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Bank Competition and Financial Stability

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Abstract

Under the traditional "competition-fragility" view, more bank competition erodes market power, decreases profit margins, and results in reduced franchise value that encourages bank risk taking. Under the alternative "competition-stability" view, more market power in the loan market may result in greater bank risk as the higher interest rates charged to loan customers make it more difficult to repay loans and exacerbate moral hazard and adverse selection problems. But even if market power in the loan market results in riskier loan portfolios, the overall risks of banks need not increase if banks protect their franchise values by increasing their equity capital or engaging in other risk-mitigating techniques. The authors test these theories by regressing measures of loan risk, bank risk, and bank equity capital on several measures of market power, as well as indicators of the business environment, using data for 8,235 banks in 23 developed nations. The results suggest that—consistent with the traditional "competition-fragility" view—banks with a greater degree of market power also have less overall risk exposure. The data also provide some support for one element of the "competition-stability" view—that market power increases loan portfolio risk. The authors show that this risk may be offset in part by higher equity capital ratios.

This paper—a product of the Finance and Private Sector Team, Development Research Group—is part of a larger effort in the department to study bank concentration and competition. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at lklapper@worldbank.org.

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Bank Competition and Financial Stability

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Bank Competition and Financial Stability

I. Introduction

There is a current debate in the banking literature regarding the effect of competition on the stability of banks. Under the traditional "competition-fragility" view, more bank competition erodes market power, decreases profit margins, and results in reduced franchise value – the ongoing concern or market value of the banks beyond their book values. This encourages banking organizations to take on more risk to increase returns (e.g., Marcus 1984, Keeley 1990, Demsetz, Saidenberg, and Strahan 1996, Carletti and Hartmann 2003). For example, Keeley (1990) finds that increased competition and deregulation following relaxation of state branching restrictions in the U.S. in the 1980s eroded monopoly rents and resulted in a surge of bank failures. Similarly, Hellmann, Murdock, and Stiglitz (2000) argue that removal of interest ceilings on deposits erodes franchise value and encourages moral hazard behavior by banks. Some recent empirical research is consistent with this view, finding that more competition (measured using the Lerner index) is associated with a higher-risk loan portfolio measured using nonperforming loans in Spain (Jimenez, Lopez, and Saurina 2007).[1]

Recent literature has arisen that takes a contrary "competition-stability" view. Boyd and De Nicolo (2005) contend that more market power in the loan market may result in higher bank risk as the higher interest rates charged to loan customers make it harder to repay loans and exacerbate moral hazard incentives of borrowers to shift into riskier projects. The higher rates may also result in a riskier set of borrowers due to adverse selection considerations. It is also possible that a highly concentrated banking market may lead to more risk taking if the institutions believe that they are too big to fail and are more likely to be explicitly or implicitly protected by the government safety net. Some recent empirical work is consistent with this view. Boyd, De Nicolo, and Jalal (2006) and De Nicolo and Loukoianova (2006) both find that the Z-index, an inverse measure of bank risk, decreases with banking market concentration (measured using the Herfindahl-Hirschman index or HHI), implying that the risk of bank failure rises in more concentrated markets. In addition, Schaeck, Cihak, and Wolfe (2006) implement a logit

[1] Note that franchise value deters bank risk taking to the extent that owners believe that their ownership of the bank is at risk in the event of insolvency. If regulators are expected to forbear and leave ownership intact, the owners may not have significant incentives to control risks (Frame and White forthcoming).

model and duration analysis and find that more competitive banking systems (measured using the Panzar and Rosse H-statistic) have lower likelihoods of bank failure and a longer time to crisis, and hence are more stable than monopolistic systems.

Note that the two strands of the literature need not necessarily yield opposing predictions regarding the effects of competition and market power on stability in banking. Even if market power in the loan market results in riskier loan portfolios, the overall risks of the banks need not increase. If banks enjoy higher franchise value derived from their market power, they may protect this value from the higher loan risk with other methods. Specifically, they can offset the higher risk exposure through more equity capital, reduced interest rate risk, sales of loans or credit derivatives, a smaller loan portfolio, or other risk-mitigating techniques. Thus, when a bank charges higher rates for business loans and has a riskier loan portfolio, the bank may still choose a lower overall risk. This argument suggests that it is important in studies of the effects of market power on bank risk that dependent variables are chosen to reflect both loan risk and bank risk, thereby distinguishing whether one or both of the theories may be operative simultaneously. While some previous research used the Z-index as an inverse proxy for overall bank risk, other papers focused on nonperforming loans, which only measure loan risk. No prior study to our knowledge has estimated the effects of market power or measures of competitiveness on both loan risk and overall bank risk using the same model. Few studies have also investigated the effect of competition on banks' capital ratios. Schaek and Cihak (2007) show that banks tend to hold higher capital ratios in more competitive environments in the context of European banking.

An additional issue in the tests of these opposing theories is the measure of market power. A number of studies use measures of concentration, such as the HHI or n-firm concentration ratio, to indicate market power, but these have been shown to be ambiguous indicators (e.g., Berger, Demirguc-Kunt, Levine, and Haubrich 2004).[2] For example, Beck, Demirguc-Kunt, and Levine (2006) find that both concentration and competitiveness in banking measured in other ways – such as entry and activity restrictions – improve financial stability, suggesting that concentration might not be an appropriate measure of the degree of

[2] Alegria and Schaeck (2008) show that bank concentration measures are sensitive toward the number of banks in each country and that their choice affects the inferences regarding the degree of competition.

competitiveness in banking. Some studies employ the Panzar and Rosse H-statistic to assess the degree of competitiveness in banking (e.g., Claessens and Laeven 2004, Schaeck, Cihak, and Wolfe 2006, Molyneux and Nguyen-Linh 2008). There are also some issues with this proxy for the degree of market power, particularly because it requires that banks be in long-run equilibrium (Shaffer 2004). As indicated above, one study of the effect of concentration on bank loan risk uses the Lerner index (Jimenez, Lopez, and Saurina 2007). No prior study to our knowledge assesses the prevailing market structure comparing the effects of using different measures of competition. In this study, we include multiple measures of competition to check for robustness of the findings.

An important feature of our approach is that we control for possible endogeneity of the measures of the degree of market power. Endogeneity can arise when causality is reversed, i.e., when the degree of market power depends on loan risk, overall bank risk and capitalization levels. If a well-capitalized bank decides to pursue a growth strategy and merges with another bank, it can then increase the bank's degree of market power. Similarly, if a bank increases its loan portfolio risk and its overall bank risk, then the higher expected return may provide an incentive for the firm to gain a higher degree of market power. To address this potential endogeneity, we turn to instrumental variable techniques, using a GMM estimator. Following Schaeck and Cihak (2007), we employ activity restrictions, banking freedom, and the percent of foreign- and government-owned banks as instruments to explain measures of the degree of market power.

A further issue in testing the theories is the effect of the business environment for banks. For example, banks operating in nations with weak business environments may find it difficult to expand their loan portfolios to take on additional risks. We include data on an index of legal rights, which measures the degree to which collateral and bankruptcy laws facilitate lending in our analysis. We also control for foreign bank ownership in all regressions.

This paper uses Bankscope data on 8,235 banks in 23 developed nations to test these alternative views.[3] We include three proxies for financial stability, including a measure of overall bank risk (the Z-index), a measure of loan risk (the ratio of nonperforming loans to total

[3] The list of countries and the number of banks are included in the Appendix.

loans), and the capital ratio (equity to assets ratio) as indicator of effort to control overall bank risk. We compute and consider separately several alternative measures of bank competition, including the Lerner index, which is based on the deviation between price and marginal costs. For several reasons, we prefer the Lerner index, but we also include in our analyses traditional measures of the degree of competition such as the HHI using deposits and loans to check for robustness. Following recent research (Martinez-Miera and Repullo 2008), we allow for a nonlinear relationship between measures of risk and market structure in banking.

By way of preview, the results suggest that – consistent with the "competition-stability" view – banks with a higher degree of market power bear significantly more loan portfolio risk. The findings also lend support to the "competition-fragility" view because we find that banks with more market power also enjoy less overall risk exposure. The greater financial stability derives at least in part from holding significantly more equity capital.

The remainder of the paper is structured as follows. Section II provides a review of the literature on competition and stability in banking. Section III outlines our econometric methodology. Section III describes the data and variables used in these econometric tests. We present the test results in Section IV and conclude in Section V.

II. Literature Review

The banking industry serves as a major conduit through which instability may be transmitted to other sectors in the economy by disrupting the interbank lending market and payments mechanism, by reducing credit availability, and by freezing deposits. The fear that increased competition may add to financial system fragility has traditionally motivated regulators to focus on developing policies that preserve stability in the banking sector.

A large academic literature provides support to the "competition-fragility" nexus (see Carletti and Hartmann (2003) for a review of the literature). Interest in the relationship between competition and stability in banking was triggered by the seminal article by Keeley (1990), who showed that increased competition in the 1980s eroded monopoly rents and led to an increase in bank failures in the U.S. In a situation in which a large number of banks compete, profit margins are eroded and banks might take excessive risks to increase returns. As more marginal loan applicants receive financing, the quality of the loan portfolio is likely to deteriorate and thereby

increase bank fragility. Hellmann, Murdock, and Stiglitz (2000) show that competition for deposits can also undermine prudent bank behavior. They list the U.S. Savings and Loans crisis and the Japanese crisis as examples of excessive risk taking that led to large social costs. They put the blame on financial liberalization which removed barriers to entry and branching restrictions, in addition to deregulating interest rates. Increased competition for deposits, in turn, lowers bank profitability and destroys franchise value, fueling moral hazard incentives. When banks are highly competitive and franchise values are low, banks have a moral hazard incentive to take risks because of the government safety net. That is, they have the option to "put" their assets to the deposit insurer or the government if they take risks and lose all their capital. The authors argue that deposit rate controls thwart the market-stealing effect and provide incentives for banks to behave prudently. They also argue that restrictions on competition for deposits are also more efficient than increasing capital requirements in curbing the "gambling for resurrection" behavior.

As banks gain market power, their franchise value increases. Because franchise value represents intangible capital that will only be captured if the bank remains in business, such banks face high opportunity costs of going bankrupt and they become more reluctant to engage in risky activities. They tend to behave prudently by holding more equity capital, by holding less risky portfolios, and/or by originating a smaller loan portfolio.

Alternatively, when banks gain market power, it is also possible that their risk exposure increases. The "competition-stability" strand of the literature contends that financial instability increases as the degree of competitiveness is lessened. Banks with market power will earn more rents by charging higher interest rates on business loans. Stiglitz and Weiss (1981) show that higher interest rates may increase the riskiness of loan portfolios because of adverse selection (worse projects are funded) and moral hazard (risk shifting) problems. While increased funding costs discourage safer borrowers, other borrowers are induced to choose riskier projects and are likely to face a higher probability of default. The volume of nonperforming loans would then increase, adding to the bank's risk exposure and undermine financial stability.[4]

[4] Conversely, as competition in the loan market rises, Koskela and Stenbacka (2000) construct a model to show that project-holders will increase their investments because of lower lending rates. The authors argue that competition

Recent work by Boyd and De Nicolo (2005), Boyd, De Nicolo, and Jalal (2006), and Schaeck, Cihak, and Wolfe (2006) concurs that market power may destabilize the system and be detrimental for financial stability. When making asset allocation decisions, banks are faced with both a portfolio decision and an optimal contracting problem. The portfolio decision allocates financial claims among bonds and other traded securities in markets where banks are price takers, and where there is no private information. Banks, however, have to solve an optimal contracting problem with their borrowers. The latter possess private information and their actions depend on the terms of the loan contract. Boyd and De Nicolo (2005) and Boyd, De Nicolo, and Jalal (2006) argue that existing research on financial stability assumes that competition is allowed in deposit markets, but is suppressed in loan markets. They introduce models where competition is allowed in both deposit and loan markets and where banks have to solve for a non-trivial asset allocation problem. The empirical findings of Boyd, De Nicolo, and Jalal (2006) indicate that the probability of failure increases with more concentration in banking, and they refute the trade-off between bank competition and stability. However, their conclusions are drawn using concentration indicators, which might be insufficient measures of market structure. In a survey of the literature on bank concentration and competition, Berger, Demirguc-Kunt, Levine, and Haubrich (2004) distinguish between concentration and broader measures of competition, and conclude that the competitiveness in banking cannot be gauged using classical concentration indicators. Molyneux and Nguyen-Linh (2008) also investigate the relationship between competition and bank risk in South East Asian banking and find that competition does not increase bank risk-taking.

Further, a closer look at the results of Boyd, De Nicolo, and Jalal (2006) casts doubt on their finding that the probability of bank failure increases in more concentrated markets. Although the correlation coefficient between concentration and financial stability and the regression parameter estimate of concentration in relation to financial stability are significantly negative, implying the prevalence of a trade-off, their values are almost zero (-0.06 and -0.0004 respectively), pointing to a possible lack of an economically meaningful association between concentrated banking markets and financial stability. Another work by Schaeck, Cihak, and Wolfe (2006) uses an alternative measure of the degree of competitiveness and concludes that

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into the credit market will reduce bankruptcy risk of borrowers and conclude that there is no trade-off between lending market competition and financial fragility.

more competitive banking systems are more stable than monopolistic systems because of a lower likelihood of bank failure and a longer time to crisis. However, their proxy of market structure, the Panzar and Rosse H-statistic, is derived from another study by Claessens and Laeven (2004) that was estimated using another data set.

These findings are tested by Jiménez, Lopez, and Saurina (2007) in the context of Spanish banks. The authors construct a Lerner index based on bank-specific interest rates as a measure of the degree of market power in the commercial loan market and find a negative relationship between loan market power and portfolio risk. They show that nonperforming loans decrease with a rise in the degree of power in the loan market, thus promoting financial stability. Their findings support the franchise value paradigm and do not provide evidence for the "risk-shifting" paradigm identified by Boyd and De Nicolo (2005). However, the Jimenez, Lopez and Saurina (2007) study only considers loan portfolio risk and does not examine the risk of the bank; as a result, it does not provide evidence on overall bank risk or financial fragility.

Other recent empirical cross-country evidence on the relationship between bank concentration, bank competition, and banking system fragility is ambiguous. For instance, Beck, Demirguc-Kunt, and Levine (2006) find that the likelihood of financial crises is lower in more concentrated banking systems, yet higher in less competitive systems (characterized by fewer entry and activity restrictions) and countries with less developed legal systems.

III. Outline of the Econometric Methodology

We test the implication of market structure on the risk potential of banks using firm-level data from 23 industrialized countries. We allow for a nonlinear relationship between financial stability and market structure in banking, following Martinez-Miera and Repullo (2008). Our basic GMM regression model is based on a cross-section of banks, and has the general form:

$$\text{Financial Stability}_i = f(\text{Market Structure}_i, \text{Market Structure}_i^2, \text{Business Environment}_k) \quad (1)$$

Table 1 shows variable names and definitions of our dependent, explanatory and instrumental variables. Subscripts *i* and *k* refer to bank and country, respectively.

We use different risk exposure indicators as dependent variables to proxy for financial stability: the volume of nonperforming loans (NPLs) to total loans to account for loan portfolio risk[5], the Z-index as an inverse measure of overall bank risk, and equity to total assets (E/TA) for the bank's capitalization level. Both NPLs and E/TA are averaged for each bank over the period under study.

The Z-index is an inverse proxy for the firm's probability of failure. It combines profitability, leverage, and return volatility in a single measure. It is given by the ratio:

$$Z_i = \frac{ROA_i + E/TA_i}{\sigma_{ROA\,i}} \tag{2}$$

where ROA_i is the period-average return on assets for bank *i*, E/TA represents the period-average equity to total assets ratio for bank *i*, and σ_{ROAi} is the standard deviation of return on assets over the period under study. The Z-index increases with higher profitability and capitalization levels, and decreases with unstable earnings reflected by a higher standard deviation of return on assets. It inversely proxies the bank's probability of failure and is an indicator of financial stability at the firm level. Thus, we use one observation per bank, despite having multiple years of data.

We examine the impact of market structure in banking on risk-taking and financial stability using the Lerner index as a proxy for market power. The Lerner index represents the mark-up of price over marginal costs and is an indicator of the degree of market power. It is a "level" indicator of the proportion by which price exceeds marginal cost, and is calculated as:

$$Lerner_{it} = (P_{TAi\,t} - MC_{TAit}) / P_{TAit} \tag{3}$$

where P_{TAit} is the price of total assets proxied by the ratio of total revenues (interest and noninterest income) to total assets for bank *i* at time *t*, and MC_{TAit} is the marginal cost of total assets for bank *i* at time *t*. The resulting $Lerner_{it}$ is averaged over the period under study for each bank *i*. MC_{TAit} is derived from the following translog cost function:

$$\ln Cost_{it} = \beta_0 + \beta_1 \ln Q_{it} + \frac{\beta_2}{2} \ln Q_{it}^2 + \sum_{k=1}^{3} \gamma_{kt} \ln W_{k,it} + \sum_{k=1}^{3} \phi_k \ln Q_{it} \ln W_{k,it} + \sum_{k=1}^{3} \sum_{j=1}^{3} \ln W_{k,it} \ln W_{j,it} + \varepsilon_{it} \tag{4}$$

where Q_{it} represents a proxy for bank output or total assets for bank *i* at time t (e.g., Shaffer 1993, Berg and Kim 1994, Fernandez de Guevara, Maudos, and Pérez 2005), and $W_{k,it}$ are three input prices. $W_{1,it}$, $W_{2,it}$, and $W_{3,it}$ indicate the input prices of labor, funds, and fixed capital,

[5] We also include the volume of nonperforming loans to total equity for robustness.

respectively, and are calculated as the ratios of personnel expenses to total assets, interest expenses to total deposits and other operating and administrative expenses to total assets, respectively.[6] Equation (3) is estimated separately for each country *k* in the sample to reflect potentially different technologies. Year fixed effects are also introduced with robust standard errors by bank to capture the specificities of each firm. Marginal cost is then computed as:

$$MC_{TA_{it}} = \frac{Cost_{it}}{Q_{it}}\left[\beta_1 + \beta_2 \ln Q_{it} + \sum_{k=1}^{3} \phi_k \ln W_{k,it}\right]$$

Finally, the Lerner index is averaged over time for each bank *i* for inclusion in the regression model. As noted above, we also specify as alternative measures of market power more traditional measures of the degree of competition, the HHI using deposits and loans.

Our measures of market power or market structure are calculated on a nationwide level. We acknowledge that banking markets do not always correspond with national borders. Some banking products, such as wholesale credits and off-balance sheet liabilities to large corporations are competed for on an international basis. Other products, such as retail deposits and small business loans, are more often competed for on a local basis, and the national level of banking market power may not coincide with the market power exercised at the local level.

To address the likely endogeneity of measures of market power, we employ an instrumental variable technique with a Generalized Method of Moments (GMM) estimator. A common problem in using empirical data is heteroskedasticity, and we test for its presence using several tests.[7] Although the Instrumental Variables coefficient estimates remain consistent in the presence of heteroskedasticity, the estimates of their standard errors are inconsistent, preventing valid inference and rendering the estimator inefficient. The usual diagnostic tests for endogeneity and overidentifying restrictions will also be invalid if heteroskedasticity is present.[8] Such estimation issues can partially be addressed by using heteroskedasticity consistent or robust standard errors, but the usual approach when facing heteroskedasticity of an unknown form is to use the GMM estimator, introduced by Hansen (1982). The GMM does not require

[6] A potential problem with the Lerner index, as we calculate it, is that we take as given the ratio of interest expenses to deposits, W_2, which may itself embody market power in the deposit market.
[7] Among the tests for heterogeneity, we employ the Pagan-Hall, White/Koenker and Breusch-Pagan/Godfrey/Cook-Weisberg tests, but we only report the results of the Breusch-Pagan/Godfrey/Cook-Weisberg tests.
[8] In order to test for endogeneity, we report the results of the First Stage F test; we also report the results of the Hansen's J test of overidentification.

distributional assumptions on the error terms; it is also more efficient than 2SLS because it accounts for heteroskedasticity (Hall 2005).

We use activity restrictions, banking freedom, and the percent of foreign- and government-owned banks as instruments in the analysis. Schaeck and Cihak (2007) employ the same instruments with a 2SLS technique; we account for the presence of heteroskedasticity by implementing a GMM estimation. Activity restrictions are a key determinant for the scope of operations of banks and are likely to affect the level of competitiveness. This index provides information as to whether banks can engage in securities, insurance, and real estate activities, and whether they can hold stakes in nonfinancial institutions. Further, banking freedom represents a broad indicator for the openness of a banking system, capturing whether foreign banks are allowed to operate freely, whether difficulties are faced when setting up domestic banks, and whether the government influences the allocation of credit. Other instrumental variables for the degree of competition include the percent of foreign- and government-owned banks. These instruments directly impact competition, but cannot be assumed to directly affect loan risk, bank risk, or the capital level. We test for the relevance of these instruments or the endogeneity of market power using the First Stage F test, and we use the Hansen's J test of overidentification to check their validity.

IV. Data and Variables Employed in the Tests

We retrieve bank-level financial data for the years 1999-2005 from the BankScope database provided by Fitch-IBCA (International Bank Credit Analysis Ltd). Our initial sample includes 8,274 banks located in more than 30 developed countries.[9] We apply a number of filtering rules to eliminate non-representative data, reducing our analysis sample to 8,235 banks operating in 23 different industrial countries. Specifically, banks with missing loan-to-asset ratios and income statement data are excluded from the sample, in addition to banks where negative expenses are reported and banks with equity levels in the bottom and top 1% tail of the distribution. Careful consideration is made to drop banks and not bank-year observations in order to sustain and benefit from the panel dimension of the data. Further, income statement variables are winsorized at the top and bottom 1% of the distribution, as are other ratios like loans to assets and equity to assets. Countries with fewer than five banks are also dropped from the original sample.

[9] The developed nations correspond to the International Monetary Fund definition for "high-income" countries.

Table 2 shows descriptive statistics for the variables used in our main regressions. All bank-level variables are averaged by bank over the period 1999-2005, and country-level variables are averaged by country over the period under study. The dependent variables include the ratio of nonperforming loans to total loans, the bank Z-index, and equity to total assets. The key exogenous variable is the measure of bank market structure proxied by the Lerner index, but we also include traditional measures of concentration such as the HHI deposit and loan indices to ensure robustness.

We control for bank size and for foreign bank ownership. We also collect country-level data on business regulations and their enforcement from the World Bank Doing Business database to proxy for the business environment in a particular country (World Bank 2006.) Our control variable is an index of legal rights, which measures the degree to which collateral and bankruptcy laws facilitate lending. We include the log value of GDP per capita in all regressions to control for variations in economic development.

V. Empirical Results

A. Main Regression Results

Tables 3, 4, and 5 present our main regression results. We estimate GMM regressions with robust standard errors clustered at the country level to correct for within-country correlation. We test for the presence of heteroskedasticity in our data set and report the results of the Breush-Pagan/Godfrey/Cook-Weisberg statistic. We also run diagnostic tests for both the relevance (using the First Stage F-test) and the validity (using the Hansen's J test) of the instruments of the degree of market power. The results support the presence of heteroskedasticity –and hence the use of the GMM estimator— and show that our instruments are both relevant and valid.

We use three dependent variables to proxy for financial stability: In Table 3 we measure loan portfolio risk with the ratio of nonperforming loans, and in Tables 4 and 5 we measure overall bank risk and leverage risk with the Z-index and bank capitalization ratio, respectively.

All regressions include either the Lerner index, HHI-deposit index, or HHI-loan index as a measure of industry competition, and which are instrumented with indicators of activity restrictions, banking freedom and the percent of foreign and government owned banks. In all cases, higher values of the Lerner index, HHI-deposit index, and HHI-loan index imply higher

degrees of market power and hence a less competitive environment. We also include bank size, foreign bank ownership, the Legal Rights index and the log value of GDP per capita in all regressions to control for variations in the business environment and economic development. Our objective is to study the impact of market structure on financial stability. As discussed above, we include a quadratic term in the estimated equations to allow for a nonlinear relationship between measures of bank risk/loan risk and market structure in banking.

Table 3 shows our results using nonperforming loans to total loans as our proxy for loan portfolio risk. The coefficients of the linear terms are positive across all proxies of market power, while the coefficients of the quadratic terms are negative using HHI proxies of market structure. In order to evaluate the type of relationship between the degree of market power and NPLs, the inflection point of each quadratic function is calculated and compared with the distribution of the data. For example, in Model 1, the inflection point in Table 3 is -0.20, which is approximately the 4^{th} percentile of the Lerner index distribution, implying that more that 96 percent of the data lies above the inflection point. Given that the coefficient of the Lerner quadratic term is positive, the relationship between the degree of market power and loan portfolio risk is significantly positive. Similarly, the results obtained for the HHI deposits show that the estimated function has a maximum (the sign of the quadratic term is negative) that occurs at the value of 0.25. With 99% of the data lying below the inflection point (the 99^{th} percentile of the HHI deposits data for developed countries occurs at 0.228), a significant and positive relationship is established between the HHI deposits and NPLs. A comparable analysis of the results using the HHI loans also indicates a significant and positive association between market power and the ratio of nonperforming loans to total loans. In line with the "competition-stability" view of Boyd and De Nicolo (2005), the findings indicate that more market power is associated with riskier loan portfolios. The results are consistent across the three different proxies of market power.

Our main argument is that, even if market power in banking results in riskier loan portfolios, the bank's overall risk needs not increase. Table 4 examines the impact of the degree of competitiveness on the overall bank risk, using the Z-index as an inverse proxy of such overall risk. A higher value for the Z-index may come from either higher earnings or more capital and

indicates more financial stability, while greater variability in earnings reduces the Z-index and thereby increases the bank's overall risk.

The results of Models 1, 2 and 3 show that the estimated quadratic functions have a downward oriented parabola shape with a positive linear term. The inflection points (0.37, 0.15 and 0.21 respectively for the Lerner index, the HHI deposits and the HHI loans respectively) all occur above the 99th percentile of the Lerner index data, implying a positive relationship between all proxies of market power and the Z-index. This suggests that more market power is associated with significantly higher overall bank stability. The results lend support to the "competition-fragility" view that an increase in competition in banking is likely to erode the franchise value of firms and encourage banks to increase their overall risk exposure. We do not interpret this result as a contradiction to the previous finding that more market power leads to a riskier loan portfolio. When banks enjoy higher franchise value derived from their market power, they are likely to command higher loan rates, thereby increasing the riskiness of their loan portfolio. However, the fact that banks with more market power also enjoy greater overall financial stability seems to suggest that they protect their franchise value from the higher loan risk with other risk management methods.

In Table 5, we seek to establish whether banks enjoying a higher degree of market power do in fact hold more equity capital as a cushion to absorb unexpected losses resulting from their loan portfolio risk. The results of Model 1 indicate that the inflection point occurs around the 50th percentile of the data and no significant positive or negative relationship can be established between the Lerner Index and the equity-to-assets ratio. In contrast, the inflection point for Model 2 is evaluated at -0.03 and lies below the 1st percentile of the HHI deposits data (because the quadratic function is upward oriented), so that a significant and positive relationship emerges between the degree of market power and bank capitalization levels. The positive sign in Model 3 indicates that this result is maintained using the HHI loans as well. Thus, the findings indicate that bank capitalization levels are higher for banks with more market power using the HHI deposits and loans proxies of market structure, while the results of the Lerner index seem to imply that half of banks with more market power do hold more equity capital.

In sum, more market power in industrial countries leads to riskier loan portfolios, but overall bank risk is reduced at least in part because banking institutions are likely to hold significantly more equity capital. This result implies that banks enjoying more market power seem to be exposed to less overall bank risk, most likely as a result of their higher franchise value.[10]

Finally, we briefly consider our control variables. First, we find that larger banks carry significantly less NPLs and therefore have a better loan portfolio quality (maybe due to better monitoring technologies) than smaller banks; they also enjoy greater overall stability notwithstanding their lower capitalization levels. This finding may seem anomalous, but the equity to assets ratio used in the analysis does not consider the riskiness of bank assets and it could also be the case that the greater stability of large banks results from the use of better hedging techniques to immunize portfolios without necessarily increasing the bank's capital base.

Second, foreign ownership is associated with greater bank fragility as measured by a lower Z-index. This evidence might be explained by the nature of foreign banks. Foreign banks might only provide limited products or primarily serve firms from their home country, which might lead to more volatile earnings. In addition, international tax differences might encourage profit shifting from local subsidiaries or branches (Huizinga and Laeven, 2007). However, foreign ownership is also associated with greater bank capitalization, which may be due to differences in capital requirements for foreign-owned banks.

Third, we also find some evidence that stronger legal rights is related to lower capitalization levels. It might be the case that in generally strong business environments with strong investor protection, banks are less compelled to hold higher capitalization levels. We also find that economic development, measured by GDP per capita, is associated with less bank fragility and higher levels of bank capitalization.

[10] One reason why equity capital and stability are positively related is that capital is built up through inertia as retained earnings. That is, higher ROA generates more equity capital as dividend payouts are relatively fixed (e.g., Berger 1995, Berger, DeYoung, Flannery, Lee, and Oztekin 2008).

B. Robustness Checks

We run a number of robustness checks on our main models (not shown in tables). First, we run our regressions using different control variables from the World Bank's Doing Business report (World Bank 2006) including cost to register property, credit information, public registry, private bureau, cost to enforce contracts and informal economy. Our main results are maintained. Second, our results are robust to excluding GDP per capita. Third, we exclude the quadratic (squared) term in our regressions to force a linear relationship between the degree of market power and the various measures of bank risk exposures. The robustness checks are generally robust with the findings of the previous sections. Banks with more market power carry riskier loan portfolios, but increased market power is also generally accompanied by greater levels of financial stability in terms of reduced overall risk. The robustness tests also confirm the finding that banks with more market power hold significantly more equity capital.

VI. Conclusions

Under the traditional "competition-fragility" view, more bank competition erodes market power, decreases profit margins, and results in reduced franchise value. This encourages banking organizations to take on more risk to increase returns. Under the alternative "competition-stability" view, more market power in the loan market may result in higher bank risk as the higher interest rates charged to loan customers make it harder to repay loans, and exacerbate moral hazard and adverse selection problems. Both theories have received some degree of empirical support using different measures of bank or loan risk and the degree of competition or market power.

We argue that the two strands of the literature need not necessarily yield opposing predictions regarding the effects of competition and market power on stability in banking. Even if market power in the loan market results in riskier loan portfolios, the overall risks of the banks need not increase. If banks enjoy higher franchise value derived from their market power, they may protect this value from the higher loan risk through more equity capital, a smaller loan portfolio, or other risk-mitigating techniques. Thus, when banks charge higher rates for business loans and have a riskier loan portfolio, they may still choose a lower overall risk level.

We test the theories by regressing measures of loan risk, bank stability, and bank equity capital on several measures of market power, using bank-level data for 23 industrial nations. We take account of the endogeneity of market power by employing activity restrictions, banking freedom, and the percent of foreign- and government-owned banks as instruments. Our results suggest that, consistent with the traditional "competition-fragility" view, banks with a higher degree of market power also have less overall risk exposure. However, the data also provide some support for one element of the "competition-stability" view – that market power does increase loan risk in these nations. This risk may be offset in part by higher equity capital ratios.

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Table 1. Variable Definitions

Variable	*Definition*
Dependent Variables:	
NPLs	The bank-level ratio of nonperforming loans to total loans; a higher value indicates a riskier loan portfolio. Values are averaged over time. Source: BankScope, 2007.
Z-index	The bank-level Z-index; a larger value indicates a higher bank stability and less overall bank risk. Source: BankScope, 2007.
E/TA	The bank-level capitalization ratio, measured as the ratio of equity to total assets; a higher ratio indicates lower bank risk. Values are averaged over time. Source: BankScope, 2007.
Explanatory Variables:	
Lerner Index	A country-level indicator of bank competition, measured by the Lerner index, which is calculated as the average bank-level measure of the mark-up of price over marginal costs, with higher values indicating less competition in the banking sector. Source: BankScope, 2007.
HHI deposits	A country-level indicator of bank concentration, measured by the Herfindahl-Hirschman Deposits Index, with higher values indicating greater market concentration. Source: BankScope, 2007.
HHI loans	A country-level indicator of bank concentration, measured by the Herfindahl-Hirschman Loans Index, with higher values indicating greater market concentration. Source: BankScope, 2007.
Bank Size	The log value of Total Assets. Source: BankScope, 2007
Foreign Ownership	A dummy variable set to 1 when total foreign shareholding exceeds 50% of total bank ownership. Source: BankScope, 2007.
Ln (GDPPC)	The log value of GDP per capita. Source: WB-WDI, 2007.
Legal rights index	An index measuring the degree to which collateral and bankruptcy laws facilitate lending. The index ranges from 0 to 10 with higher scores indicating that collateral and bankruptcy laws are better designed to expand access to credit. Source: Djankov, McLiesh, and Shleifer (2007)
Instrumental variables:	
Activity Restrictions	An index and takes on values between (1) and (4), with higher values indicating greater restrictions on bank activities and nonfinancial ownership and control. Activities are classified as unrestricted (1), permitted (2), restricted (3), or prohibited (4), with possible index variation between four and sixteen. Source: Barth, Caprio and Levine (2007).
Banking Freedom	An index ranging from (1) to (5), with higher values indicating fewer restrictions. The index informs whether foreign banks are allowed to operate freely, the difficulties when setting up domestic banks, and on government influence over the allocation of credit. Source: Heritage Foundation.
Percent of foreign banks	Percent of foreign-owned banks. Source: Barth, Caprio, and Levine (2007).
Percent of government banks	Percent of government-owned banks. Source: Barth, Caprio, and Levine (2007).

Table 2. Summary Statistics

Variable	No. of Banks	Mean	Std. Dev.	Min	Max
NPLs to total loans	7767	0.01	0.01	0.00	0.18
Z-Index	8235	56.76	48.86	6.07	280.90
Equity to Assets	8235	0.12	0.07	0.04	0.64
Lerner Index	8156	0.22	0.16	-0.55	0.59
HHI deposits	8235	0.05	0.04	0.04	0.80
HHI Loans	8235	0.04	0.05	0.03	0.77
Legal Rights	8143	6.93	0.61	3.00	10.00
Log of Total Assets	8235	11.76	1.42	7.49	20.33
Log of GDP per capita	8235	10.44	0.11	9.44	10.77

Table 3. The Effect of Market Power on NPLs

This table shows bank-level GMM regressions with robust standard errors clustered at the country level to correct for within-country serial correlation. The dependent variable is the ratio of nonperforming loans to total loans, to proxy a bank's loan portfolio risk. Explanatory variables are defined in Table 1. Indicators of market power, Lerner Index, HHI (Deposits) and HHI (Loans) are instrumented using activity restrictions, banking freedom, and percent of banks that are both government and foreign owned. The First Stage F statistic tests the relevance of the instrumental variables, where rejecting the null hypothesis implies that the variables are not exogenous. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. The $\chi 2$ test of heteroskedasticity includes the Breusch-Pagan/Godfrey/Cook-Weisberg test. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. Robust standard errors appear in parentheses below estimated coefficients.

	Dependent Variable: Market Structure		
	Model (1)	**Model (2)**	**Model (3)**
	Lerner Index	**HHI Deposits**	**HHI Loans**
Degree of Market Power	21.882	175.55	303.842
	(21.300)	(54.303)***	(114.274)***
Degree of Market Power Squared	55.389	-344.334	-716.327
	(26.223)**	(176.544)*	(266.620)***
Inflection point	-0.20	0.25	0.21
Sign of the relationship	+	+	+
Ln(Total Assets)	-1.438	-0.404	-0.434
	(0.394)***	(0.095)***	(0.126)***
Foreign Ownership	1.514	-1.175	0.835
	(0.535)***	(1.124)	(0.717)
Legal Rights	-14.601	-3.123	3.633
	(3.421)***	(9.727)	(14.286)
Ln(GDPpc)	151.135	40.105	-46.571
	(33.757)***	(96.466)	(149.798)
Constant	-1.438	-0.404	-0.434
	(0.394)***	(0.095)***	(0.126)***
Number of Banks	7568	7641	7641
First Stage F-test	42.404	26.228	45.853
Prob > F	0.000	0.000	0.000
Hansen's J χ^2	3.599	4.271	3.753
P-value	0.165	0.118	0.15
$\chi 2$ test of heteroskedasticity	1500	1600	1300
P-value	0.000	0.000	0.000

Table 4: The Effect of Market Power on the Z-index

This table shows bank-level GMM regressions with robust standard errors clustered at the country level to correct for within-country serial correlation. The dependent variable is the Z-index, which is used as an inverse indicator of a bank's fragility; a higher value indicates greater bank stability. Explanatory variables are defined in Table 1. Indicators of market power, Lerner Index, HHI (Deposits) and HHI (Loans) are instrumented using activity restrictions, banking freedom, and percent of banks that are both government and foreign owned. The First Stage F statistic tests the relevance of the instrumental variables, where rejecting the null hypothesis implies that the variables are not exogenous. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. The $\chi 2$ test of heteroskedasticity includes the Breusch-Pagan/Godfrey/Cook-Weisberg test. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. Robust standard errors appear in parentheses below estimated coefficients.

	Dependent Variable: Market Structure		
	Model (1)	**Model (2)**	**Model (3)**
	Lerner Index	**HHI Deposits**	**HHI Loans**
Degree of Market Power	7.863	10.649	8.718
	(3.293)**	(3.180)***	(2.409)***
Degree of Market Power Squared	-10.63	-34.407	-21.067
	(4.324)**	(13.661)**	(5.834)***
Inflection point	0.37	0.15	0.21
Sign of the relationship	+	+	+
Bank Size	-0.038	0.09	0.093
	(0.068)	(0.003)***	(0.004)***
Foreign Ownership	-0.012	-0.022	-0.017
	(0.021)	(0.039)	(0.019)
Legal Rights	0.605	1.408	1.608
	(0.286)**	(0.363)***	(0.342)***
Ln(GDPpc)	-3.024	-12.238	-14.289
	(2.875)	(3.660)***	(3.633)***
Constant	-0.038	0.09	0.093
	(0.068)	(0.003)***	(0.004)***
Number of Banks	8030	8109	8109
First Stage F-test	21.798	24.065	41.242
Prob > F	0.000	0.0000	0.0000
Hansen's J χ^2	1.463	1.702	4.378
P-value	0.481	0.427	0.112
$\chi 2$ test of heteroskedasticity	199.00	171.64	137.31
P-value	0.000	0.000	0.000

Table 5: The Effect Market Power on Bank Capitalization

This table shows bank-level GMM regressions with robust standard errors clustered at the country level to correct for within-country serial correlation. The dependent variable is bank capitalization (the ratio of equity to total assets). Explanatory variables are defined in Table 1. Indicators of market power, Lerner Index, HHI (Deposits) and HHI (Loans) are instrumented using activity restrictions, banking freedom, and percent of banks that are both government and foreign owned. The First Stage F statistic tests the relevance of the instrumental variables, where rejecting the null hypothesis implies that the variables are not exogenous. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. The $\chi 2$ test of heteroskedasticity includes the Breusch-Pagan/Godfrey/Cook-Weisberg test. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels respectively. Robust standard errors appear in parentheses below estimated coefficients.

	Dependent Variable: Market Structure		
	Model (1)	**Model (2)**	**Model (3)**
	Lerner Index	**HHI Deposits**	**HHI Loans**
Degree of Market Power	-0.691	0.184	1.022
	(0.858)	(0.201)	(0.169)***
Degree of Market Power Squared	1.587	2.891	-1.365
	(1.320)	(0.999)***	(0.493)***
Inflection point	0.22	-0.03	0.37
Sign of the relationship	+/-	+	+
Bank Size	-0.004	-0.018	-0.018
	(0.013)	(0.002)***	(0.002)***
Foreign Ownership	0.032	0.049	0.043
	(0.023)	(0.017)***	(0.020)**
Legal Rights	0.008	-0.028	-0.006
	(0.005)	(0.006)***	(0.003)**
Ln(GDPpc)	0.062	0.182	0.109
	(0.036)*	(0.027)***	(0.018)***
Constant	-0.499	-1.408	-0.809
	(0.438)	(0.240)***	(0.182)***
Number of Banks	8030	8109	8109
First Stage F-test	18.12	23.94	45.39
Prob > F	0.000	0.000	0.000
Hansen's J χ^2	2.215	5.531	1.030
P-value	0.330	0.063	0.597
$\chi 2$ test of heteroskedasticity	576.97	137.31	1126.3
P-value	0.000	0.000	0.000

Appendix

List of Countries and Number of Banks

Country	No. of banks
Austria	34
Bahamas	9
Bahrain	4
Belgium	14
Canada	36
Denmark	30
France	79
Germany	120
Ireland	9
Italy	29
Japan	6
Kuwait	6
Luxembourg	68
Macau	5
Netherlands	9
Norway	5
Qatar	6
Sweden	11
Switzerland	112
Taiwan	18
United Arab Emirates	17
United Kingdom	43
USA	7565