – Results obtained with dynamic one-step system GMM estimations – 129 French banks (N = 2064 observations)

129 French banks	Z-SCORE				Return on average assets				Equity to total assets ratio			
	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$
B_{loans}	-.0502*** (-2.87)				.0882 (0.73)				-.5886*** (-2.83)			
$B_{deposits}$		-.2294*** (-4.38)				.7646** (2.08)				-3.325*** (-5.45)		
HHI_{loans}			1.1e-08*** (3.83)				1.42e-07 (1.55)				-5.46e-07 (-1.00)	
$HHI_{deposits}$				-.0011*** (-10.27)				-.0005 (-0.93)				-.0115*** (-6.01)
Net loans to total assets ratio	.0181*** (18.60)	.0179*** (18.60)	.0194*** (10.94)	.0140*** (11.53)	-.0718*** (-19.21)	-.0727*** (-19.05)	-.0562*** (-3.00)	-.0720*** (-19.11)	.1457*** (10.28)	.1404*** (10.16)	.1634*** (1.79)	.1238*** (7.38)
GDP per capita	.4341 (1.48)	.2264 (1.00)	-.2825 (-0.75)	-.6056** (-2.37)	17.42*** (8.08)	17.41*** (10.82)	17.46*** (2.75)	18.38*** (12.16)	-.5586 (-0.16)	-1.848 (-0.70)	-4.606 (-0.29)	-12.02*** (-3.96)
D1(2008-210)	-.1588*** (-13.03)	-.2044*** (-11.54)	-.1337*** (-6.91)	-.0748*** (-5.16)	-.7488*** (-8.70)	-.5601*** (-4.30)	-.7112** (-2.05)	-.7302*** (-7.93)	-2.066*** (-14.35)	-2.766*** (-13.39)	-2.245*** (-2.55)	-1.181*** (-6.23)
D2(2011-2013)	-.0960*** (-8.25)	-.1262*** (-8.58)	-.0709*** (-4.15)	-.0600*** (-5.19)	-.9790*** (-12.63)	-.8455*** (-8.21)	-.9764*** (-3.54)	-1.001*** (-15.14)	-1.248*** (-9.12)	-1.738*** (-10.13)	-1.223* (-1.67)	-.8692*** (-6.39)
D3(2020-2021)	-.0707*** (-4.35)	-.0773*** (-5.30)	-.1014*** (-4.00)	-.1522*** (-8.49)	1.123*** (9.74)	1.111*** (10.48)	1.146*** (2.66)	1.137*** (10.74)	-.6828*** (-3.58)	-.7108*** (-4.16)	-.6572 (-0.60)	-1.512*** (-6.87)
Const	3.294 (1.48)	9.320*** (3.32)	-2.193 (-0.58)	14.90*** (5.25)	445.0*** (26.29)	421.2*** (20.02)	427.6*** (6.13)	454.5*** (25.90)	-7.603 (-0.29)	86.70*** (2.65)	58.45 (0.33)	88.38** (2.50)
Wald chi2(8) test (Prob > chi2)	200199.64 (0.000)	202386.85 (0.000)	63238.05 (0.000)	140038.47 (0.000)	4451.58 (0.000)	4327.49 (0.000)	251.45 (0.000)	4393.21 (0.000)	74240.38 (0.000)	75696.75 (0.000)	1873.71 (0.000)	52489.52 (0.000)
AB AR(1) z (Pr > z)	-7.80 (0.000)	-8.05 (0.000)	-4.24 (0.000)	-5.36 (0.000)	-7.95 (0.000)	-7.75 (0.000)	-1.56 (0.119)	-7.94 (0.000)	-3.06 (0.002)	-3.27 (0.001)	-1.00 (0.318)	-2.03 (0.042)
AB AR(2) z (Pr > z)	-2.95 (0.003)	-2.68 (0.007)	-0.76 (0.445)	-1.55 (0.121)	2.45 (0.014)	0.96 (0.337)	-0.08 (0.934)	2.73 (0.006)	-2.29 (0.022)	-1.93 (0.053)	-0.07 (0.941)	-1.93 (0.054)
Sargan test chi2 (Prob > chi2)	1306.28 (0.000)	1309.58 (0.000)	400.46 (0.000)	813.29 (0.000)	750.94 (0.000)	725.56 (0.000)	39.65 (0.012)	740.70 (0.000)	2921.65 (0.000)	2956.63 (0.000)	72.91 (0.000)	2034.02 (0.000)

This table presents the results of the author's estimations, using dynamic one-step system GMM estimations, considering as dependent variables the proxies for bank stability, the natural logarithm of the computed Z-score as well as two components of the Z-score: the return on assets (representing bank profitability) and the equity to total assets (representing bank capitalization). Separate equations are estimated for each of the computed measures of bank competition in the loan and deposit markets: Boone indicators (Bloans, Bdeposits,) and Herfindahl-Hirschman Indices (HHIloans and HHIdeposits). All equations include two control variables: the ratio of the net loans to total assets, and the natural logarithm of the real per capita GDP, as well as the three dummies representing the years of the crises that affected the EU banking sector over the period 2006-2021. ***significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 4 – Summary of the results obtained for all considered panels when bank stability is represented with the Z-score

784 EU banks	Z-SCORE							
	B_{loans}		$B_{deposits}$		HHI_{loans}		$HHI_{deposits}$	
	FE	GMM	FE	GMM	FE	GMM	FE	GMM
Bank competition measure	-***	-***	-***	-***	+	+***	+	+**
Net loans to total assets ratio	+***	+***	+***	+***	+***	+***	+***	+***
$D1_{(2008\text{-}210)}$	-***	-***	-***	-***	-***	-***	-***	-***
$D2_{(2011\text{-}2013)}$	-***	-***	-***	-***	-***	-**	-***	-***
$D3_{(2020\text{-}2021)}$	-***	-***	-***	-	-***	-***	-***	-***

322 German banks	Z-SCORE							
	B_{loans}		$B_{deposits}$		HHI_{loans}		$HHI_{deposits}$	
	FE	GMM	FE	GMM	FE	GMM	FE	GMM
Bank competition measure	-***	-***	-***	-***	+***	+***	+***	+***
Net loans to total assets ratio	+***	+***	+***	+***	+***	+***	+***	+***
$D1_{(2008\text{-}210)}$	-***	-***	-***	-***	-***	-	-***	-***
$D2_{(2011\text{-}2013)}$	+***	+***	+***	+***	+***	+***	+***	+***
$D3_{(2020\text{-}2021)}$	-***	-***	-***	-***	-	-	-***	-

129 French banks	Z-SCORE							
	B_{loans}		$B_{deposits}$		HHI_{loans}		$HHI_{deposits}$	
	RE	GMM	RE	GMM	RE	GMM	RE	GMM
Bank competition measure	-	-***	-***	-***	-	+***	+	-***
Net loans to total assets ratio	+***	+***	+***	+***	+***	+***	+***	+***
$D1_{(2008\text{-}210)}$	-***	-***	-***	-***	-***	-***	-***	-***
$D2_{(2011\text{-}2013)}$	-***	-***	-***	-***	-***	-***	-***	-***
$D3_{(2020\text{-}2021)}$	+	+***	-	+***	-	+***	-	+***

This table summarises the main results presented in the previous tables for the panel including all EU banks and the sub-panels separately including only the German or the French banks. The table highlights the results obtained with both fixed and random panel estimations, and with dynamic one-step system GMM estimations but only when the dependent variable is the natural logarithm of the computed Z-score. The columns of the table summarise the results obtained with one of the competition measures: Boone indicators (Bloans, Bdeposits,) and Herfindahl-Hirschman Indices (HHIloans and HHIdeposits). They also highlight the results of one control variable (the net loans to total assets ratio as the three three dummies representing the years of the crises that affected the EU banking sector over the period 2006-2021. ***significant at 1% level; ** significant at 5% level; * significant at 10% level.

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Annex I – Number of banks by EU member-state and their representativeness

EU country (*)	Number of banks	% of the total banks	% of the deposits in 2021	% of the provided loans in 2021
Austria	27	3.44	2.62	2.44
Belgium	19	2.42	3.66	3.37
Bulgaria	9	1.15	0.20	0.14
Croatia	4	0.51	0.21	0.14
Cyprus	5	0.64	0.42	0.30
Czech Rep.	12	1.53	0.96	0.70
Denmark	15	1.91	1.17	1.85
Estonia	4	0.51	0.09	0.08
Finland	7	0.89	1.39	1.81
France	129	16.45	31.05	32.97
Germany	322	41.07	26.82	26.30
Greece	6	0.77	0.76	0.50
Hungary	6	0.77	0.44	0.29
Ireland	6	0.77	1.23	0.82
Italy	63	8.04	9.66	9.68
Latvia	5	0.64	0.08	0.05
Lithuania	4	0.51	0.13	0.07
Luxembourg	34	4.34	1.33	0.94
Malta	7	0.89	0.12	0.07
Netherlands	16	2.04	6.68	7.28
Poland	18	2.30	1.47	1.16
Portugal	12	1.53	1.27	0.94
Romania	6	0.77	0.30	0.19
Slovakia	5	0.64	0.19	0.20
Slovenia	7	0.89	0.17	0.11
Spain	28	3.57	5.55	4.74
Sweden	8	1.02	2.05	2.84

This table reports the number of the banks of each EU country that were considered in the estimations of this paper, their representativeness in terms of the whole panel of EU banks as well as their representativeness in terms of the provided loans and deposits of the considered banks in 2021. The data used in the paper related to banks and their performance were sourced from the Moody's Analytics BankFocus database in December 2022.

Annex II – Descriptive statistics and correlation matrix

Descriptive statistics

Variables	Mean	Std. Dev.	Min	Max
Z-SCORE	1.25589	.5069129	-3.91	4.51042
Return on average assets	.4159933	2.166072	-41.02	199.02
Equity to total assets ratio	8.501389	5.062143	-30.52	84.47
B_{loans}	-.7073609	.9828586	-10.67	6.18
$B_{deposits}$	-.4137062	.9746707	-9.56	7.47
HHI_{loans}	1614.922	1146.449	31.55	7248.81
$HHI_{deposits}$	1639.166	1018.358	9.93	6611.28
Net loans to total assets ratio	58.57312	19.83139	0.00	221.62
GDP per capita	10.47276	.4480094	8.64	11.63

Correlation matrix

Variables	Z-SCORE	Return on average assets	Equity to total assets ratio	B_{loans}	$B_{deposits}$	HHI_{loans}	$HHI_{deposits}$	Net loans to total assets ratio	GDP per capita
Z-SCORE	1.0000								
Return on average assets	0.2151	1.0000							
Equity to total assets ratio	0.8038	0.0734	1.0000						
B_{loans}	-0.1023	-0.0295	-0.1058	1.0000					
$B_{deposits}$	-0.1106	-0.0117	-0.1141	0.3182	1.0000				
HHI_{loans}	0.0495	0.0050	0.0655	-0.394	-0.0280	1.0000			
$HHI_{deposits}$	0.0403	-0.0002	0.0634	-0.345	-0.0559	0.9692	1.0000		
Net loans to total assets ratio	0.1902	-0.0198	0.0730	0.0650	0.0093	-0.0546	-0.0250	1.0000	
GDP per capita	-0.1402	-0.0219	-0.0869	0.2223	0.2394	-0.1754	-0.2193	-0.119	1.0000

This table presents the descriptive statistics and the correlations between the variables included in the empirical estimations to analyse the relevance of competition of the stability of the EU banking sector. It reports the statistics of the dependent variables: Z-score, the return on average assets and the equity to total assets ratio, as well as the computed measures of bank competition in the loan and deposit markets: Boone indicators (Bloans, Bdeposits,) and Herfindahl-Hirschman Indices (HHIloans and HHIdeposits) and the two control variables: the ratio of the net loans to total assets, and the natural logarithm of the real per capita GDP, as well as the three dummies representing the years of the crises that affected the EU banking sector over the period 2006-2021. The data used in the paper related to banks and their performance were sourced from the Moody's Analytics BankFocus database, in December 2022. The values of the real GDP per capita were sourced in November 2022 from the World Bank database "Global Financial Development".