

BANK COMPETITION, REGULATIONS, AND STABILITY
IN DEVELOPED COUNTRIES

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BANK COMPETITION, REGULATIONS, AND STABILITY
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DECLARATION OF ORIGINALITY

I, Gamze Danışman, certify that

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ABSTRACT

Bank Competition, Regulations, and Stability in Developed Countries

The objective of this dissertation is to first explore the influence of competition on bank stability. It is then examined how bank regulation and supervision variables in a country such as the stringency of capital requirements, restrictions on activities, and the power of supervisory authorities, affect bank stability directly and interact with competition in forming the risk-taking bank behavior. A sample of 6,936 banks in 25 developed countries in various parts of the world is used for the years 2007-2015. The findings show that competition-fragility view holds and the decrease in stability under competition arises from both more volatile profits and lower capitalization ratios. There is no evidence of non-linearity in competition and stability relationship as reported in the recent literature. Capital requirements appear to be a very successful regulatory tool in increasing bank stability, both directly and indirectly through interacting with market power. Lower activity restriction is another effective regulatory instrument to decrease bank risk-taking for any level of market power, but the restrictions on activities decrease bank risk more for banks with lower market power. Lower supervisory power emerges as another useful tool in increasing bank stability through decreasing overall bank risk, regardless of the level of market power. It is finally observed that the 2007-2009 financial crisis negatively influences bank soundness. However, it is found that banks with market power remained to be stable during the crisis period, through having lower profit volatility.

ÖZET

Gelişmiş Ülkelerde Bankacılık Sektöründe Rekabet, Regülasyonlar ve İstikrar

Bu tezin amacı, rekabetin banka istikrarı üzerindeki etkisini incelemektir. Aynı zamanda, bir ülkedeki sermaye yeterliliği, faaliyet kısıtlamaları ve düzenleyici otoritenin düzenleme ve denetim gücü gibi bankacılık düzenleme ve denetim değişkenlerinin, banka istikrarını nasıl doğrudan etkilediği ve bankaların risk alma davranışlarını şekillendirirken rekabetle nasıl etkileşim kurdukları incelenmiştir. 2007-2015 yılları arasında dünyanın çeşitli bölgelerindeki 25 gelişmiş ülkeden 6,936 bankanın verileri kullanılmaktadır. Analiz sonuçları gelişmiş ülkelerde rekabetin kırılganlığı arttırdığı yönündeki görüşü desteklemektedir ve kırılganlık artışı kârlardaki dalgalanmalardan ve düşük sermaye oranlarından kaynaklanmaktadır. Rekabet ve istikrar ilişkisinde doğrusal olmayan herhangi bir yapı gözlemlenmemiştir. Sermaye yeterliliği, hem doğrudan hem de piyasa gücü ile etkileşim yoluyla, bankaların istikrarını arttırmada başarılı bir düzenleyici araç olarak ortaya çıkmaktadır. Düşük faaliyet kısıtlamaları, herhangi bir pazar gücü düzeyinde toplam banka riskini azaltmak için etkili bir düzenleyici araçtır; ancak, piyasa gücü düşük olan bankalar için düşük faaliyet kısıtlamaları banka riskini daha fazla azaltmaktadır. Düzenleyici otoritenin düzenleme ve denetim gücünün az olması, bankanın piyasa gücünün seviyesine bakılmaksızın, banka istikrarını arttırmada bir başka kullanışlı araç olarak ortaya çıkmaktadır. Son olarak, 2007-2009 mali krizinin banka istikrarı üzerinde olumsuz bir etkiye sahip olduğu gözlemlenmiştir, ancak, piyasa gücü yüksek bankalar, kârlarındaki dalgalanmayı azaltarak istikrarlarını korumuşlardır.

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To my daughter,

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ABBREVIATIONS

ATM	Automatic Teller Machine
BHC	Bank Holding Company
CR3	Concentration Ratio of the largest three banks
CR5	Concentration Ratio of the largest five banks
CRR	Capital Requirements Regulation
EU	European Union
GDP	Gross Domestic Product
G-SIBs	Global Systematically Important Banks
HHI	Herfindahl-Hirschman Index
ICT	Information and Communication Technology
IV	Instrumental Variable
NPL	Non-Performing Loans
OLS	Ordinary Least Squares
P2P	Peer-to-peer
ROA	Return on Assets
QAT	Qualitative Asset Transformation
SCP	Structure-Conduct-Performance
SIFI	Systematically Important Financial Institutions
TBTF	Too-big-to-fail
UK	United Kingdom
US	United States
2SLS	Two-Stage Least Squares

CHAPTER 1

INTRODUCTION

Banks are vulnerable to instability due to their special functions in the financial system. They intermediate between investors and borrowers by achieving a unique maturity transformation in their balance sheets. While bank panic runs and systemic crises create a source of bank instability from the liability side; risk-taking behavior of banks generates another source of instability from the asset side (Matutes & Vives, 2000; Carletti, 2008). The stability of banking industry is very crucial because any instability may spread by contagion to the whole economy by distorting the interbank lending market and credit availability, and ultimately can lead to recessions (Allen & Gale, 2000).

The recent history of banking sector can be categorized into two periods: a tightly regulated and stable period from the 1940s to the 1970s with limited competition, followed by a period of liberalization, deregulation and greater instability, culminating with the 2007-2009 financial crisis (Vives, 2010). The process of liberalization and deregulation of branching and activity restrictions in the former period increased competitive pressure on the banks from both inside and outside the banking industry, mainly stemming from non-bank intermediaries, shadow banking, and market-based finance. Consequently, banks expanded into new and risky lines of business and new locations, which have resulted in excessive risk-taking, individual bank failures and systemic crises in the 1980s and 1990s. Excessive competition and inadequate regulations were argued to be primary causes for failures (Keeley, 1990; Demirguc-Kunt & Detragiache, 2005) in this period. The 2007-2009 global financial crisis has increased

concerns over competition and regulatory policies in banking. The increase in competitive pressure has brought a relatively recent trend of bank consolidation to gain market power and reap economies of scale, increasing the size of banks. The competitive environment is altered by the bailouts of too-big-to-fail (TBTF) banks which generated an uneven platform (Laeven & Levine, 2007; Vives, 2016).

The 2007-2009 financial crisis overrode concerns regarding the competition policy and regulatory deficiencies (Barth, Caprio, & Levine, 2013). Therefore, post-crisis regulatory reforms were in place with Basel III in various countries and the Dodd-Frank law in the United States (US) for preserving stability in banking and avoiding any further TBTF crisis. There is, however, a very recent debate that started mainly in the US about the tighter regulations under the Dodd-Frank law becoming burdensome for all banks, and especially smaller banks. Therefore, some directives are proposed in 2017 to decrease regulatory requirements to the extent which would assure that banks can lend and that the economy can grow. Some policymakers, on the other hand, argue that the core post-crisis reforms have substantially prevented risky behavior without restricting credit availability or economic growth and unwinding the regulations has to be considered cautiously.

The afore-mentioned discussions motivate to explore the following research questions throughout the thesis: Is competition in banking good for a stable banking system? Is competition responsible for major failures in banking or does improper regulation and supervision need to be taken into account? How do banking regulations and the intensity of competition interact in forming the risk behavior of banks? How does the recent financial crisis period (2007-2009) affect bank stability, and is competition more detrimental to bank stability during this period?

How competition in banking industry affects stability is a broadly debated topic in the banking literature. The findings in the theoretical literature can be categorized into two main areas. The competition-fragility literature claims that fragility in banking is observed when there is competition in the market. The main argument is that there is high pressure on profits under more competition, which reduces the franchise value of banks. Risk-taking incentives of banks, in turn, are reduced (Keeley, 1990; Suarez, 1994). Another argument rests on relationship banking, which states that under competition, banks gain fewer informational advantages from relationship banking. Banks lose their motivation to screen the borrowers and assume greater risks (Besanko & Thakor, 1993; Boot & Greenbaum, 1993). The more recent competition-stability view states that competition brings a stable banking industry. Boyd & De Nicolo (2005) show that banks have decreased credit risks under competition, which is due to lower loan rates. However, the recent literature assumes an imperfect correlation in default of loans and indicates a nonlinear relationship (Martinez-Miera & Repullo, 2010). The empirical literature for both single-country and cross-country studies are also inconclusive for either view (Salas & Saurina, 2003; Jimenez, Lopez, & Saurina, 2013; Beck, De Jonghe, & Schepens, 2013; Schaeck & Cihak, 2014).

Bank regulations aim to mitigate the trade-off between competition and stability and achieve a stable banking sector (Carletti, 2008). Regulations such as capital requirements, proper supervision and disclosure requirements are always seen as main ingredients of a stable banking system (Basel I, II and III frameworks in Europe). However, there is no broad academic agreement on the effect of different bank regulations and supervisory applications on the bank stability which results from different institutional settings among different countries (Barth, Caprio, & Levine,

2004). For example, higher capital requirements put bank equity under risk, decrease risky bank behaviors, and ameliorate the moral hazard problem created by deposit insurance (Keeley, 1990; Keeley & Furlong, 1990). However, there is also an opposite franchise value effect that occurs when capital requirements reduce banks' franchise values and encourage gambling so that the overall effect on bank stability is ambiguous (Koehn & Santomero, 1980; Kim & Santomero, 1988; Hellmann, Murdock, & Stiglitz, 2000). Another example is that activity restrictions, on the one hand, decrease conflicts of interest that may arise from diverse activities and would provide less opportunity for risky behavior and therefore stabilize the banking system (Saunders, 1985; Benston, 1990; Boyd, Chang, & Smith, 1998). On the other hand, diversified activities permit to conduct economies of scale and scope from both the production and the product side and offer services more efficiently and increase bank stability (Saunders & Walter, 1994). While a strong and independent banking supervisory agency would be able to diminish the risk-taking behavior of managers (Stigler, 1975; Barth et al., 2004), it may also impact bank stability negatively due to the self-interests rather than social welfare (Djankov, La Porta, Lopez-de-Silanes, & Shleifer, 2002). Overall, the effect of different regulations on bank stability is rather ambiguous and needs to be clarified. Moreover, an optimal amount of regulation in different institutional settings has to consider the level of competition (Vives, 2010).

In this thesis, how competition affects stability in the banking sector and the possible nonlinearity in this relationship are examined for developed countries. It is then considered how bank regulation and supervision variables such as capital stringency, restricted bank activities, and powerful supervisory agencies impact bank stability directly and interact with competition in forming the risk-taking incentives of banks.

Finally, it is explored how the recent financial crisis period (2007-2009) influences bank soundness and whether competition is more detrimental during this period.

Despite the ongoing debate on the relationship between competition and banking stability among academicians and policymakers, the effect of competition and regulations on banking stability is not yet well established. In this thesis, the impact of competition on bank fragility is explored in developed markets, and it is aimed to contribute to this inconclusive debate. There is also limited empirical evidence on how regulations interact with competition to affect the risk behavior of banks. This thesis attempts to help close this gap, too.

To the best of our knowledge, only two studies are exploring the impact of the interaction of competition and regulations on soundness in banking, namely Agoraki, Delis, & Pasiouras (2011) and Beck et al. (2013). While Agoraki et al. (2011) employ a sample of Central and Eastern European countries, Beck et al. (2013) explore only the indirect effect of various market regulatory and institutional measures through the competition on bank stability in a cross-country sample, including both developed and developing countries. This thesis differs from Agoraki et al. (2011) in that, first, the focus is on developed countries where the results are expected to differ from transition countries due to different institutional contexts (Barth et al, 2004). Second, the empirical strategy is very different from Agoraki et al. (2011) as detailed in Chapter 4. The thesis also differs from Beck et al. (2013) in that the focus is on three specific regulatory variables, which are capital requirements, activity restrictions, and supervisory power. While Beck et al. (2013) focus only on the indirect impact of various regulatory and institutional measures, this thesis examines both direct and indirect impact of the three regulatory measures through competition which provides more concrete policy

implications for developed countries. This thesis also differs from them in that it further examines the effect of 2007-2009 financial crisis period on bank stability to see whether competition is more detrimental to stability. As in Agoraki et al. (2011), the focus is limited on three regulatory policies, namely stringency in capital requirements, restricted bank activities and the power of supervisory authority because they possess both a well-established theoretical background and a high priority in Basel accords and policymakers' agendas.

The empirical analysis is carried out for 6,936 banks in 25 developed markets in various parts of the world for the years 2007-2015. As a measure of competition, the Lerner index is employed, which has been quite popular in the recent literature. The econometric models are estimated using fixed-effects panel data estimation techniques, and country-time fixed effects are included to allow for heterogeneity within a country and a given year. The country-year level is used when clustering the error terms. One period lagged independent variables are used to decrease the impact of reverse causality. While endogeneity concerns are mitigated by the use of lagged independent variables, there are other possible causes of endogeneity which may be created by omitted variables. Therefore, instrumental variable (IV) technique is employed, using a Two-Stage Least Squares (2SLS) estimator, to control for endogeneity.

The findings indicate that competitive environment in banking increases both bank default risk and credit risk, and the competition-fragility view holds for developed countries. While bank default risk indicates the individual bank distress and measured by the Z-score; bank credit risk captures the risk of the loan portfolio and captured by non-performing loans ratio. The results are robust controlling for endogeneity, decomposing the Z-score and using alternative indicators for competition and bank stability.

Decomposition of the Z-score reveals that the decrease in stability under competition originates both from more volatile profits and lower capitalization ratios. On the other hand, non-linearity of competition is not observed.

Next, the influence of bank regulatory variables on the stability of banking is explored, and it is observed that capital requirements appear to be a very successful regulatory tool in increasing bank stability both directly and indirectly through interacting with market power. The stabilizing effect of capital requirements is higher in banks with more market power. The decomposition of the Z-score shows that more stable profits and higher bank equity ratios are the channels for the stabilizing effect of more stringent capital requirements. Lower activity restriction is another effective regulatory instrument to decrease bank risk-taking for any level of market power, but restrictions on activities decrease bank risk more for banks with lower market power. It is observed that restricted regulations on bank activities lead to excessive risk-taking, mainly through more volatile profits. Finally, lower supervisory power emerges as another effective tool in increasing bank stability by decreasing overall bank risk for all levels of market power. Decomposition of the Z-score again indicates that banks in countries with higher supervisory power engage in excessive risk-taking, mainly through more volatile profits. Overall, the results show that taking into account interactions between regulations and competition leads to more accurate conclusions on the net impact of regulations on fragility in banking.

Finally, considering the 2007-2009 financial crisis effects, it is observed that the crisis period has a direct negative influence on bank stability, through both increasing the volatility of profits and decreasing bank capitalization ratio. However, banks with market power remained stable during the crisis period by having lower profit volatility.

The rest of the dissertation is outlined as follows: Chapter 2 presents competition in the banking sector with presenting the uniqueness, fragility, and business models of banks, competition paradigm in banking, a historical overview of competition in banking, measures of competition and bank stability, and the literature on competition and bank stability. Chapter 3 summarizes the historical overview of regulations in banking and the relevant literature on regulations and the bank stability relationship. The methodology and data are described in Chapter 4, and Chapter 5 presents the results. A summary of the findings is provided in Chapter 6, and it concludes with some implications and suggestions for research in the future.

CHAPTER 2

COMPETITION IN THE BANKING SECTOR

The banking sector is entirely different from other sectors of the economy due to its specific functions which make it prone to tight regulations, supervision, and public intervention. An overview of competition in the banking sector and its particular characteristics are presented in this chapter, and the uniqueness and fragility of banks, business models in banking, competition paradigm in banking, and historical overview of competition in banking is discussed. Next, the different measures of competition and risk-taking, frequently used in the empirical literature on banking, are presented. Finally, the theoretical and the empirical literature on competition and bank stability relationship are discussed in Sections 2.7 and 2.8, respectively.

2.1 The uniqueness and fragility of banks

Typical functions of banks include intermediary services between lenders and borrowers by gathering deposits, providing loans, transaction and payment services and financing entrepreneurial projects. Banks are vulnerable to instability, mainly due to the unique maturity transformation they undertake in their balance sheets (Matutes & Vives, 2000; Carletti, 2008). They take on various risks through the qualitative asset transformation (QAT) in which the characteristics of a bank's assets are different in many terms from its liabilities (Bhattacharya & Thakor 1993).

Sources of bank instability originate from both the liability side and the asset side. Bank instability from the liability side occurs through bank runs and systemic

crises. Banks provide demandable contracts to depositors that can be withdrawn in a fixed amount, and if such withdrawals exceed the total amount available to banks from short-term investments, then banks need to sell illiquid assets, potentially initiating a bank run (Bryant, 1980). Moreover, a systemic crisis may occur if the bank defaults spread to the whole economy, which can happen as a result of contagion effects. While contagious runs are the diffusion of a single bank run to other banks, domino effects result from difficulties of distressed banks spreading to other banks through interbank market commitments and payment systems (Allen & Gale, 2000). Another channel of contagion is that a banking crisis may negatively affect the whole economy through the feedback effects between financial and real sectors with a credit crunch. When a substantial part of the financial system has problems, it may lead to systemic risk, which causes fragility in the whole economy because of the central function of financial institutions.

Instability from the asset side arises from excessive risk-taking. Agency theory implies that when the objectives of the principal and the agent do not match, the agent does not always act in line with the principal's expectations (Jensen & Meckling, 1976). While the agency problem occurs in all leveraged firms, banks are more prone to the problem due to the opacity of bank assets, making them vulnerable to misallocation of resources. Moreover, the allocation of bank debt among small and uninformed depositors prevents their effective monitoring, which in turn leads banks, subject to limited liability, to engage in risky behavior without being easily detected (Matutes & Vives, 2000; Carletti, 2008).

2.2 Business models in banking

The liberalization and deregulation process in developed markets after the 1970s has altered the focus of banks from gathering deposits and providing loans to conducting a diverse range of activities. These activities include the provision of services to investors and firms such as asset management, underwriting equity and debt issues, securitization, consulting, and insurance and proprietary trading (Vives, 2016).¹ Instead of investing in branches, banks started investing in information technology, communication networks, and specialized human capital. The relative weight of trading increased in the bank's balance sheets, replacing traditional relationship banking.

Information technology brought securitization, which allowed transforming illiquid loans such as mortgages into tradable instruments, and banks were able to extend more credit to investors and spread credit risk to investors with different risk profiles. Meanwhile, through securitization, banks were able to reduce capital requirements by off-balance sheet financing (Brunnermeier, 2009; Acharya, Schnabl, & Suárez, 2013). Banks' incentives for risk-taking and the intensity of competition have increased as larger scale operations became available. For instance, some institutions took hidden tail risks through highly leveraged positions in securitized subprime mortgages, which led to extreme losses during the 2007-2009 financial crisis (Acharya, Cooley, Richardson, & Walter, 2010).

Liberalization and the more recent consolidation trend have also increased the size of the largest banks and differentiated their business models from the rest of banks. In particular, large banks' business models are characterized by lower risk-weighted capital, more non-interest income, a lower deposit share in the total liabilities, more

¹ Proprietary trading refers to banks trading for their profits instead of trading on behalf of their clients.

market-based activities and more complex organizations (Laeven, Ratnovski, & Tong, 2014).

2.3 Competition paradigm in banking

The standard competition paradigm in favor of competition regarding cost minimization and allocative efficiency is not entirely valid for banking because many market failures distort the nature of competition and its outcomes. The main market failures include asymmetric information, switching costs and networks in retail banking and two-sided competition in deposits and loans.

The first market failure in banking is asymmetric information between banks and potential borrowers during the process of providing loans. Broecker (1990) analyzes the effect of competition in the loan market and shows that the competition mechanism does not work properly for banks. When a bank increases its loan rate above those of its competitors, it increases its earnings. On the other hand, the quality of firms which apply for loans declines, reducing the bank's profits. Riordan (1993) shows that competition decreases the informativeness of signals that banks receive on the borrower's loan quality, which leads to decreased bank portfolio quality and financing of less efficient investment projects. Moreover, Gehrig (1998) shows that competition from new entries deteriorates bank portfolio qualities because banks then reduce their investment on improving the quality of the borrower screening tests.

Banks also gather information on borrowers through the course of a relationship which creates another informational asymmetry. When a borrower needs to reapply for a loan, he chooses the incumbent bank, which grants that bank an informational monopoly. The borrower does not exert adequate effort, and the expected return on the

investment projects diminishes (Rajan, 1992). The presence of adverse selection through heterogeneous borrowers and the information acquisition through lending generate endogenous fixed costs, keep other banks out of the market, and limit competition (Dell'Ariccia, 2001).² While the literature on competition under asymmetric information does not directly address the consequences of bank stability, it provides initial perceptions on their relationship.

The second market failure inherent in banking and distorting competition outcomes is switching costs, which is a crucial source of bank market power and consists of costs incurred by consumers when switching from one bank to another (Vives, 2001). On the one hand, banks desire lower switching costs because new customers can easily apply to them. On the other hand, they do want higher switching costs to lock in customers and discourage them from changing their bank.

Another banking market failure that disrupts competition is network structures. Banks sharing Automatic Teller Machine (ATM) networks is an example of a strategic variable that influences competition. Matutes & Padilla (1994), using a two-period model, show that depositors have easier access to their deposits in a shared ATM network and banks, in turn, gain from offering lower deposit rates. On the other hand, an ATM network ensures that banks are substitutable and increases price rivalry when possibly higher rates are offered by a rival bank. Banks choose to share ATM networks when the ATM is used less frequently in transactions. Equilibrium occurs by either no sharing or partial sharing of ATM networks due to maintaining some differentiation. The possible threat of new entrants may further encourage banks to share their network to

² Adverse selection arises due to an information asymmetry between borrowers and banks where borrowers may undertake risky projects, and banks might not be aware of these projects.

obtain a concentrated structure and monopoly prices (McAndrews & Rob, 1996).

Similar findings are reached by Degryse (1996) in a context where the bank customers can use different types of remote access, such as telephone or postal services.

Introducing remote access steals depositors from rival banks (stealing effect). On the other hand, the substitutability of banks is promoted (substitution effect), and which of these two effects dominates defines the equilibrium.

Banks compete in deposit markets to attract new depositors and also compete in loan markets to provide new loans to customers, which may lead to a final bias in competitive behavior. Yanelle (1997) shows that banks aim for gaining market power in one of these markets and offer noncompetitive prices in the other market.

2.4 Historical overview of competition in banking

Whether competition is good for the banking sector has been called into question for a long time. In Figure 1 the percentage of countries that experienced a banking crisis is displayed between 1900 and 2008 (Reinhart & Rogoff, 2008). As depicted in Figure 1, the recent history of the banking sector is divided into two distinct periods. A tightly regulated, interventionist and stable period from the 1940s to the 1970s with limited competition, followed by a period of liberalization, deregulation and greater instability, culminating with the 2007-2009 financial crisis (Vives, 2010). The competition was limited in banking from the 1930s to the 1970s, and public authorities preferred to deal with a concentrated banking sector and a collusive environment in a range of countries. The argument was that competition narrows bank margins and increases incentives for risky behavior and destabilizes the system.

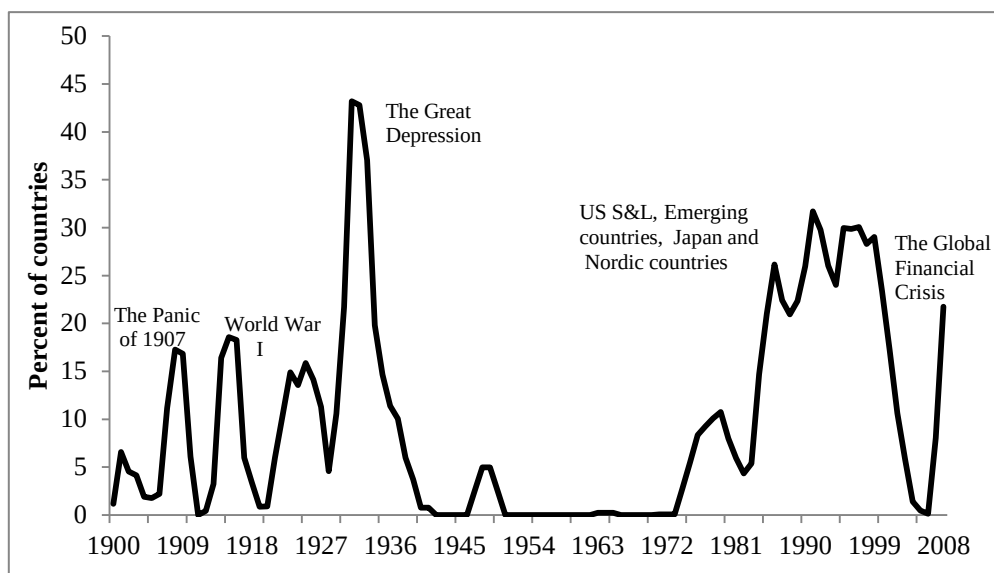


Figure 1. The proportion of countries with a banking crisis

Therefore, restrictive policies are conducted by regulators, among which are rate ceilings, activity limitations, and branching restrictions. The Glass-Steagall Act, initiated in 1933 in the US, inhibited performing commercial, investment and insurance activities under one single entity. After the 1970s, competition started to be favored with the belief that competition enhances efficiency, and financial liberalization and deregulation emerged (Vives, 2016). The process of liberalization and deregulation was mainly initiated in the US with the termination of deposit rate regulations by the Depository Institutions Deregulation and Monetary Control Act in 1980. Then the process continued with the removal of geographical expansion restrictions by the Riegle-Neal Act in 1994, and the Gramm-Leach-Bliley Act in 1999 (Kroszner & Strahan, 2014).³

The liberalization process in Europe included the “Big Bang” deregulation of 1986 in the United Kingdom (UK) and the establishment of the European Union (EU) in

³ Gramm-Leach-Bliley Act aimed to modernize the banking industry by repealing Glass-Steagall Act that inhibited performing commercial, investment and insurance activities under one single entity.

1999 (Vives, 2016). The process accelerated with advances in information and communication technology (ICT), which boosted productivity and globalization advance through international capital movements, reductions in transportation costs and barriers to trade.

The liberalization and deregulation process increased competition for banks from both inside and outside the banking industry, mainly from non-bank financial intermediaries and market-based finance. Borrowers have access to funding directly from the market, which deteriorates the intermediary role of traditional banking, and non-bank financial intermediaries and shadow banking capture market share from banks.⁴ Moreover, with more hard information available on borrowers in the market, banks face diminished market power, and borrowers can more easily switch from one bank to another bank or non-bank lending companies without facing too much switching costs (Vives, 2016).

Recent competitors for banks have emerged as fin-tech companies, which challenge the traditional banking business and put competitive pressure on banks by offering services such as transaction payments, lending, insurance and financial advising. According to the “Special Report on International Banking,” published in *The Economist* on May 9, 2015, few of them seek to get any share of the core business from taking deposits, but each introduces a superior and cheaper service in its specialist field. Even though banks have the biggest share in the market for transaction payments, newer innovations are brought by non-bank companies such as PayPal, Apple Pay and Google Wallet, which allow people to pay in shops through their phones without any need to

⁴ Shadow banking refers to financial intermediaries that act like banks but are not regulated as banks. Examples include investment banks, structured investment vehicles (SIVs), hedge funds and money market funds.

open a bank account. Lending is another area which attracts many non-bank players with peer-to-peer (P2P) lending platforms, which match people in need of money with lenders, individuals and companies looking for investment. Moreover, financial advisory business from investment professionals is also challenged by “robo-advisors,” which generate investment advice based upon the historical data they have on customers and which is offered at a lower price (Vives, 2016).

Banks expanded into new and risky lines of business and new locations due to increased competitive pressure, which has resulted in excessive risk-taking, individual bank defaults, and crises occurred in various countries (such as the US Savings and Loan crisis in the 1980s, the Japan crisis in the 1990s, Scandinavia in the early 1990s and the crisis in Spain in the 1980s). Excessive competition and inadequate regulations were argued to have been primary causes of the failures (Keeley, 1990; Demirguc-Kunt & Detragiache, 2005).

The increase in competitive pressure has brought a relatively recent trend of bank consolidation to gain market power and reap economies of scale, increasing the size of banks. Large banks are characterized by diversification economies, high leverage, and more unstable funding. TBTF subsidies from governments and regulators preferring to deal with concentrated banking sectors are other reasons for the increase in bank size (Laeven & Levine, 2007). The number of banks started falling in the US, both before and after the 2007-2009 crisis, by 22% from 1997 to 2007 and 17% from 2007 to 2012. The same trend applies to Europe with 29% of a decrease in the number of banks from 1997 to 2007 and 6% of a decrease from 2007 to 2012. The 2007-2009 crisis further increased the consolidation trend in Europe, but instead stabilized it in the US (Vives, 2016).

2.5 Measures of competition

This section briefly introduces the most commonly used measures of competition, before reviewing the theoretical and empirical literature on competition and bank stability in Sections 2.7 and 2.8. The structural and non-structural measures form the two main categories of measures for competition that are used in the empirical studies.

The structural measures rest on the Structure-Conduct-Performance (SCP) from industrial organization, which links market structures with performances. It argues that market structure influences the way how firms behave and how they perform. Therefore, the paradigm depicts that structure influences performance (Claessens, 2009). Market structure measures are used for the structural approach as a proxy for competition, which includes the ratios for concentration, the count of banks in a country and the Herfindahl-Hirschman Index (HHI). The count of banks just considers the number of banks in a market. The k-bank concentration ratio and HHI are briefly presented below.

The sum of market shares of the k largest banks is considered while calculating the k-bank concentration ratio (CRk). $\sum_{i=1}^k s_i$, where the market share of the i-th bank and the number of banks is denoted by s_i and k, respectively. The choice of k is somewhat arbitrary but is usually between 3 and 5. Concentration ratios assign the same weight to each bank in the market and do not consider the effect of small-sized banks. The index ranges from 0 to 1. It reaches zero for infinitely many numbers of banks of the same size and approaches one if the banks considered in the calculation generate the entire banking industry (Bikker & Haaf, 2002).

The squares of market shares of banks are considered while computing the Herfindahl-Hirschman index (HHI): $\sum_{i=1}^n s_i^2$ where the square of the market share of i-

th bank and the count of banks are denoted by s_i^2 and n , respectively. The index varies from $1/n$ to 1, and the lowest value is reached when the market is comprised of n equally-sized banks (Bikker & Haaf, 2002). Since this index accounts for all sizes of banks, including smaller banks; it is also known as the full-information index.

The structural approach through SCP paradigm is criticized in the literature for three main reasons (Berger, Demirguc-Kunt, Levine, & Haubrich, 2004; Claessens & Laeven, 2004; Claessens, 2009). First, the market structure may not be exogenous; instead, it might be a result of firm behavior. Second, competition in an industry may be affected by factors other than concentration, such as ownership structure, entry or exit barriers, and activity restrictions. Third, the firm performance may be influenced by factors other than competition, such as the country's macroeconomic context and the legal system.

Competition is a crucial element to achieve static and dynamic efficiency in banking, and empirical evidence indicates that poor use of inputs in banks leads to significant inefficiencies. Many banks function below their technical capabilities (Demirguc-Kunt & Huizinga, 1999), and it is, therefore, essential to use measures of competition which compute whether financial institutions act efficiently from a cost point of view (Claessens & Klingebiel, 2001). Moreover, it is crucial to consider competition from all banking and non-banking financial intermediation. A competitive environment does not necessarily indicate a higher number of firms. When contestability is present, a concentrated system can indeed be competitive.⁵ For instance, as indicated in Claessens & Klingebiel (2001), many European and Canadian financial systems have

⁵ In a contestable market, entry and exit are costless. Even if there is a monopoly, potential competition with new entries and exits disciplines the behavior of existing players.

concentrated banking systems, with the three largest banks market share often exceeding 30%, but they are counted as quite competitive. Developing countries, on the other hand, are not regarded as competitive as the developed ones, yet their concentration level of the largest banks is somewhat higher. The main difference between these two groups is that developed countries include more competition through different non-bank forms of financial intermediation. Therefore, increased competition and more consolidation need not be inconsistent.

The US has confronted a significant number of mergers in the last decades, without consolidation resulting in a reduction in the level of competition, but originating from possible improvements in efficiency, risk diversification, and the need for economies of scale and scope (Berger, Demsetz, & Strahan 1999). The US banking system is characterized by many small banks, and the consolidation trend may reflect an adjustment from a restrained state of banking. The EU Single-Market Program also encountered both considerable consolidations in banking systems within countries as well as increased competition (Vives, 1998).

The recent literature further emphasizes that concentration and competition are not correlated in banking, and they underline the necessity to consider bank-level competition measures (Berger et al., 2004, Schaeck et al., 2009). Moreover, they state that relying on country-level concentration ratios as a proxy of competition can lead to biased findings. As a response to these criticisms on structural measures, new measures of competition are introduced, like the H-Statistics, Lerner Index and Boone Indicator, which instead measure banks' conduct directly regarding marginal revenues and costs.

H-statistic, developed by Panzar & Rosse in 1987, considers how a variation in the cost of input prices affects equilibrium revenues earned by banks. In a perfectly

competitive market, marginal costs and revenues rise by the same amounts, but in a monopolistic market, the same increase in input prices leads to a lesser extent on an increase in revenues. A reduced form of the equation of revenues is considered for the calculation of the H-statistic:

$$\ln(TR_{it}) = \alpha + \sum_{k=1}^n \beta_k \ln(W_{k,it}) + \sum_{j=1}^n \gamma_j \ln(CF_{j,it}) + \varepsilon_{it} \quad (2.1)$$

where i and t denote bank and time. TR_{it} is total revenue, $W_{k,it}$ stands for the k -th input factor, and $CF_{j,it}$ shows other firm-specific control variables (Bikker et al., 2012). The H-statistic is then equal to $\sum_{k=1}^n \beta_k$, which is the sum of the percentage changes in gross revenue concerning inputs. If H-statistic ≤ 0 , a monopoly is obtained, and if $0 < \text{H-statistic} < 1$, monopolistic competition is reached. Finally, H-statistic=1 indicates perfect competition. For the profit-maximizing condition to hold, H-statistic assumes equilibrium in the market, which is the main drawback because equilibrium is quite rare. Moreover, it does not consider the differences between banks, such as size, product, and geographic differentiation. However, it is still commonly used in empirical research because it measures bank behavior directly.

The level of bank market power is calculated by the Lerner index and how much the marginal price is increased above the marginal cost is captured. It is a proxy for current and future profits and calculated as below:

$$\text{Lerner}_{it} = \frac{P_{it} - MC_{it}}{P_{it}} \quad (2.2)$$

The indices i and t denote bank and time, and higher values denote more market power and less competition. P_{it} indicates the price of bank activities, and MC_{it} show marginal costs which are generated from translog cost functions. The Lerner index is very beneficial because it is at the bank level and provides a better way to distinguish among different banking products. However, one drawback is that the information on prices and marginal costs can be difficult to collect.

The Boone indicator is introduced by Boone (2008) to measure the degree of competition. It is assumed that under competition more efficient banks perform better and steal market share from the rest of the banks. The Boone indicator is calculated using the following equation:

$$\ln(MS_{st}) = \alpha + \sum_{t=1, \dots, T-1} \beta_t D_t * \ln(MC_{st}) + \sum_{t=1, \dots, T-1} \theta_t D_t + \varepsilon_{st} \quad (2.3)$$

where market shares and marginal costs are indicated by MS and MC, respectively. D stands for time dummies, and the error term is denoted by ε_{st} . The Boone indicator is indicated by the coefficient β which can be interpreted as a profit-elasticity index. A larger negative value of β indicates more competition in the market.

2.6 Measures of bank stability

Stability in banking is commonly measured with respect to two different approaches in the empirical literature, which include the occurrence of systemic banking distress and the measurement of individual bank distress (Beck, Demirguc-Kunt, & Levine, 2006b). Systemic banking crises are measured by identifying the presence of the whole banking

system distress and do not take into account individual bank level fragility. A systemic distress occurs when the banking system cannot perform the basic intermediary functions effectively. Systemic distress is commonly measured as a dummy variable in the empirical literature which takes the value 1 when a systemic crisis occurs and 0 when it does not.

Individual bank distress measures bank-level individual fragility and entry into bankruptcy. Individual bank fragility is also essential because many systemic crises in banking initiate as distress in individual banks. The failure of an individual large international bank has negative repercussions on many other banks in various regions. There are two commonly used measures for the individual bank distress. These include the Z-score and non-performing loan ratio (Beck, 2008).

The overall bank risk and entry into bankruptcy is captured by the Z-score (Roy, 1952) with higher values imply a lower default risk and more bank stability. It is calculated as:

$$Z_{it} = \frac{ROA_{it} + (E/A_{it})}{\sigma(ROA)_{it}} \quad (2.4)$$

where the return on assets, the equity-to-asset ratio, and the standard deviation of ROA is denoted by ROA, E/A, and $\sigma(ROA)$, respectively. It therefore takes higher values when profitability and capital levels are higher and when returns are less volatile. The number of standard deviations such that returns fall from the mean to remove the equity in the bank is captured by the Z-score (Boyd & Runkle, 1993).

The Non-Performing Loans (NPL) Ratio is the ratio of the amount of non-performing loans to gross loans of a bank, which is a proxy for the loan portfolio risk.

2.7 Theoretical literature on competition and bank stability

In Section 2.3 the banking market failures, such as asymmetric information, network externalities, and switching costs, are presented, and how those market failures distort the competition paradigm in the banking sector is discussed. However, this literature does not say much about how competition affects the stability in banking. In this section, this relationship is investigated more directly, and a theoretical literature review about the effects of competition on banking stability is provided, focusing on studies that have been most influential.

The theoretical literature on bank competition and stability consists of two strands. The competition-fragility view is supported by the earlier studies, which states that banks' risk-taking incentives are increased under intense competition. More recent studies promote the "competition-stability" view, which states that competition in banking maintains a sound banking system by reducing banks' incentives for excessive risks.

2.7.1 Competition-fragility view

The traditional view which supports that competition deteriorates the stability of the banking sector is well established in the literature. As pointed out in Section 2.1, bank instability can arise both on the asset side, as a consequence of excessive risk-taking behaviors, and on the liability side, as a result of bank runs. This section presents main

contributions from the competition-fragility literature by first considering the effects of competition on the assets and then on the liabilities of banks.

Competition and fragility from the asset side

The franchise/charter value argument is the cornerstone of the competition-fragility literature and takes inspiration directly from Keeley (1990). It mainly states that competitive banking system deteriorates the stability by reducing banks' charter values. The franchise value is an intangible asset that represents the expected future profits and the opportunity cost of going bankrupt. In other words, it represents the rents available to shareholders and managers. When conducting risky behaviors, banks must balance the gains if they succeed, with the loss of charter value if they fail (Northcott, 2004). Profits are the main driver of the charter value through generating a buffer against negative externalities which leads share price to increase above its book value, reinforces the franchise value and makes banks less vulnerable. Efficiency and a good reputation are among other drivers of charter value.

Keeley (1990) provides a theoretical framework to show that, banks' market power is enhanced when their franchise value increases and they face higher bankruptcy costs, which leads to prudent behavior by holding more equity capital. Keeley concluded that the increase in competition deteriorated the stability of the US banking industry, causing many failures in the 1980s. Suarez (1994) proposes a dynamic model and finds that charter value is an incentive for banks to conduct prudent behaviors and stay in business, confirming Keeley's findings. Bolt & Tieman (2004), in a dynamic framework, find that banks ease their acceptance criteria under more competition. While

they attract more demand and become profitable in the short run, the quality of loans deteriorates, and they face a higher probability of failure in the long term.

Another argument in the competition-fragility view rests on relationship banking. Banks earn fewer informational rents under competition, which in turn reduces their incentives to screen the borrowers and assume more significant risks. Under more competition, each bank gathers information on a smaller set of borrowers, which in turn hinders the banking screening criteria and leads to providing loans to low credit quality borrowers (Besanko & Thakor, 1993; Boot & Greenbaum, 1993; Marquez, 2002).

A somewhat different argument under the competition-fragility view relies on portfolio diversification and supervision. In more concentrated banking systems, banks are fewer in number, larger in size and better diversified, which helps them to achieve economies of scale in intermediation and increases their stability (Diamond, 1984). The limited number of banks in countries with concentrated banking systems improves the quality and effectiveness of regulatory and supervisory activities and increases stability (Allen & Gale, 2004).

Competition and fragility from the liability side

The influence of competition on bank liability risk is disregarded in the literature (Carletti & Hartmann, 2002). As discussed in Section 2.1, bank instability may arise from the liability side from the coordination problem of depositors, which fosters runs and panics. Smith (1984) develops a model where banks compete with each other in the deposit market to attract depositors. Banks are not aware of the time of the withdrawals and depositors themselves are the only ones that know their liquidity needs. Smith

concludes that higher levels of competition destabilize the environment and that the introduction of deposit rate ceilings may counterbalance this effect.

Matutes & Vives (1996), developing the banking model of Diamond (1984), conclude that competition is not solely responsible for the fragility, and bank runs may emerge independently of market structure. The model has multiple equilibriums that arise from coordination problems between depositors. Moreover, Vives (2010) confirms that bank runs take place independently of market structure; however, an increase in competitive conditions increases bank fragility and the probability of a financial crisis, due to coordination problems between depositors.

Competition may also affect banking stability through the functioning of the interbank market. Allen & Gale (2004) show that a liquidity shortage of a bank may lead to bankruptcy in a perfectly competitive market because other banks have no incentives to provide liquidity to the troubled bank. Difficulties of distressed banks spread to other banks through interbank market commitments and payment systems. An imperfectly competitive market, on the other hand, is more stable since each bank, realizing that its behavior affects the overall equilibrium through contagion, is more willing to provide funds to the troubled banks (Allen & Gale, 2000). Saez & Shi (2004) confirm that if the market is concentrated, banks willingly provide liquidity to the distressed bank, which in turn makes them better off.

2.7.2 Competition-stability view

The alternative view states that bank soundness is improved under competitive environments. Since this strand of literature is relatively recent, contributions are not

that many. The two main arguments explaining competition-stability view include the risk-shifting paradigm and the TBTF view.

Moral hazard and adverse selection problems form the base for the risk-shifting paradigm. Moral hazard occurs when a party behaves less prudently since it does not entirely bear the consequences of its actions. Moral hazard occurs due to two mechanisms of banking. First, the large allocation of bank debt among small and uninformed depositors prevents their effective monitoring, which leads banks, being subject to limited liability, to engage in risky behavior. Second, banks rely on future bailouts due to the lender of resort mechanisms when they face problems, which further increase their incentives for risk-taking. Adverse selection arises due to the information asymmetry between borrowers and banks, where borrowers may undertake risky projects, and banks might not be aware of these projects.

The risk-shifting paradigm and competition-stability view became well known after Boyd & De Nicolò (2005). They developed a model solving an optimal contracting problem with moral hazard where the borrower, not the bank, decides on the riskiness of the investment made with the loan and banks compete both in the loan and deposit markets. Borrower behavior is unobservable or observable at cost, and the bank acts as an agent for its depositors and as principal for its borrowers. Lower deposit rates and higher interest rates on loans are achieved when banks gain market power, and both of these effects lead to more profits for banks. However, higher loan rates increase moral hazard problems by inducing borrowers to adjust their investment choices, moving towards riskier ones and thus further increasing the probability of loan defaults. Therefore, their model implies that banks will face lower loan portfolio risk under a more competitive environment, which leads to increased banking sector stability.

Nevertheless, the authors themselves comment that analyzing competition is complicated and the outcome from both the deposit and loan channels may be ambiguous, but more importantly, they point out the importance of considering both loan market and deposit market channels.

Boyd & De Nicolò (2005) were not the first in the literature to raise doubts about the competition-fragility hypothesis. Stiglitz & Weiss (1981) state that higher interest rates charged by banks discourage safe borrowers and attract risky borrowers, which leads to increased non-performing loans and deteriorates stability. Caminal & Matutes (2002) introduce a model where banks reduce the moral hazard and adverse selection problems through credit rationing and costly monitoring. Banks limit loans to risky borrowers through credit rationing. On the other hand, by costly monitoring, banks control investment projects and limit agency problems. The implication is that it is not necessarily the case that more competition decreases the stability of the financial sector.

Another argument in the competition-stability view rests on TBTF policies and focuses on the effect that concentration has on stability. Mishkin (1999) states that concentrated banking systems are fragile because there are TBTF banks in the system, which results in rescue policies that protect systematically important financial institutions (SIFIs) from failing but increase their risk-taking incentives. Besides, they are more interdependent and more inclined to contagion, strengthening the negative link between concentration and stability.

Another argument is that transparency may decline as bank size grows with increased concentration and as banks expand to new geographical markets and business lines. Managerial efficiency and corporate control are reduced by the decrease in transparency which increases bank risk (Beck, 2008).

Martinez-Miera & Repullo (2010) assume an imperfect correlation in the loan's probability of default and consider that more competition shrinks interest incomes coming from performing loans. On the one hand, loan rates decrease under more competition, and their model predicts a "risk shifting effect" that leads to less loan portfolio risk. On the other hand, "margin effect" implies that lower interest payments from loans reduce bank revenues which increase bank risk. The final effect of an increase in competition on stability depends on which of the two forces dominates. The risk-shifting and the margin effects prevail in more concentrated and competitive markets, respectively, which results in a nonlinear U-shaped relationship. The U-shaped relationship indicates that bank fragility declines as banks in the market increases, but after some point fragility starts increasing.

2.8 Empirical literature on competition and bank stability

Empirical literature exploring bank competition and stability have also reached ambiguous conclusions, which differ depending on the chosen sample, the period under study, the proxies used for competition and stability, and the methodology employed. The literature is quite vast, and only some highly cited empirical studies are reviewed, as summarized in the Appendix A, which can be classified into single-country and cross-country studies.

Most of the earlier empirical literature finds support for the competition-fragility view. Keeley (1990) tests whether the increase in competition following the relaxation of the financial industry restrictions has increased bank risk (as proxied by the capital-to-asset ratio at market values and the risk premium paid on large, uninsured certificates of deposit). Keeley, using a sample of large US bank holding companies, concludes that the

increase in competition erodes franchise values and decreases the stability of the US banking industry, which brought about many bank failures in the 1980s. As displayed in Appendix A Panel A, several later single-country studies confirm the results provided by Keeley.

Demsetz, Saidenberg, & Strahan (1996) find that franchise value and stock-return volatility are inversely correlated using a sample of 100 US bank holding companies between 1986 and 1994. Salas & Saurina (2003) uses a sample of 21 Spanish commercial banks for the years 1968-1998. They observe that banks with higher charter values (proxied by Tobin's Q) are more stable. Bofondi & Gobbi (2004), using a sample of 729 Italian banks from 1986 to 1996, find that loan losses increase as banks in the market increases.

As presented in Appendix A Panel B, several cross-country studies have investigated this relationship and found support for the competition-fragility view. Beck, Demirguc-Kunt, & Levine (2006a) and Beck et al. (2006b) examine the impact of bank concentration (as proxied by CR3) and bank regulations on banking systemic stability (as proxied by systemic crisis dummy). They employ a sample of 69 countries for the years 1980-1997 and conclude that lower crisis probability is reached under more concentration. On the other hand, they further find that policies and regulations that ease competition (such as fewer restrictions on activities and lower barriers to entry) lower banking system fragility. Levy Yeyati & Micco (2007) conclude that concentration (as proxied by CR3 and CR5) has no effect on bank competition (as proxied by H-statistic) and bank risk by employing a sample of Latin American banks for the years 1993-2002. However, they find that competitive banking systems are not stable. Berger, Klapper, & Turk-Ariss (2009) find that stability in banking (as proxied by the Z-score) is achieved

when banks have more market power by employing a sample of 8,235 banks from 23 developed markets. They also provide evidence that credit risk (as proxied by non-performing loans) is increased by more market power and comment that overall bank risk is decreased through holding more capital, controlling for endogeneity. Turk-Ariss (2010) uses a sample of 821 banks in 60 developing economies and concludes that market power reinforces both bank stability and profit efficiency. Agoraki et al. (2011) explore the relationship between banking regulations, competition and bank fragility. A sample of 546 banks in 13 Central and Eastern European countries over the years 1998–2005 is employed. Their results, controlling for endogeneity, indicate that fragility is decreased when banks have higher market power. Beck et al. (2013) employ a sample of 79 countries for the years 1994-2009 and use the Lerner index and the Z-score as measures of competition and bank risk-taking, respectively. Beck et al. (2013) observe that the stability of banks is enhanced when banks have market power.

In contrast, some recent studies find evidence for the competition-stability view. Boyd, De Nicolo, & Jalal (2006), using HHI as a proxy for competition, indicate that concentration increases the probability of failure in banking. They examine 2,500 small US banks in 2003 and 2,700 banks from 134 countries over the period 1993 to 2004, excluding major developed countries. However, they are criticized for employing concentration indices as a measure for competition because classical concentration indicators are insufficient measures of competitiveness in banking. Schaeck, Cihak, & Wolfe (2009) use H-statistic as a proxy for competition on a sample of 45 countries from 1980 to 2005 and find that competitive banking environments are more stable due to a lower crisis probability. Schaeck & Cihak (2014), utilizing a sample of 3,325 banks from 10 European countries for the years 1995-2005, find that competition contributes to

soundness by achieving more efficient banking. They use different estimation techniques, such as fixed effects panel data estimators and 2SLS, to account for endogeneity. Soedarmono, Machrouh, & Tarazi (2013) employ a sample of 11 emerging countries in Asia over the period 1994-2009. Their results, controlling for endogeneity, show that banks with more market power have higher capital ratios and higher income volatility. Since capitalization levels are not adequate, the overall impact is higher default risk. Jimenez et al. (2013), using a sample of 107 Spanish banks from 1988-2003, examine the nonlinearity of competition and stability relationship. Controlling for endogeneity, their results show a U-shaped relationship when competition is proxied by using traditional market concentration measures and bank risk is measured by NPL ratio. However, when competition is measured by the Lerner index, the nonlinear relationship is no longer evident, but results provide evidence for the franchise value paradigm in the loan market.

CHAPTER 3

REGULATORY OVERVIEW IN BANKING

In Chapter 2, it is discussed that the impact of competition on bank stability is ambiguous and the relationship is not yet well-understood. Bank regulations may help to understand the dynamics of competition and fragility in banking and, therefore, this chapter provides a regulatory overview in banking. Section 3.1 presents the historical regulatory overview and Section 3.2 surveys the literature on the impact of bank regulations, namely capital requirements, activity restrictions and supervisory power, on bank stability.

3.1 Historical overview of regulations in banking

The bank regulatory framework in a country includes laws for financial institutions, and it significantly influences the degree of competition and the stability of the banking industry (Claessens & Klingebiel, 2001). As discussed in Section 2.3, market failures in banking such as adverse selection and moral hazard, distort the competition paradigm, and may lead to risky bank behaviors. Regulatory policies aim to fix these market failures, protect the soundness of the banking system and small investors, and foster the competitiveness of the system. This aim is consistent with regulations working on behalf of social welfare (Stigler, 1971, 1975). On the other hand, some studies point out to regulations being shaped by self-interest and the political interests of regulators rather than social prosperity (Djankov et al., 2002).

Prudential regulation and the safety net are initiated in advanced economies precisely to achieve a stable banking system and avoid unfavorable consequences for the

whole economy. Prudential regulation involves, among other requirements, risk-based capital, disclosure rules, and supervision, which are the three pillars of the Basel frameworks of the Basel Committee. The deposit insurance mechanism and the lender of last resort together form the safety net. Deposit insurance mechanisms exist in many countries and prevent bank runs without disrupting the maturity-transformation process that banks engage in (Diamond & Dybvig, 1983). The central bank supports and lends to solvent banks by acting as the lender of last resort.

The aim of introducing regulation and safety net arrangements is to prevent bank runs and systemic crises because they are inefficient, which genuinely holds for panic bank runs but may not apply to information based runs. Allen & Gale (1998) find that when bank runs are based on lower earnings expectations and early withdrawing involving no costs, bank runs are efficient. On the other hand, when early withdrawals incur costs, bank runs reduce depositors' welfare, and central bank intervention is convenient.

Even though the safety net arrangements operate well for achieving a stable banking system, they may also introduce distortions. They may lead to risky bank behavior because depositors have diminished incentives for monitoring, and these mechanisms cause moral hazard problems because banks rely on future bailouts when they face problems (Merton, 1977; Boot & Greenbaum, 1993). Therefore, the necessity for other regulatory measures is emerged, such as capital and deposit rate regulations, and activity and entry restrictions. However, these measures are also criticized for being ineffective or resulting in other distortions. Thus, side effects of regulations are critical in understanding the role of competition in the banking environment (Carletti, 2008).

The 2007-2009 financial crisis, which resulted in state aid and bailouts of up to 30% of their GDP in EU and US to rescue failing banks, overrode concerns about the competition policy and regulatory deficiencies. The general idea was that regulation lagged behind financial liberalization, and therefore post-crisis regulatory reforms were put in place. The effectiveness of the three pillars of the Basel II requirements was in question. Risk-weighted capital requirement ratios were ineffective, as they did not predict failure probabilities (Vives, 2016). Supervision was also ineffective, letting shadow banking grow without adequate controls. Supervisors were given too much discretion that involved looser regulatory requirements and no prompt corrective actions (Vives, 2016).

Therefore, post-crisis regulatory reforms were put in place by the introduction of the Basel III, which includes capital and liquidity requirements, transparency, special requirements for SIFIs, corporate governance measures, improved resolution procedures, structural banking reform and changes in regulatory frameworks in various countries. Basel III in particular increases the quality and quantity of capital requirements and adds a minimum leverage ratio and two liquidity requirements.⁶ For some complex securitizations, capital requirements are strengthened, and the off-balance-sheet disclosure requirements are improved. Several policy requirements are brought for SIFIs and Global Systematically Important Banks (G-SIBs), ranging from recovery and resolution plans, additional loss absorption capacities and more supervision to more risk governance. Capital Requirements Directive IV and the Capital Requirements Regulation (CRR) 71 are issued by the EU in May 2013 to include the capital

⁶ While the minimum total capital requirements do not change and stay at 8% of risk-weighted assets, the threshold is increased for the common equity from 2% to 4.5% and two dynamic capital buffers are added.

requirements in the Basel III framework into the laws of the EU. The US issued the Dodd-Frank Act in 2010 to end bailouts and avoid any other financial crisis, with tighter requirements for domestic SIFIs on capital, liquidity, and leverage. All initiatives in various countries have a common aim to divide the functions of commercial and investment banking. The purpose of these commissions is to control excessive risk-taking and TBTF issue by restricting the activities while allowing for scope economies.

However, there is a recent debate started mainly in the US stating that tighter regulations under Dodd-Frank law and Basel III agreements have become burdensome for banks, and they hamper economic growth. It is argued that banks got very restricted and the tighter regulations that were put in place after the 2007-2009 financial crisis prevented banks from lending. Therefore, some directives were proposed in the US in 2017 to lift some regulation to make sure that banks can lend and the economy can grow. Some policymakers, on the other hand, argue that the core post-crisis reforms have substantially prevented risky behavior without restricting credit availability or economic growth, and that unwinding the regulations has to be considered cautiously.

Vives (2016), among others, argues that optimal regulation policy involves a combination of prudential (capital, liquidity, and disclosure) requirements, a lender of last resort, and other conduct (macroprudential) and structural measures (activity restrictions). Moreover, the optimal amount of financial regulation will change over time and depends on different country circumstances like the degree of financial liberalization (Stiglitz, 2001; Claessens & Klingebiel, 2001).

3.2 Literature on the impact of bank regulations on bank stability

The main reason behind the establishment of banking regulations is the vulnerability of banks to runs and crises. Bank regulations may help to decrease the trade-off between competition and stability and achieve a stable banking sector (Carletti, 2008).

Regulations such as capital requirements, proper supervision and disclosure requirements have always been seen as main factors in making a stable banking system (Basel I, II and III frameworks in Europe). Therefore, the growing literature has sparked investigations on how regulation affects bank stability. However, there is no broad academic agreement on how different bank regulation variables influence the stability of sector, which is due to different institutional settings among different countries (Barth et al., 2004).

Deposit insurance mechanism and lender of last resort, which together generate the safety net, are traditionally the most commonly used mechanisms and regulatory tools for keeping the banking sector stable. While deposit insurance prevents bank runs without disrupting the maturity-transformation process that banks engage in (Diamond & Dybvig, 1983), central banks support insolvent banks by acting as the lender of last resort. As indicated in Section 3.1, even though the safety-net arrangements operate well for achieving a stable banking system, they may also introduce some distortions because depositors have diminished incentives for monitoring and banks rely on future bailouts when they face problems (Merton, 1977; Boot & Greenbaum, 1993). Therefore, they bring a need for further regulatory measures, such as risk-adjusted deposit insurance mechanism, more stringent capital requirements, and entry and activity restrictions, which help to limit the negative consequences of competition. However, they are also criticized as being ineffective or resulting in other externalities (Carletti, 2008).

Next, the literature that relates bank regulations with competition and bank stability is provided. The regulation variables that are examined in the thesis include stringency on capital requirements, restrictions on bank activities and powerful supervisory authority. Most of the literature is theoretical in nature and empirical evidence quite scarce.

3.2.1 Capital requirements

Capital regulations are among the aims of the Basel agreements to reduce systemic risk and one of the most critical tools of banking regulations for inducing prudent behavior. It requires bank owners to invest in their institution a certain minimum amount to enter into the banking industry or to continue operations as a bank. Over the last decade, capital requirements classify among the different risk classes of assets, and they are extended to cover various types of risk with different weights.

As indicated by Vives (2010), the 2007-2009 financial crisis has shown that it is crucial to design the appropriate level of bank capital requirements to induce stability and that the optimal level of capital requirements depends in general (in an increasing way) on the intensity of competition. Demirguc-Kunt, Detragiache, & Merrouche (2013) further state that the recent financial crisis has shown that capital regulations are insufficient because many of the banks that were rescued complied with minimum capital requirements. Therefore, a consensus is reached on establishing more stringent capital standards with Basel III. However, there is still a lively post-crisis debate on the optimal level of capital that banks should hold.

Theory offers different predictions on how the amount of capital affects bank stability. The first strand of research claims that more stringent capital requirements

reduce bank fragility by risking bank equity and diminish the problem of moral hazard induced by deposit insurance (Furlong & Keeley, 1989; Keeley, 1990; Keeley & Furlong, 1990). Another reason is that the screening of borrowers and risk management systems of banks are enhanced by higher capitalization (Coval & Thakor, 2005; Allen, Carletti, & Marquez, 2011). Capital requirements help align the incentives of banks with depositors and the general public by ensuring that banks hold sufficient buffers against unexpected losses and further improve the supervision process of banks by regulators. Capital requirements are also viewed as a buffer against banking crises, and they reduce the probability of a costly financial crisis (Barrell et al., 2009). Martinez-Miera & Suarez (2014), utilizing a dynamic general equilibrium model, observe that capital requirements decrease the inefficient allocation of resources for investments, which in turn generates a more moderate loss of bank capital and a lower contraction in real activity in case of a systemic shock.

On the other hand, some theoretical studies point to the possible negative effects of capital stringency and state that capital requirements may reduce the charter value of banks (Koehn & Santomero, 1980; Kim & Santomero, 1988). Koehn & Santomero (1980), using a Markowitz two-parameter portfolio model, show that more stringent capital requirements increase bank failure risk through a rise in the asset risk of utility maximizing banks. Kim & Santomero (1988), applying the single-period mean-variance model, argue that uniform capital ratios do not consider individual banks' different risk preference structures and authorizes risky banks to overcome the restrictions through financial leverage. They support the transition to risk-weighted capital regulation and derive optimal weights in their model. Rochet (1992) extends the work of Koehn & Santomero (1980) and observes that capital regulations cannot prevent risky behaviors

when banks are value-maximizing and that they can only be effective if the risk weights of the capital-asset ratio are equal to the systematic risk of assets. Besanko & Kanatas (1996) argue that, in an imperfect information environment, capital requirements reduce monitoring incentives of bank insiders who undertake unobservable actions that maximize primarily their welfare, but not that of outside investors. There is a further negative effect arising from asset-substitution, which in turn weakens the quality of banks' portfolios and increase overall riskiness. Blum (1999) shows that, in a dynamic framework, tighter capital requirements lower expected profits of the bank and leads to a higher probability of default. Since raising equity is costly, banks increase their risk today to increase the amount of equity for the future.

Some theoretical studies explore the effect of regulations on bank stability in competitive environments and how regulations, including capital requirements, mediate this relationship. More competition leads fragility both in static and dynamic contexts and regulations may help to limit the negative externalities of competition (Carletti, 2008). Hellmann et al. (2000) employ a dynamic theoretical model where banks compete for deposits. They suggest that more stringent capital requirements diminish risk-taking behavior of banks by putting bank equity under risk, which is called a “capital-at-risk effect.” However, they claim that a reverse “market stealing effect” occurs when stringency in capital requirements reduces the franchise values. Specifically, banks compete for depositors by offering a higher deposit rate, and they invest in riskier loans. Therefore, the overall effect of the stringency in capital requirements is ambiguous. They suggest that capital requirements alone is not adequate to limit risky behavior and other policy instruments like deposit rate ceilings need to be introduced to limit the degree of competition for deposits.

Repullo (2004) examines the role of capital requirements and deposit rate ceilings to reduce risky behavior where their dynamic model assumes imperfect competition for deposits. They conclude that capital requirements can reduce deposit rates without affecting banks' franchise values. Their model indicates that the capital-at-risk effect is evident, and capital regulation is useful in obtaining a prudent equilibrium, but the depositors' welfare decreases. Risk-based capital requirements improve the welfare by maintaining prudent behavior without decreasing deposit rates. Bolt & Tieman (2004) use a dynamic theoretical framework with competition for loans and find that increased competition leads to greater risk-taking. Banks ease their acceptance criteria, which increase the demand for loans, but the quality of loan portfolios decreases in the long term since riskier borrowers obtain financing. They state that capital requirements induce banks to impose more stringent loan conditions on their customers, and that they are thus a useful regulatory tool to control the instability of the competitive banking system.

There is a burgeoning empirical literature surrounding the influence of capitalization on bank risk, providing ambiguous results. Bichsel & Blum (2004) argue that capitalization and bank risk are positively correlated, where the implied volatility of assets is used as a measure for bank risk. However, they indicate no significant correlation between capitalization and the default probability of banks when bank default risk is proxied by the Z-score. The determinants of the performance of banks during the 2007-2009 financial crisis are explored by Beltratti and Stulz (2012), and they observe that capitalization is one of them. They further find that well-capitalized large banks experience higher returns on their stocks. Nevertheless, capitalization does not have a significant impact on bank risk. Anginer & Demircuc-Kunt (2014), using a

sample of more than 1,200 listed banks in over 45 countries for the period 1998 to 2012, claim that higher levels of capital diminishes the systemic risk. Berger & Bouwman (2013), employing a sample of US banks, find that while capital improves survival probability of small banks; other banks take advantage of higher levels of capital mainly in crisis periods. Some further cross-country studies explore the impact of capital regulations on bank stability and find evidence of positive effects of capital stringency on bank stability. Barth et al. (2004) empirically test the relationship between bank regulatory tools, and efficiency and the fragility in banking using a dataset of 107 countries. Their results show that higher capital regulations are positively related to fewer non-performing loans. Fernandez & Gonzalez (2005), using a sample of 29 countries, observe that capital requirements are effective at reducing bank fragility. Agoraki et al. (2011), utilizing a sample of Central and Eastern European countries, observe that capital requirements reduce credit risk which is reversed for banks with more market power. However, they claim that higher capitalization levels do not influence bank default risk. Employing a cross-country sample of 79 countries, Beck et al. (2013) explores the market regulatory and institutional measures through the competition on bank stability and finds no indirect impact of capital requirements on this relationship.

3.2.2 Activity restrictions

Activity restrictions consider whether banks are allowed to participate in activities which are considered as non-traditional. Activities on securities, real estate, and insurance and non-financial firm ownership and control are the ones considered among the non-traditional bank activities.

In many countries, regulations determine the scope of different activities and range of product and services a bank can conduct. Such restrictions, by all means, have a direct influence on the whole financial sector, not only banks. For example, while activity restrictions on commercial banks in the US have led to the growth of a large financial market and an American system of “commercial banking,” Germany, on the other hand, has a relatively smaller stock market with fewer listings.⁷ Besides, German banks are under “universal banking” arrangements. They are authorized to undertake equity investments and act as a member of the board of directors in the non-financial firms (Boyd et al., 1998). The US Glass-Steagall Act initiated a debate on whether banks should be allowed to participate directly in investment banking and insurance activities. Whether to authorize ownership stakes in non-financial institutions is another related question faced by many countries (Claessens & Klingebiel, 2001). There are two models at opposite ends of the spectrum that can be recognized from the different configurations of permissible bank activities. In the first, banks are not authorized to act in any securities business or other non-traditional financial service activity. The second one is characterized as an integrated universal banking system and permits banks to conduct all types of financial activities.

The theory provides a mixed picture for the effect of activity restrictions on bank stability. The benefits of activity restrictions arise from increased conflicts of interest and financial risks with diverse activities, and the complexity in monitoring integrated banks. First, when banks conduct such different activities, conflicts of interest may arise (Saunders, 1985; Benston, 1990). Conflict of interest concerns is more prevalent in bank

⁷ The key regulations restricting the US banks’ equity investments are the Glass-Steagall Act and the Bank Holding Company Act in 1933 and 1970, respectively (Boyd et al., 1998).

agent activities, for example, during advisory to potential investors when they try to sell low-quality securities without disclosing the risks. Second, the theoretical model of Boyd et al. (1998) implies that more activities permit banks to engage in risky behavior. Moral hazard problems lead to an increased risk of bank failure, with adverse consequences for the overall efficiency of investments in an economy. They conclude that social welfare is enhanced with activity restrictions when there is generous deposit insurance. Third, the informational asymmetry is more prevalent in banks with diverse activities. While the primary aim of the supervision of commercial banks is protecting the rights of depositors; supervision of securities activities is mainly aimed at consumer protection, avoiding problems arising from agency relationships. Therefore, the joint occurrence of securities and commercial banking activities can make supervision more complex (Claessens & Klingebiel, 2001; Barth et al., 2004).

There are alternative theoretical reasons provided by the opponents of activity restrictions, and two main arguments are prevalent. First, less restriction on activities permits banks to conduct economies of scale and scope from both the production and the product side and offer services more efficiently. Economies of scope from the production side arise when the costs of different specialized institutions offering similar products are higher than the cost of one institution producing several products. In addition, fixed costs such as staff, information acquisition, and distribution facilities can be shared (Baumol, Panzar, & Willig 1982). Economies of scope, from conducting diverse activities on the product side, originate from many cost advantages, such as better information access and client relationship management, along with wider distribution channels, and better risk management. Besides, economies of scope may

also arise from the consumption side such as lower search costs and lower product prices (Saunders & Walter, 1994).

Second, the stability of banks would be enhanced by broader activities that arise from the diversification of benefits. The total profits of a bank with diverse activities would be more stable than banks with restricted ones if the earnings from different sources of financial activities are not highly correlated. Activity restrictions reduce the chance of banks to diversify the risk of their portfolios outside their primary lines of business and ultimately increase bank fragility. Moreover, the potential risks arising from dis-intermediation would affect an integrated bank less, because the risk will be offset by an increase in other activities, reducing incentives for risky lending (Claessens & Klingebiel, 2001).⁸

Other theoretical studies study how activity restrictions mediate the competition and bank stability link. The theoretical model of Matutes & Vives (2000) claim that the effectiveness of a deposit insurance mechanism depends on whether it is either flat-rate or risk-adjusted. When flat-rate deposit insurance is conducted, asset restrictions need to be complemented with the deposit insurance scheme. In contrast, when risk-based deposit insurance is used, deposit insurance by itself may be sufficient to improve welfare. Moreover, Hellmann et al. (2000) state that while capital requirements and activity restrictions may reduce the riskiness of the banks' balance sheets, they may also imply more herding and less diversification. Therefore, the effect on bank stability under competitive environments is also ambiguous.

⁸ Dis-intermediation refers to the elimination of financial intermediaries and borrowers raise money directly from investors.

While the majority of the empirical evidence seems to indicate that restricting bank activities has an adverse impact on bank stability, the evidence is better described as mixed. Barth et al. (2004) test the link between regulations, efficiency, and the fragility of banking employing a dataset of 107 countries. Their results indicate that greater activity restrictions lead to a higher banking crisis probability, and they further comment that broad activities permit banks to gain different sources of income. Fernandez & Gonzalez (2005), using a dataset on 29 countries, analyze whether banking regulatory variables are effective in controlling bank risk. Their results indicate that stricter banking restrictions are effective in reducing bank fragility and the requirements on accounting are substitutes for more restrictions on bank activities. Beck et al. (2006a; 2006b), using a cross-country dataset on 69 countries and 47 crisis periods, find that countries with regulations restricting bank activities face a higher systemic crisis probability. Their argument is that regulatory restrictions on activities prevent banks from diversifying their risks into different business lines. Employing a cross-country sample of 79 countries, Beck et al. (2013) observe that a competition-fragility view is more prevalent when there are stricter activity restrictions and comment that regulatory authorities need to take this into account. On the other hand, Agoraki et al. (2011), using a sample on Central and Eastern European countries, observe that while the effect of activity restrictions on credit risk is insignificant, it significantly reduces insolvency risk of banks. Moreover, they claim that higher activity restrictions indirectly decrease bank risk through higher market power.

3.2.3 Supervisory power

Supervisory function concerning the financial institutions is more crucial than in other sectors due to their unique role as intermediaries between diverse players in the economy and being exposed to high fragility. Strengthening the monitoring of banks is another emphasis of the Basel accords on prudential supervision and regulation.

Supervisory power discloses the supervisory authority power and whether they act promptly and proactively to correct any problems, in some cases against bank management.

Supervisors intervene in the financial sector to preserve soundness and a competitive environment, and to protect consumers. Along with the liberalization process, financial supervision became even more important in countries with explicit deposit insurance due to its potential to increase incentives for risky bank behavior, resulting mainly from the reduction in depositor incentives to monitor banks (Barth, Caprio, & Levine, 2006). The optimal design of supervisory policies is related to the structure of regulatory regimes and governments decide on the organizational structure of the supervisory authority which is closely related to the permissible scope of financial services provision (Claessens & Klingebiel, 2001). Some countries choose to follow an overall approach to bank supervision, focusing on direct official supervision, while others prefer adopting regulations that stress the private-sector monitoring of banks.

The public interest view reveals the advantages of powerful supervisors. It assumes that there are inherent market failures in banking and powerful supervisory agencies are capable of ameliorating these failures through directly controlling, regulating and disciplining banks. Furthermore, this approach assumes that powerful supervisory agencies have incentives to improve these failures and promote the

economic welfare (Stigler, 1971, 1975). Therefore, this approach implies that powerful supervisors enhance the capital allocation by reducing corruption in lending and maintain an optimal degree of competition to increase the efficiency of intermediation and improve banking system stability (Barth et al., 2004).

The private interest view, on the other hand, argues that government supervisors and politicians may not have exact incentives to ameliorate banking market failures and enhance social welfare, but try instead to maximize their welfare. While market failures such as information asymmetry hinder private monitoring, government failures may be so significant that they lead to socially counterproductive results such as reduced bank efficiency and intensified corruption (Shleifer & Vishny, 1998; Barth et al., 2004). Specifically, banks may use supervisory agencies to protect and enrich themselves, or supervisors may use their positions to provide credit to their connections. Politicians may use regulations to create rents through campaign contributions and bribes and benefit themselves when supervisory authorities are subject to political influence (Quintyn & Taylor, 2002). This view, therefore, claims that the optimal approach needs to rely on government institutions to enhance private monitoring of banks through more effective disclosures so that investors can induce stronger corporate governance over banks (Barth et al., 2006). The behavior of a supervisor is modeled by Boot & Thakor (1993) which is self-interested with uncertain abilities to monitor banks, and their results suggest that the distortion in social welfare depends on the uncertainty in the regulator's perceived ability. They indicate that greater supervisor power may deteriorate bank operations, depending on the bank supervisor's self-interest incentives.

Empirical evidence of supervisory power on bank stability is also limited, and conclusions are mixed. Barth et al. (2004), using a dataset of 107 countries, claim that

overall official supervisory power does not significantly impose stable banking. They further indicate that supervisory power leads to increased corruption in countries with weak corporate governance and empowerment of the monitoring of the private sector is a better tool to promote bank stability. Fernandez & Gonzalez (2005), using a dataset on 29 countries, find that supervisory power has no significant relation with bank risk-taking. Agoraki et al. (2011), employing a sample of Central and Eastern European countries, observe that higher supervisory power significantly reduces bank credit risk and default risk. They claim that strengthening supervisory power is a direct tool to enhance bank stability and that supervisors need to improve auditing of financial institutions.

CHAPTER 4

DATA AND METHODOLOGY

This chapter presents the methodology and sample, and the link between bank competition, regulations and soundness is examined for banks in developed countries. First, how bank competition impacts the stability of banks is investigated, which is followed by exploring whether there is any inherent nonlinearity in this relationship. Next, how bank regulation variables of interest influence the risky behavior in banks is examined. Furthermore, the interaction of the regulation and supervision variables with the competition measure is analyzed to observe whether their impacts differ with the intensity of competition in the environment. Finally, the direct impact of the financial crisis period (2007-2009) and the indirect effect of this period through market power on bank stability are explored to observe how the most significant crisis in recent history affected the competition-stability relationship.

The rest of the chapter is structured as follows. First, the methodology and the empirical models are outlined. Then the sample selection procedure is presented along with the variables, and some descriptive statistics are displayed.

4.1 Methodology

First, a measure of competition is regressed on bank stability to explore the relationship between them. Since the stability of the banking sector is driven not only by the level of competition, bank and country-specific variables are included in the regression. The econometric model, therefore, takes the following form:

$$Bank\ Stability_{ijt} = \alpha + \beta_1 * Comp_{ijt-1} + \beta_2 * X_{ijt-1} + \beta_3 * Y_{ijt-1} + \varepsilon_{ijt-1} \quad (4.1)$$

The bank, country and time are represented by the indices i, j and t, respectively; competition measure is indicated by the variable *Comp*; X_{ijt-1} characterizes the bank-specific control variables, and Y_{ijt-1} stand for country-level control variables.

The non-linearity of competition is tested by adding a squared term for competition measure, using Equation 4.2 below:

$$Bank\ Stability_{ijt} = \alpha + \beta_1 * Comp_{ijt-1} + \beta_2 * Comp_{ijt-1}^2 + \beta_3 * X_{ijt-1} + \beta_4 * Y_{ijt-1} + \varepsilon_{ijt-1} \quad (4.2)$$

Then, the three regulation and supervision variables of interest (capital requirements, activity restrictions, and supervisory power) and their interactions with competition measure are added in Equation 4.3 to observe whether they impact bank stability directly and indirectly through competition.

$$Bank\ Stability_{ijt} = \alpha + \beta_1 * Comp_{ijt-1} + \sum_{k=2}^4 \beta_k * Reg_{kjt-1} + \sum_{l=5}^7 \beta_l * Comp_{ijt-1} * Reg_{ljt-1} + \beta_8 * X_{ijt-1} + \beta_9 * Y_{ijt-1} + \varepsilon_{ijt-1} \quad (4.3)$$

Reg stands for a vector of three regulation variables, and *Comp*Reg* stands for the vector of the interaction of the regulation variables with competition measure. The interaction terms are collinear with their direct components. Therefore, before interacting bank regulation variables with the competition measure, zero mean and unit variance of regulatory measures are achieved by normalizing to reduce multicollinearity.

The period of analysis, 2007–2015, covering the subprime crisis of 2007-2009, nicely permits us to compare the post-crisis and crisis periods. Therefore, the direct effect of the 2007-2009 financial crisis period and the indirect effect of this period through market power on bank stability is finally examined to observe whether competition is more detrimental on stability during this period. To address this, an indicator variable “Crisis” that takes a value of 1 for the period 2007-2009 and its interaction with competition is included in the regression, using Equation 4.4 below:

$$\begin{aligned} \text{Bank Stability}_{ijt} = & \alpha + \beta_1 * \text{Comp}_{ijt-1} + \beta_2 * \text{Crisis}_{ijt-1} + \beta_3 * \text{Comp}_{ijt-1} * \text{Crisis}_{ijt-1} + \beta_4 * \\ & X_{ijt-1} + \beta_5 * Y_{jt-1} + \varepsilon_{ijt-1} \end{aligned} \quad (4.4)$$

All the econometric models in Equations 4.1- 4.4 are estimated using fixed-effects panel data estimation techniques as confirmed by the Hausman tests.⁹ Following Beck et al. (2013) and Demircuc-Kunt et al. (2013), country-time fixed effects are included by using dummy variables for each country and year pair which controls for the heterogeneity within a country and a year. The country-year level is used when clustering the error terms. The country-year dummy variables greatly reduce the possible omitted variable problems, such as differences in different macroeconomic variables, policy applications, and differences in accounting and regulatory standards.

The independent variables in the regression are one period lagged to reduce the possible impact of reverse causality. While endogeneity concerns are mitigated due to the use of lagged independent variables, there are other possible causes of endogeneity such as omitted variables. To consider the other sources of endogeneity, IV techniques

⁹ with a test statistic 1,805.25 and significance level of 1% for Equation 4.1.

are implemented, using a 2SLS estimator.¹⁰ Following Beck et al. (2013) and Schaeck & Cihak (2014); loan growth, cost-income ratio, and a two-period lagged Lerner index are used as instruments to describe measures of market power. These instruments have ex-ante theoretical plausibility because loan growth and cost-income ratio are the potential sources of bank market power and likely highly correlated with it. However, it is not evident in the literature why these variables would be directly correlated to bank risk-taking. Various specification tests are conducted to validate the relevance and strength of the instruments. Finally, in the IV regressions, bank fixed effects are employed, and error terms are clustered on the country level.

4.2 Data

4.2.1 Data sources

Fitch Connect Database from Fitch Solutions constitutes the primary source of data in the analysis. Annual data on private and listed banks in more than 30 developed countries is initially considered for the years 2007-2015.¹¹ All value data are expressed in US dollars. Although most of the variables are in ratios, the ones that are in levels are expressed in 2010 US dollars to remove the effect of inflation.¹² The initial sample comprised 8,680 banks in developed countries. However, following the literature (Berger et al., 2009; Beck et al., 2013), the following filtration is performed to reach the final sample.

¹⁰ Agoraki et al. (2011) deals with endogeneity by using dynamic panel data estimation with system GMM estimators.

¹¹ Developed countries correspond to the IMF definition for “high-income” countries.

¹² Bank size is the only variable in level entering the regression model directly.

First, only consolidated banks are considered where the information on loan-to-asset ratios and income statement variables are available. Second, countries with fewer than seven banks are excluded. Third, banks with total assets, total liabilities and net income fewer than five consecutive years, and banks with negative expenses are further excluded. As in Berger et al. (2009), banks are dropped instead of bank-year observations to gain advantage from the panel structure of the data. Income statement variables are winsorized at the top and bottom 1% of distribution. After employing the filtration mentioned above, the final sample is reduced to 6,936 private and listed banks in 25 developed countries for the years 2007-2015.

The names of countries and the number of banks are displayed in Table 1, which shows that countries are selected from various regions of the world. As depicted in Table 1, the majority of the observations are from the US (87.80%), which may lead to concerns of a disproportionately large number of US banks in the sample. Therefore, in the robustness checks, the weighted linear regressions are performed by multiplying each observation with the inverse of the number of banks in a country, which verifies that the findings are not solely originated from the countries that have the highest share of the sample. In addition, the overrepresentation of US banks is limited in the robustness checks by decreasing the number of banks in the US sample with including the largest 100 US banks for each year and as well as 900 randomly selected US banks.

Data for bank regulation variables are gathered from the World Bank database on Bank Regulation and Supervision constructed by Barth, Caprio, & Levine (2001) and updated by Barth et al. (2006, 2008 & 2013). The database is developed by the World Bank, is a unique worldwide survey on how the regulation on banks is conducted. The fourth version of the survey started in 2011, was completed in 2012 and released in

2013, which is an extended version of earlier ones released in 2001, 2003 and 2007, respectively. Since the dataset covers the period 2007-2015, Version III of the dataset is utilized for the years 2007-2010 and Version IV for the years 2011-2015. Other studies that have employed this database across some years pursued a similar approximation (e.g., Fernandez & Gonzalez, 2005). Since Versions III and IV of the survey cover the crisis and post-crisis periods and the introduction of Basel III, it permits us to compare the post-crisis state of banking regulation and supervision to crisis period levels.

Table 1. Countries, Number of Banks, Lerner Index, and Z-score

Countries	Number of banks	Lerner index	ln(Z-score)
Australia	31	0.317	4.090
Austria	42	0.087	3.385
Bahrain	22	0.156	3.487
Belgium	19	0.217	3.505
Canada	50	0.231	4.268
Denmark	19	0.094	3.402
Finland	12	0.319	3.880
France	69	0.232	4.154
Germany	52	0.170	3.617
Hong Kong	31	0.328	4.109
Ireland	10	0.008	2.321
Italy	54	0.104	3.411
Japan	129	0.276	4.060
Latvia	10	0.113	2.706
Luxembourg	9	0.268	3.648
Netherlands	32	0.115	3.275
New Zealand	14	0.347	3.514
Norway	36	0.333	3.774
Portugal	16	0.114	3.277
Singapore	10	0.381	4.388
Spain	40	0.178	3.749
Sweden	17	0.374	3.626
Switzerland	49	0.195	3.750
UK	73	0.145	3.640
US	6,090	0.187	4.052
Total Developed countries	6,936	0.188	4.018

Note: This table displays the number of banks, average Lerner index and the Z-score for each country in the sample of 25 developed countries.

World Bank World Development Indicators database is used for the other county-level macroeconomic variables. A list of all country-level variables employed in the analysis and brief descriptions of them are presented in Table 2.

Table 2. Country Controls

Description	
Panel A: Bank Regulatory and Supervisory Variables	
Capital requirements index	Capital stringency on the minimum amount of capital and its components. Ranges from 0- 10 and more stringency is implied with higher values.
Activity restrictions index	Considers whether banks can participate in non-traditional activities, such as activities on securities, insurance, real estate, and the ownership of non-financial firms. Ranges from 4-16 and more restrictions are imposed with higher values.
Supervisory power index	Indicates the supervisory authority power to take specific actions to proactively and promptly prevent problems against banks. The index ranges from 0-14, and more powerful supervisors are implied by higher values.
Panel B: Macroeconomic variables	
Real GDP per capita growth	Annual percentage growth rate of GDP per capita
Inflation	The annual growth rate of the GDP implicit deflator

Note: This table shows the list of country-level variables and brief descriptions of them. While Panel A lists the bank regulation and supervision variables; Panel B specifies the macroeconomic variables.

4.2.2 Variables

This section presents the descriptions of the variables in the analysis, starting from those used to gauge the level of bank competition and stability and then considering the other bank-specific and country-specific control variables. Note that, the complicated relationship between bank competition, regulations, and soundness requires bank-level

measures of competition and stability. Country-level indicators, on the other hand, would not reveal the heterogeneity across different countries. Therefore, competition and bank stability are measured by the bank-level Lerner index and the Z-score, respectively, which are the two well-known and popular indicators in the recent literature.

4.2.2.1 Competition measure: The Lerner index

The Lerner index is employed in the analysis to measure competition which is widely used in the recent literature (Berger et al., 2009; Jimenez et al., 2013; Beck et al., 2013) and computes the level of market power. It is very beneficial in the empirical literature because it can be computed at the bank level and captures how much a bank can assign its marginal price above its marginal cost, and it is a proxy for current and future profits. Moreover, it transforms the concept of franchise value into one number and therefore creates a link between theory and empirical evidence.

As reviewed in Section 2.5, the recent literature on banking points out that the concentration and competition are not correlated, and they emphasize the necessity to use bank-level measures (Claessens & Laeven, 2004; Berger et al., 2004, Schaeck et al., 2009). Relying on country-level concentration ratios as a proxy of competition can lead to biased findings. Empirical evidence indicates that poor use of inputs in banks leads to significant inefficiencies, and many banks function below their technical capabilities (Demirguc-Kunt & Huizinga, 1999).

Therefore, the use of competition measures which specifically consider whether financial institutions are acting efficiently from a cost point of view is more appropriate (Claessens & Klingebiel, 2001). Moreover, it is crucial to consider competition from all

banking and non-banking financial intermediation. The Lerner index overcomes these criticisms and considers competition from both banking and non-banking financial intermediaries. The Lerner index is computed for each bank and year, mainly following Berger et al. (2009) as in Equation 4.5 below:

$$\text{Lerner}_{it} = \frac{P_{it} - MC_{it}}{P_{it}} \quad (4.5)$$

The indices i and t denote bank and time respectively, and higher values denote more market power and less competition. P_{it} indicates the price of bank activities and is proxied by *total operating income/total assets*. Total operating income includes both interest income on loans and dividends, and non-interest income on trading activities, securities, net fees and commissions. The following translog cost function is used to derive marginal costs which are shown by MC_{it} :

$$\begin{aligned} \ln C_{it} = & \alpha_0 + \alpha_1 \ln Q_{it} + \alpha_2 (\ln Q_{it})^2 + \sum_{j=1}^3 \beta_j \ln w_{it}^j + \sum_{j=1}^3 \sum_{k=1}^3 \beta_{jk} \ln w_{it}^j \ln w_{it}^k + \\ & \sum_{j=1}^3 \gamma_j \ln w_{it}^j \ln Q_{it} + \varepsilon_{it} \end{aligned} \quad (4.6)$$

The bank, country and time are represented by the indices i , j and t , respectively; C_{it} measures total operating costs, and Q_{it} represents bank output proxied by total assets. The price of fixed assets (w_1), the price of labor (w_2) and the price of borrowed funds (w_3) show the three input prices. While the ratio of other operating and administrative expenses to total assets is employed as a measure for w_1 , the ratio of personnel expenses

to total assets is used as a measure for w_2 .¹³ The variable w_3 is proxied by the ratio of interest expenses to the sum of total deposits and money market funding.

The regression in Equation 4.6 is conducted for each of the 25 countries to consider the different technologies. Year fixed effects are included with robust standard errors clustered by banks. Input prices have homogeneity of degree one by imposing the following restrictions on the regressions:

$$\sum_{j=1}^3 \beta_j = 1, \sum_{j=1}^3 \gamma_j = 0 \text{ and for all } k=1,2,3: \sum_{j=1}^3 \beta_{jk} = 0.$$

Marginal cost is calculated at bank-year level as follows:

$$MC_{it} = \frac{\partial C_{it}}{\partial Q_{it}} = \frac{C_{it}}{Q_{it}} (\widehat{\alpha}_1 + 2\widehat{\alpha}_2 \ln Q_{it} + \sum_{j=1}^2 \widehat{\gamma}_j \ln \frac{w_{it}^j}{w_{it}^3}) \quad (4.7)$$

Table 3 displays the descriptive statistics for the bank-level variables and depicts that the Lerner index ranges from -1.461 to 0.633, with an average of 0.188 and a standard deviation of 0.248. While between-bank and within-bank variation over time are quite similar, within country-year variation is greater between countries. This observation confirms the selected methodology, where country-time fixed effects are included to allow for heterogeneity within a country and a year. Table 1 shows country-level averages of the Lerner index in the sample, where the total average index is 0.188.

Market power reaches a minimum of 0.008 in Ireland and a maximum of 0.381 in

¹³ Other operating and administrative expenses include non-staff related operating expenses incurred through the course of business, such as amortization, depreciation, software costs, administrative expenses, operating lease rentals and audit and professional fees.

Singapore. The US, which comprises the highest number of observations in the sample, has an average of 0.187.

Table 3. Descriptive Statistics

	N	Mean	Min	Max	Median	Stand. Dev.
<i>Panel A: Bank stability and competition measures</i>						
Ln (Z-score)	47,493	4.018	-6.591	9.981	4.112	1.252
Variation between banks						0.964
Variation within banks						0.819
Variation within country-year						1.191
Variation between countries						0.465
Equity to Asset	61,112	0.112	-0.083	0.993	0.101	0.064
Sd (ROA)	47,812	0.004	0.000	0.633	0.002	0.008
NPL ratio	59,024	0.024	0.000	1.000	0.013	0.037
Lerner index	58,530	0.188	-1.461	0.633	0.230	0.248
Variation between banks						0.178
Variation within banks						0.179
Variation within country-year						0.240
Variation between countries						0.103
HHI	62,424	0.051	0.032	0.639	0.037	0.050
<i>Panel B: Bank Controls</i>						
Ln (Total assets)	61,112	5.924	1.000	15.203	5.406	2.109
Loan to Asset	61,054	0.615	0.000	1.090	0.643	0.173
Noninterest income share	59,841	0.195	-0.150	0.936	0.162	0.151
Share of wholesale funding	58,155	0.04	0.00	1.00	0.00	0.09
Loan Loss Prov. to int. income	60,605	0.11	-130.5	39	0.05	0.92
Growth of Total assets	59,310	0.06	-0.192	0.835	0.04	0.11
BHC	62,424	0.083	0	1	0	0.28
Listed	62,424	0.104	0	1	0	0.30
<i>Panel C: Country Controls</i>						
Real GDP per capita growth	225	0.59	-12.91	25.64	0.83	3.38
Inflation	225	1.84	-4.48	15.43	1.82	1.84
Capital stringency	225	6.18	2	9	7	1.97
Activity restrictions	225	8.11	5	12	8	1.89
Supervisory power	225	10.39	6	14	11	2.20

Note: The table shows summary statistics for the bank and country controls. While Panel A provides information on bank stability and competition measures, Panel B shows bank-specific controls. Panel C displays information on the country controls.

Figure 2 presents the time series evolution of the Lerner index, which permits us to investigate how competition changes in the sample over time from 2007 to 2015. The bank-year level values of the index are averaged by country yearly from 2007 to 2015. The figure indicates that competition increases from 2007 to 2009 but then starts

decreasing from 2009 to 2015. In other words, market power decreases from 2007 to 2009 but then starts increasing from 2009 to 2015, which indicates initial evidence that the crisis and post-crisis periods witnessed an adjustment in the nature of the competitive environment in developed countries.

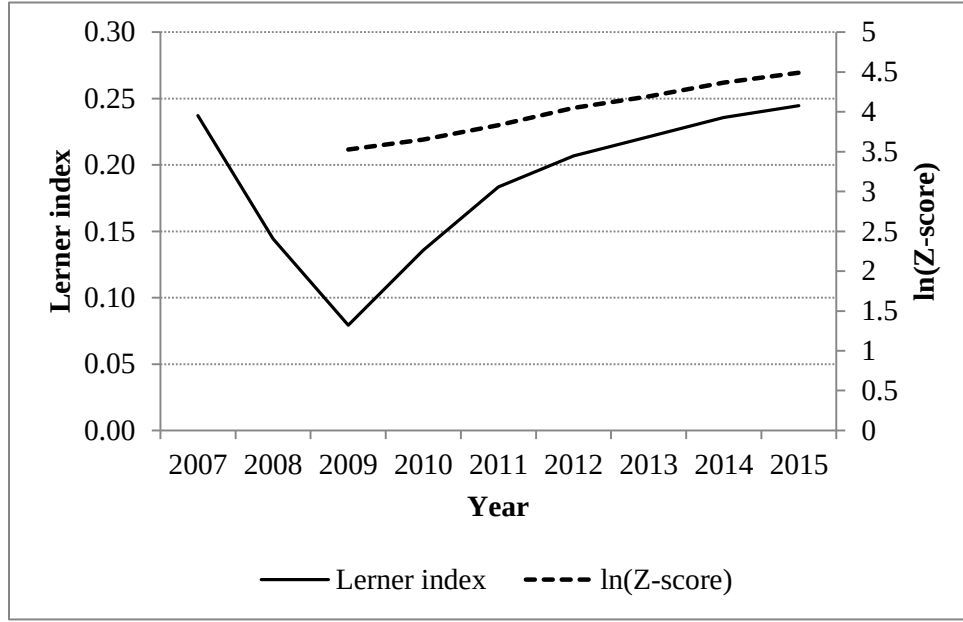


Figure 2. Historical evolution of bank competition and stability

While the Lerner index is preferred as a more valid competition measure for reasons indicated as above, a traditional measure of the degree of competition is also utilized, the HHI, to determine whether the results are robust. HHI indicates a country-level measure of concentration, with higher values showing more concentration. The squares of market shares of banks are considered while computing the Herfindahl-Hirschman index (HHI): $\sum_{i=1}^n s_i^2$ where the square of the market share of the i-th bank and the count of banks are denoted by s_i^2 and n, respectively.

4.2.2.2 Bank stability measure: The Z-score

The Z-score as a measure of bank risk-taking is employed in the analysis. It is a popular measure in the literature as a default risk of banks (Laeven & Levine, 2009; Demirguc-Kunt & Huizinga, 2010; Houston, Lin, Lin, & Ma, 2010). It is a proxy for the entry into bankruptcy (Roy, 1952) with higher values implying more stable banking. It is calculated as:

$$Z_{it} = \frac{ROA_{it} + (E/A_{it})}{\sigma(ROA)_{it}} \quad (4.8)$$

where the return on assets, the equity-to-asset ratio, and the standard deviation of ROA is denoted by ROA, E/A, and $\sigma(ROA)$, respectively. It therefore takes higher values when profitability and capital levels are higher and when returns are less volatile. The number of standard deviations such that returns fall from the mean to remove the equity in the bank is captured by the Z-score (Boyd & Runkle, 1993).

The three-year rolling time windows are used in computing $\sigma(ROA)$ to consider variability in the denominator and to avoid that the variation in the index is solely originated from the change in capital and profitability. Another reason for using the rolling time window is to refrain from the standard deviation to be calculated over periods of different length for different banks that would occur due to the unbalanced panel structure (Turk-Ariss, 2010; Schaeck & Cihak, 2014). Since the Z-score is highly skewed, a natural logarithm transformation is used.

Table 3 displays that $\ln(Z\text{-score})$ ranges from -6.591 to 9.981 with an average of 4.018 and a standard deviation of 1.252. It is observed that the between bank variation of

the Z-score is larger than the variation within banks. Within country-year variation is larger than between countries, which is another justification of the selected methodology of country-time fixed effects. Table 1 displays country-level averages of $\ln(\text{Z-score})$ in the sample, where the total average index is 4.018 and where the most stable country is Singapore, with an average of 4.388 and the least stable country is Ireland, with an average of 2.321. The US, which comprises the highest number of observations in the sample, has an average of 4.052.

As a robustness check, the NPL ratio is employed as another indicator of bank stability to see whether the results are consistent using this alternative measure. While overall bank risk is captured by the Z-score, NPL ratio proxies for credit risk and calculated as the ratio of non-performing loans to gross loans. The log-odds transformation $\ln\left(\frac{NPL}{100-NPL}\right)$, is used and a transformation of the variable's range from the unit interval to real line is achieved.

Furthermore, another indicator of bank stability is used, which is the Z-score calculated differently. Instead of calculating the volatility of profits using three-year rolling windows, they are calculated over the full sample period. It is noted that there are drawbacks in calculating the volatility of profits over the full sample period because it does not permit for any variability in the denominator of the Z-score.

Figure 2 shows the time series evolution of $\ln(\text{Z-score})$ from 2007 to 2015, where the volatility of profits is computed in three-year rolling windows and bank-year level values are averaged yearly by country. The figure indicates that bank stability increases from 2009 to 2015. Note that since the Z-score is calculated using three-year

rolling windows for the standard deviation of profits, the observations for the years 2007-2009 are lost.

One concern pointed out in Beck et al. (2013) is that the Lerner index and the Z-score both contain profitability in their computations. It is therefore crucial to verify that any positive correlation between the two is not mechanical, but instead economically meaningful. Figure 2 indicates that the Lerner index and $\ln(Z\text{-score})$ follow a similar path over time and they are positively correlated, i.e., market power and bank stability are positively correlated. Figure 3 displays that the Lerner index and profit volatility are negatively related, which shows that market power is negatively related to profit volatility, bringing consistent results. Therefore, this is the first evidence signaling that they are not mechanically correlated by having profitability as the primary driver.

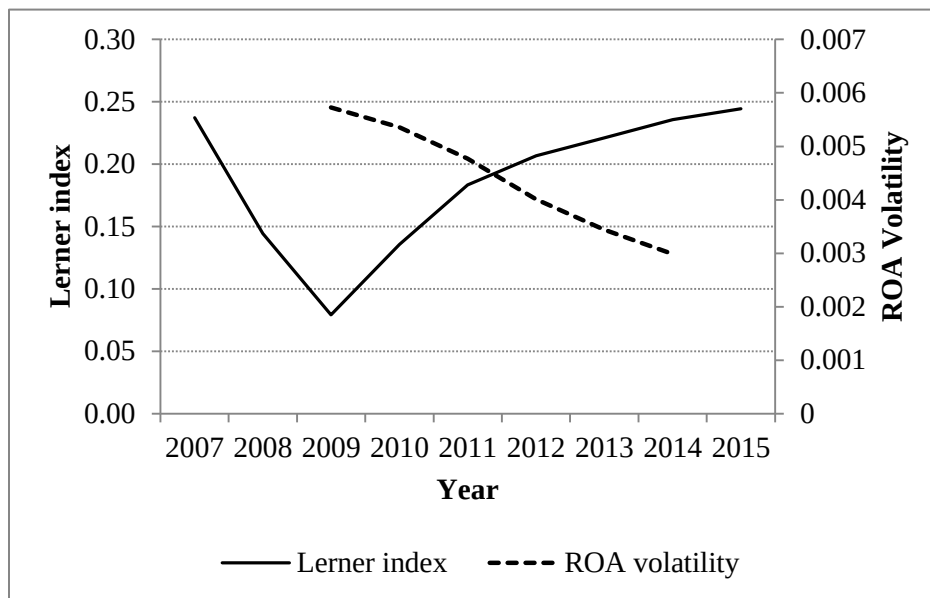


Figure 3. Historical evolution of bank competition and ROA volatility

4.2.2.3 Bank regulatory and supervisory variables

In this thesis bank regulation and supervision variables — stringency of capital requirements, restrictions on activities and the power of supervisory authority — and their interactions with market power are investigated. These indices are briefly presented below.

Capital requirements index

Capital requirements index informs on the stringency of capital regulation regarding the minimum level of capital and the tightness of regulations on components of this capital to understand the nature and sources. Both initial and overall capital stringency form the index. The initial stringency deals with the origins of funds that can be used for initial capitalization and ranges from 0 to 3. For instance, it measures whether the initial capital includes cash, government securities or other assets, and whether these sources are confirmed by authorities. The overall capital stringency indicator shows whether some risk elements are considered such as credit and market risk, and whether value losses are extracted while calculating the minimum amount of capital and ranges from 0-7.

Therefore, the capital requirements index can take values between 0 and 10, with tighter capital requirements are indicated by higher values and has an average of 6.18, as displayed in Table 3. The country with the least stringent capital requirements is New Zealand, with an index value of 2 for all the years between 2007 and 2015. The highest value of the index is 9, with the highest capital requirements corresponding to the following countries: Australia and Latvia for the years 2011-2015 and Spain, Norway and Portugal for the years 2007-2010. Note that, as explained in Section 4.2.1, Version III of the dataset is utilized for the years 2007-2010 and Version IV for the years 2011-

2015. Therefore, the dataset permits us to compare the post-crisis state of banking regulation and supervision to crisis period levels. It is worthy to note that capital requirements have increased post-crisis in the overall sample, moving from an average of 5.82 in 2007-2010 to 6.48 in 2011-2015.

Activity restrictions index

The activity restrictions index considers whether banks are allowed to invest in activities other than traditional banking activities. It comprises of four indicators which measure whether securities, insurance, and real estate activities are restricted and whether banks may conduct non-financial activities other than those strictly related to the banking business (e.g., owning and controlling non-financial firms).

The index measures whether these activities are unrestricted, permitted, restricted, or prohibited in corresponding countries and ranges from 4-16, with higher values showing more restrictive rules and hence more difficulties for banks to diversify away from the traditional banking activities. As displayed in Table 3, the index has an average of 8.11 and reaches a minimum of 5, with least activity restrictions in the UK and New Zealand in 2007-2010 and Switzerland and Ireland in 2011-2015. The index points to a maximum of 12 in the US in the period 2011-2015 and in Italy in 2007-2010.

Even though the activity restrictions index seems to have decreased over time in the overall sample from an average of 8.44 in 2007-2010 to 7.84 in 2011-2015, it has increased for countries like the US (from 10 in 2007-2010 to 12 in 2011-2015) and the UK (from 5 in 2007-2010 to 6 in 2011-2015). Note that the US is marked as a country with a bank holding company structure that has quite restrictive regulations on bank activities (Claessens & Klingebiel, 2001).

Supervisory power index

Supervisory power discloses the power of the supervisory authorities in terms of whether they act promptly to prevent and correct problems, in some cases against the management of banks. The index ranges from 0-14, and the higher values represent more powerful supervisors.

It specifically provides detailed information on the supervisory authority power to (i) ask information from, and charge penalties to auditors, (ii) change a bank's organizational structure, managers, and directors, (iii) force the bank provision against any bad loans, suspend dividends, bonuses, and to take place of the rights of shareholders, and (iv) declare a bank as bankrupt. As shown in Table 3, the index has an average of 10.39 across countries. It reaches a minimum of 6, with the least powerful supervisors in Canada for the years 2007-2010 and Sweden across all years from 2007 to 2015. It reaches a maximum of 14 in Switzerland and Portugal for the years 2007-2010 and Singapore in 2011-2015. Supervisory power seems to have slightly increased post-crisis in the overall sample, moving from an average of 9.96 in 2007-2010 to 10.68 in 2011-2015.

4.2.2.4 Bank-specific variables

Numerous bank characteristics are controlled to account for the bank's business model. The bank controls are from the extant literature (Laeven & Levine, 2009; Houston et al., 2010; Beck et al., 2013; Berger, El Ghouli, Guedhami, & Roman, 2015) and are widely accepted as determinants of bank risk. Summary statistics on these variables can be found in Table 3.

- Bank size is calculated as the natural logarithm of total assets. Since it is highly skewed, this variable is taken in natural logarithm. It ranges from 1.0 to 15.2, with an average value of 5.9.
- The loan to asset ratio is a liquidity ratio, and the ratio of net loans to total assets is used as a proxy. It indicates the proportion of assets tied up in loans. The higher this rate, the higher the exposure to credit risk and it ranges from 0% to 109%, with an average of 61.5%.
- Non-interest income share is a percentage of non-interest income in total income and proxies for the composition of bank revenues. Where non-interest income includes net income from fees, asset trading and securities and insurance activities; total income consists of both interest and non-interest income. It ranges from -15.0% to 93.6%, with a mean of 19.5%.¹⁴
- The share of wholesale funding is calculated as a share of wholesale financing in total funding and proxies for the bank's debt structure. While wholesale funding is calculated as money market funding plus other borrowings (i.e., public funds, foreign deposits, brokered deposits), total funding is calculated as a sum of wholesale funding and total deposits. It ranges from 0% (i.e., financed entirely by customer deposits) to 100% (i.e., wholly funded through sources other than customer deposits), and the average is 4%.
- Loan loss provisions to interest income proxies for the credit risk and computed as loan loss provisions to total interest income with higher values indicating that risk is

¹⁴ The lowest value is negative, which is because some losses (on trading and derivatives, securities and assets at fair value) are included in the computation of the indicator.

not properly counterbalanced by higher margins.¹⁵ It ranges from -131% to 39% and the average value is 11%.¹⁶

- Annual growth in total assets controls the bank's business strategy and asset development which ranges from -19% to 84% with an average of 6%.
- Listed is a dummy variable and takes the value of 1 for publicly listed banks. Publicly listed banks may behave differently because they are subject to more monitoring from capital markets and are more informationally transparent (Barry, Lepetit, & Tarazi, 2011). As displayed in Table 3, 10.4% of the banks in the sample are listed.
- BHC is a dummy variable indicating bank holding company (BHC) membership and takes the value of 1 if the bank is a part of a bank holding company. It is expected that such membership helps the stability of a bank because when needed, the holding company is required to support its affiliates by providing capital (Houston, James, & Marcus, 1997; Berger et al., 2015). Of the banks in the sample, 10.3% are part of a bank holding company.

4.2.2.5 Other country-specific variables

In addition to the country-level bank regulation and supervision variables detailed above and displayed in Table 3, there are two more country-level variables that proxy for the macroeconomic environment, which include real GDP per capita growth and inflation.

¹⁵ Loan loss provision is an accounting allowance set aside by banks to account for losses generated by uncollected loans.

¹⁶ The ratio is negative when loan impairment charges are negative. Banks may report negative provisions because estimates of the allowance could be declining due to a decrease in credit risk and improvements in economic indicators.

The pairwise correlation coefficients between all independent variables are presented in Appendix B. Correlation coefficients are low and show no possibility of a multicollinearity problem.

CHAPTER 5

RESULTS

This chapter presents the empirical results with regard to the relationship between bank competition, regulations, and stability. Section 5.1 presents the results on the competition and stability relationship. Then Section 5.2 continues with displaying the findings on the bank regulation and supervision variables (capital requirements, activity restrictions, and supervisor power) and their interactions with competition, to see how they impact bank stability directly and whether their effect is indirectly channeled through competition. Section 5.3 shows the results on how the financial crisis period (2007-2009) influences bank soundness and the indirect impact of this period through the competition on bank stability to observe how the most significant crisis in recent history has affected the competition-stability relationship. Finally, Section 5.4 concludes with robustness tests.

5.1 Competition and bank stability relationship

Table 4 reports results on bank competition and stability regressions where country-time fixed effects are included to allow for heterogeneity within a country and a given year and the country-year level is used to cluster the error terms. The one period lagged independent variables are employed in the regression to reduce the possible impact of reverse causality. Column 1 displays the results of Equation 4.1 in which $\ln(Z\text{-score})$ and the Lerner index are used as the dependent variable and the measure of competition, respectively. The results indicate that the Lerner index and $\ln(Z\text{-score})$ are significantly

Table 4. Bank Competition and Stability Regressions

Variables	(1) ln Z-score	(2) ln(sd (ROA))	(3) ln(Equity/TA)	(4) ln(NPL/(100-NPL))	(5) ln Z-score (full)	(6) ln Z-score HHI	(7) ln Z-score IV	(8) ln Z-score nonlinearity
Lerner	2.162*** (0.094)	-1.744*** (0.072)	0.186*** (0.033)	-1.074*** (0.169)	1.845*** (0.084)		1.185*** (0.044)	2.176*** (0.076)
HHI						31.462*** (4.093)		
Size	-0.008 (0.011)	-0.021** (0.010)	-0.03*** (0.005)	0.078*** (0.008)	-0.032*** (0.008)	0.020 (0.013)	0.235*** (0.023)	-0.008 (0.013)
Loan to asset	-0.678*** (0.083)	0.479*** (0.109)	-0.212*** (0.050)	0.499*** (0.118)	-0.742*** (0.062)	-0.562*** (0.094)	-0.526*** (0.035)	-0.674*** (0.088)
Noninterest income share	-0.703*** (0.092)	0.763*** (0.118)	0.076** (0.040)	-0.073 (0.065)	-0.659*** (0.042)	-0.055 (0.052)	-0.237** (0.094)	-0.690*** (0.124)
Wholesale funding share	-0.726*** (0.152)	0.503*** (0.152)	-0.241*** (0.066)	-0.049 (0.137)	-0.579*** (0.106)	-0.892*** (0.124)	-0.611*** (0.128)	-0.726*** (0.152)
Loan loss prov. to int. income	-0.226** (0.102)	0.262*** (0.096)	0.015 (0.010)	0.527*** (0.150)	-0.037 (0.042)	-0.711*** (0.270)	-0.247 (0.151)	-0.231** (0.110)
Growth of total assets	-0.064*** (0.016)	0.071*** (0.016)	0.003* (0.001)	-0.081 (0.068)	-0.049*** (0.016)	-0.047*** (0.012)	-0.192*** (0.013)	-0.065*** (0.015)
Listed	0.066*** (0.019)	-0.068*** (0.016)	0.017** (0.007)	-0.058*** (0.020)	0.053*** (0.019)	0.035 (0.024)	0.000 (.)	0.067*** (0.019)
BHC	-0.031 (0.024)	0.021 (0.025)	-0.023 (0.014)	0.064*** (0.014)	0.008 (0.023)	-0.094*** (0.023)	0.000 (.)	-0.031 (0.023)
Real GDP per capita growth	0.297*** (0.006)	-0.218*** (0.007)	1.232*** (0.045)	-1.804*** (0.119)	1.344*** (0.044)	0.593*** (0.019)	0.094*** (0.006)	0.295*** (0.009)
Inflation	-0.627*** (0.025)	0.351*** (0.027)	-4.981*** (0.188)	6.546*** (0.465)	-5.539*** (0.184)	0.275*** (0.016)	-0.094*** (0.004)	-0.625*** (0.030)
Lerner^2								0.064 (0.180)
Constant	5.177*** (0.052)	-6.814*** (0.061)	4.178*** (0.215)	-17.531*** (0.584)	10.683*** (0.189)	2.315*** (0.140)		5.165*** (0.060)
R-sq.	0.3082	0.252	0.206	0.188	0.267	0.143		0.3083
Observations	42815	43040	48861	43292	48766	44666	41273	42815
Number of countries	25	25	25	25	25	25	25	25
Time*country dummies	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Bank FE	No	No	No	No	No	No	Yes	No
First stage F stat.							6369.9***	
Hansen's J test							1.737	
p-value							0.420	

Note: This table shows results of competition and bank stability regressions. Column 1 employs ln (Z-score) as a dependent variable, and the Z-score is decomposed and ln (Sd (ROA)) and ln (equity-to-assets ratio) are used as dependent variables in Columns 2 and 3 respectively. Column 4 employs another indicator of bank stability, ln (NPL/ (100-NPL)). In column 5, the Z-score is calculated using the volatility of profits over the full sample period. An alternative market power measure, HHI, is employed in Column 6. Column 7 controls for endogeneity, using a 2SLS estimator. Column 8 tests for the nonlinearity of competition. Robust standard errors are in parentheses. * p<0.10, ** p<0.05, *** p<0.010

and positively related, i.e., the overall bank is decreased with more market power. In other words, an increase in competition decreases bank stability, which is consistent with theoretical arguments in the competition-fragility view. Therefore, the stability of the banking sector is deteriorated under more competition by a reduction in banks' franchise values (Keeley, 1990; Suarez, 1994; Bolt & Tieman, 2004). The effect is also economically significant with one standard deviation increase in market power (which equals 0.248) leading to decreased bank risk by 54% (0.248×2.162).¹⁷

In columns 2 and 3, the Z-score is decomposed to analyze where the stability-enhancing impact of market power originates. The analyzed components are capitalization and the volatility of profits. The other component of the Z-score, ROA, is not investigated since any relationship between ROA and the Lerner index would be somewhat mechanical. Therefore the natural logarithm of the standard deviation of ROA and the natural logarithm of the equity-to-asset ratio are used as dependent variables in columns 2 and 3, respectively. The results in columns 2 and 3 indicate that an increase in market power brings more stable profits (a lower standard deviation of ROA) and higher capitalization. In other words, more competition negatively affects both the volatility of profits and capitalization.

Since profits are the primary driver of the charter value by virtue of generating a buffer against adverse externalities, increased volatility of profits under competition deteriorates the stability of the banking sector by reducing banks' franchise values. Therefore, components of the Z-score confirm the results, supporting the competition-

¹⁷ Since the Z-score is in logs, the coefficient of the Lerner index is interpreted as semi-elasticity, i.e., the percentage change in the dependent variable as a result of a numerical change in the independent variable.

fragility view and showing that a decrease in stability under competition originates from a combination of more volatile profits and lower capitalization ratios.

Moreover, market power being negatively correlated to profit volatility in Column 2 further shows that the relationship between market power and bank soundness is not mechanically formed due to having profitability as the main drivers, which is in line with observations shown in Figure 2.

Another indicator of bank stability is employed in Column 4, NPL ratio, and it is observed that market power significantly decreases non-performing loan ratio and bank loan portfolio and credit risk, confirming competition-fragility view.¹⁸

In column 5, the Z-score is calculated differently. Instead of calculating the volatility of profits using three-year rolling windows, it is computed over a full sample period. The results are consistent with computing the Z-score this way, indicating that market power has a positive and significant impact on bank stability, supporting the competition-fragility view. Please note that unless otherwise stated, three-year rolling windows are used for the calculation of the standard deviation of ROA in the rest of the analysis.

In column 6, an alternative concentration measure, HHI, is employed computed using the total assets in column 6, and the results show that concentrated banks are more stable.

While endogeneity concerns are mitigated due to the use of lagged independent variables, there are other possible causes of endogeneity which may be created by possible omitted variables. To address this potential source of endogeneity, in column 7

¹⁸The log-odds transformation is used, $\ln(NPL / (100 - NPL))$ and the range of the variable is transformed from the unit interval to the real line.

IV techniques is conducted, using a 2SLS estimator with the Lerner index treated as an endogenous variable, and the dependent variable is $\ln(\text{Z-score})$. Additionally, bank fixed effects are employed, and the error terms are clustered on the country level. Following Beck et al. (2013) and Schaeck & Cihak (2014), Lerner index is instrumented by loan growth, cost-income ratio, and two-period lagged Lerner index.¹⁹ The instruments are found to significantly explain market power.²⁰ Moreover, it is not evident in the literature (Laeven & Levine, 2009; Houston et al., 2010) whether these variables are directly correlated to bank risk.

While these instrument variables have ex-ante theoretical plausibility, various specification tests are conducted to validate the relevance and strength of the instruments. First, an F-test of excluded exogenous variables is performed for testing the relevance of IVs, where the null hypothesis is that the instruments do not explain the variation in the Lerner index. The null hypothesis is rejected at the 1% level ($F = 6369.8$ with a p-value less than 0.000). Second, the Hansen-Sargan overidentification test is considered, which is a test of overidentifying restrictions. The joint null hypothesis which states that the instruments are valid instruments is not rejected (with a J-statistic of 1.737 and p-value of 0.420). Third, Hausman's endogeneity test (1978) and Stock & Yogo's weak instrument test (2005) is considered, and these tests conclude that the instruments are both relevant and valid.^{21 22} Column 7 shows that after controlling for

¹⁹ Loan growth is the annual growth rate of loans, and the cost-income ratio is determined as the ratio of overhead costs (the large part of which is personnel expenses) to net operating income.

²⁰ Results from the first stage regression indicate that these instrument variables significantly explain Lerner index. Results are not provided here, but they are available upon request.

²¹ Hausman endogeneity test tests for differences between the Ordinary Least Squares (OLS) and IV estimates in which rejecting the null hypothesis indicates endogeneity. Our p-value results in a 0.081 which is significant at 10% level and confirms that Lerner index is endogenous, although weakly.

endogeneity, a positive and statistically significant link between market power and stability is preserved, which shows that a model without IV techniques and bank fixed effects does not lead to biased estimates.

The recent literature reports evidence of non-linearity of competition (Martinez-Miera & Repullo, 2010). Therefore, the inherent non-linearity of competition is tested, as in Equation 4.2, which includes a squared Lerner index in the regression. Table 4 column 8 displays that the coefficient of the squared term is insignificant. The inflection point occurs at -16.97, which is not even in the range of the Lerner index in the sample. Therefore, no evidence of non-linearity of competition is founded in the sample. NPL ratio is also used as a dependent variable to check the non-linearity of competition and again no evidence of non-linearity of competition is observed.²³

Most of the bank and country controls are able to explain bank stability. The loan to asset ratio, the growth of total assets, non-interest income share, the share of wholesale funding, loan loss provisions to interest income and inflation are negatively related to bank stability, with the signs expected in the theoretical framework. Higher real GDP per capita growth induces more bank stability. While public banks are significantly more stable, BHC membership does not significantly impact bank stability.

Overall, the results imply that competition increases both overall bank risk and credit risk, and the competition-fragility view holds for developed countries. The results are robust controlling for endogeneity, decomposing the Z-score and using alternative indicators for competition and bank stability. The results from decomposing the Z-score

²² We conduct the weak instrument test of Stock & Yogo (2005). It is concluded that our instruments are valid and not weak because F-statistic from the first-stage regression (6369.9) exceeds the critical value 13.91 (using 5% bias).

²³ Results are available upon request.

indicate that the decrease in stability under competition originates from both more volatile profits and lower capitalization ratios. On the other hand, no evidence of non-linearity of competition is observed, as indicated in the recent literature by Martinez-Miera & Repullo (2010).

5.2 Bank regulation variables, competition, and stability

This section investigates regulation and supervision variables of interest (capital requirements, activity restrictions, and supervisor power) and their interactions with market power, as in Equation 4.3, to see how they impact bank stability directly and whether they interact with market power in forming the risk incentives of banks.

Table 5 Column 1 displays the results where the dependent variable is $\ln(\text{Z-score})$, and regulation and supervision variables are included in the regression without including the interactions with the Lerner index. More stringent capital requirements positively impact bank soundness by decreasing overall bank risk, a finding consistent with the empirical results of Barth et al. (2004), Agoraki et al. (2011) and Berger & Bouwman (2013), among others. Capital requirements emerge as a useful regulatory tool in reducing bank risk. This finding supports the theory that underlines higher capital requirements as reducing incentives for a bank to increase asset portfolio risk by putting bank equity at risk and decreasing the moral hazard problem created by deposit insurance (Furlong & Keeley, 1989; Keeley, 1990; Keeley & Furlong, 1990). Another reason provided in the literature is that higher capitalization improves banks' risk management, the borrower screening and risk monitoring of banks, which in turn, reduces bank riskiness (Coval & Thakor, 2005; Allen et al., 2011).

Table 5. Bank Regulation Variables, Competition and Stability Relationship

Variables	(1) ln Z-score	(2) ln(sd(ROA))	(3) ln(Equity/TA)	(4) ln Z-score
Lerner	2.162*** (0.094)	-1.744*** (0.072)	0.186*** (0.033)	2.161*** (0.070)
Size	-0.008 (0.011)	-0.021** (0.010)	-0.030*** (0.005)	-0.009 (0.011)
Loan to asset	-0.678*** (0.083)	0.479*** (0.109)	-0.212*** (0.050)	-0.670*** (0.083)
Noninterest income share	-0.703*** (0.092)	0.763*** (0.118)	0.076** (0.035)	-0.691*** (0.095)
Wholesale funding share	-0.726*** (0.152)	0.503*** (0.152)	-0.241*** (0.066)	-0.717*** (0.153)
Loan Loss Prov. to int. income	-0.226** (0.102)	0.262*** (0.096)	0.014 (0.010)	-0.258** (0.107)
Growth of Total assets	-0.064*** (0.016)	0.071*** (0.016)	0.003* (0.001)	-0.064*** (0.016)
Listed	0.066*** (0.016)	-0.068*** (0.016)	0.017** (0.007)	0.074*** (0.019)
BHC	-0.031 (0.024)	0.021 (0.025)	-0.023 (0.014)	-0.035 (0.024)
Real GDP per capita growth	0.259*** (0.003)	-0.225*** (0.003)	0.040*** (0.003)	0.252*** (0.005)
Inflation	-0.474*** (0.007)	0.380*** (0.007)	-0.104*** (0.004)	-0.462*** (0.009)
Capital requirements	0.587*** (0.041)	-0.636*** (0.025)	0.087*** (0.019)	0.587*** (0.048)
Activity restrictions	-0.204*** (0.026)	0.269*** (0.017)	0.027** (0.012)	-0.227*** (0.034)
Supervisory power	-0.162*** (0.011)	0.203*** (0.008)	0.076*** (0.006)	-0.157*** (0.011)
Lerner* Capital req.				0.123** (0.061)
Lerner* Activity rest.				0.132** (0.066)
Lerner* Supervisory power				0.064 (0.054)
Constant	4.843*** (0.185)	-7.635*** (0.162)	-3.864*** (0.113)	5.016*** (0.186)
R-sq.	0.3082	0.2520	0.2060	0.3102
Observations	42815	43040	48861	42815
Number of countries	25	25	25	25
Time*country dummies	Yes	Yes	Yes	Yes

Note: The table provides information on the relationship between bank regulation and supervision variables, competition, and bank stability. Column 1 considers the impact of regulations on bank stability directly. Column 2 and 3 decomposes the Z-score and uses ln (sd (ROA)) and ln (equity-to-assets ratio) as dependent variables respectively. The interactions of regulation and supervision variables with Lerner index are added in Column 4. Robust standard errors are in parentheses.

* p<0.10, ** p<0.05, *** p<0.010

Activity restrictions have a negative and significant effect on bank stability by increasing overall bank risk, which shows that higher activity restrictions decrease bank stability for developed markets, a finding supporting the empirical results of Barth et al. (2004), Beck et al. (2006a) and Beck et al. (2006b). The finding is inconsistent with the results of Agoraki et al. (2011) which found that more restrictions on activities reduce bank credit risk and induce stability in the Central and Eastern European banking system. The inconsistency is not surprising because the impact of bank regulatory measures on stability is expected to differ under different institutional contexts among developed and transitional countries (Barth et al., 2004). Therefore, the finding in this thesis is consistent with the theoretical literature that points out that fewer bank restrictions permit conducting economies of scale and scope, and efficiency (Baumol et al., 1982; Saunders & Walter, 1994). Moreover, another reasoning provided in the literature is that activity restrictions diminish diversification advantages from different lines of business. Therefore, banks can not reduce the riskiness of their portfolios and consequently bank fragility increases (Claessens & Klingebiel, 2001).

Supervisor power also has a negative and significant effect on bank stability by increasing overall bank risk, a finding consistent with theoretical predictions of private interest view. The private interest view argues that supervisors may not intend to fix the failures in banking market and enhance social welfare, but instead try to maximize their welfare (Boot & Thakor 1993; Shleifer & Vishny, 1998; Barth et al., 2004). Specifically, banks may use supervisory agencies to protect and enrich themselves, or supervisors may use their positions to provide credit to their connections. Politicians may use regulations to create rents through campaign contributions and bribes and benefit themselves when there is lack of independence of supervisory authorities from political

influence (Quintyn & Taylor, 2002). The finding is inconsistent with the results of Agoraki et al. (2011) which found that higher supervisory power increases bank stability in the Central and Eastern European banking system.

In columns 2 and 3 of Table 5, the Z-score is decomposed to establish the source of the impact of bank regulations on stability. The components which are examined include the equity ratio and the volatility of profits. As indicated before, the other component of the Z-score, ROA, is not investigated since any relationship between profits and the Lerner index would be spurious. Therefore, the natural logarithm of the standard deviation of ROA and the natural logarithm of the equity-to-asset ratio are used as dependent variables in columns 2 and 3, respectively. It is indicated in columns 2 and 3 that an increase in capital stringency requirements in a country is significantly associated with more stable bank level profits (a lower standard deviation of ROA) and higher bank capitalization. Therefore, banks in countries with higher capital requirements are more stable through both more stable profits and higher bank equity ratios.

On the other hand, higher activity restrictions lead to more volatile profits (a higher standard deviation of ROA) on the one hand and higher bank capitalization on the other, with the effect being larger when the dependent variable is volatility of ROA. Therefore, it is concluded that banks in countries with higher activity restrictions engage in excessive risk-taking mainly through more volatile profits.

Similarly, higher supervisory power leads to both more volatile profits and higher bank equity ratios, with the coefficient of the effect on bank stability being higher when the volatility of profits is taken as a dependent variable. Therefore, banks in

countries with higher supervisory power engage in excessive risk-taking mainly through more volatile profits.

In Column 4 Table 5, the interaction of regulations with market power is considered to observe whether they have an indirect effect on the relationship between market power and stability. The purpose is to see whether these regulatory variables affect the degree of bank stability directly or whether their interaction with market power is relevant. The direct impacts of the regulation variables are the same as those observed in column 1 with significant coefficients of similar sign and magnitude. While the interaction between market power and the capital requirements index and the interaction between market power and activity restrictions both enter the regression with positive and significant coefficients, the impact of the interaction between market power and supervisory power is insignificant.

Thus, while more stringent capital requirements increase bank stability directly, capital requirements further increase bank stability by decreasing overall bank risk indirectly through market power. The effect of capital stringency on bank stability is 0.587, but given the interaction term, the net result is $0.587 + 0.123 \times \text{Lerner index}$. If the Lerner index is 0, the effect is 0.587, but if the Lerner index is 1, the result is 0.71. Therefore, the impact of capital stringency on bank stability is more favorable in banks with higher market power. In other words, market power is more beneficial in countries where there are higher capital requirements. This finding is inconsistent with Agoraki et al. (2011) because they found that the stabilizing effect of more stringent capital requirements reverses for banks with higher market power using a sample of Central and Eastern European countries. As Hellmann et al. (2000) suggest, under competition for deposits, capital requirements reduce risk-taking incentives of banks by placing bank

equity at risk where the bank faces the risks from investing in risky assets, which is called the “capital-at-risk effect.” However, there is also an opposite “market stealing effect” that occurs when stringent capital requirements lead to reduced franchise values. Specifically, banks try to steal depositors by offering a higher deposit rate, and they invest in riskier loans. Therefore, the results from this thesis indicate that “capital-at-risk effect” dominates for banks with market power and capital requirements further reduce risk-taking incentives of banks and induce stability.

On the other hand, while higher activity restrictions have a negative influence on bank stability, the negative effect is mitigated in banks with higher market power, a finding consistent with Agoraki et al. (2011) and Beck et al. (2013). The effect of activity restrictions on bank stability is -0.227, but given the interaction term, the net result is $-0.227 + 0.132 \times \text{Lerner index}$. If the Lerner index is 0, the effect is -0.227, but if the Lerner index is 1, the resulting coefficient is -0.095. A potential explanation provided by Agoraki et al. (2011) is that when activities are restricted, banks tend to focus more on the loan market. When there is competition in the market, banks with low market power tend to provide loans to risky borrowers to increase their market share which leads to decreased stability. Overall, higher activity restrictions appear to decrease bank stability by increasing overall bank risk for any level of market power, but the negative effect is mitigated in banks with more market power.

Finally, the interaction of market power and supervisory power is insignificant and supervisory power only directly deteriorates on bank stability. Therefore, lower supervisory power emerges as an effective tool in increasing bank stability, regardless of the level of market power. The finding that the interaction of supervisory power with the

competition being insignificant is consistent with Agoraki et al. (2011), however, their results indicate a direct positive influence of supervisory power on bank soundness.

A final note for this section is that the positive link between market power and stability is robust across all specifications, confirming findings that support the competition-fragility view in Section 5.1.

Overall, capital requirements appear to be a very effective tool for increasing bank stability, both directly and indirectly through market power for banks with any level of market power. However, the effect is higher for banks with higher market power. The decomposition of the Z-score shows that banks in countries with more stringent capital requirements engage in less risky behavior through both more stable profits and higher bank equity ratios. Lower activity restriction is another useful regulatory instrument that appears to increase bank stability by decreasing overall bank risk for any level of market power, but increase bank stability more for banks with low market power. Banks in countries with higher activity restrictions engage in excessive risk-taking mainly through more volatile profits. Finally, lower supervisory power emerges as another useful tool for increasing bank stability, regardless of the level of market power. Decomposition of the Z-score indicates that banks in countries with higher supervisory power engage in excessive risk-taking mainly through more volatile profits. Overall, the results show that for more accurate inferences about the net impact of regulations on bank stability, the interactions between regulations and competition needs to be taken into account.

5.3 Financial crisis period effects

The period for analysis, 2007–2015, is special because it contains data for the most significant financial crisis in recent history. Therefore, in this section, the direct effect of the crisis period (2007-2009) and the indirect effect of this period through the competition on bank stability is analyzed to observe how the financial crisis has affected the competition-stability relationship. To address this, an indicator variable, “Crisis,” that takes a value of 1 for the period 2007-2009 and its interaction with the Lerner index are included in the regression. When the standard deviation of profits is calculated using three-year rolling windows, the observations for the years 2007-2009 are lost. Since those years need to be included to analyze the impact of the crisis period on the relationship between market power and bank stability, the Z-scores calculated using the volatility of profits over the full sample period are used instead.

Table 6 Column 1 displays the regression results. The crisis period (2007-2009) negatively and significantly influences bank stability, as would be expected. However, the destabilizing impact of the crisis period is reversed for banks with market power, i.e., those banks remained stable during the crisis period.

Columns 2 and 3 of Table 6 decompose the Z-score to establish where the negative impact of the crisis period on bank stability originates from. Therefore, the natural logarithm of the standard deviation of ROA and the natural logarithm of the equity-to-asset ratio are used as dependent variables in columns 2 and 3, respectively. The crisis period continues to have a negative and significant direct effect on bank stability through both increasing volatility of profits and decreasing the bank capitalization ratio. While the interaction of the crisis period with market power is significant and positive, as shown in column 2, it turns out to be insignificant for

Table 6. The Financial Crisis Effects on Competition and Stability Relationship

Variables	(1) ln Z-score Crisis	(2) ln(sd(ROA)) Crisis	(3) ln(Equity/TA) Crisis	(4) ln (NPL/(100-NPL)) crisis
Lerner	1.649*** (0.210)	-1.300*** (0.164)	0.186*** (0.038)	-0.952*** (0.247)
Size	-0.025*** (0.007)	-0.005 (0.006)	-0.029*** (0.005)	0.076*** (0.009)
Loan to asset	-0.727*** (0.059)	0.530*** (0.072)	-0.209*** (0.049)	0.454*** (0.100)
Noninterest income share	-0.682*** (0.049)	0.774*** (0.063)	0.067* (0.035)	0.044 (0.070)
Share of wholesale funding	-0.599*** (0.100)	0.344*** (0.108)	-0.245*** (0.069)	0.076 (0.147)
Loan Loss Prov. to int. inc.	-0.037 (0.043)	0.049 (0.048)	0.014 (0.009)	0.542*** (0.161)
Growth of Total assets	-0.039** (0.019)	0.048** (0.019)	0.003 (0.002)	-0.088 (0.073)
Listed	0.050*** (0.019)	-0.042** (0.018)	0.016** (0.006)	-0.061*** (0.019)
BHC	0.014 (0.021)	-0.03 (0.024)	-0.024* (0.014)	0.062*** (0.014)
Real GDP per capita growth	0 (0.006)	0.039*** (0.005)	0.039*** (0.003)	-0.353*** (0.011)
Inflation	-0.036*** (0.010)	-0.064*** (0.008)	-0.104*** (0.004)	0.620*** (0.016)
Crisis	-0.972*** (0.036)	0.304*** (0.030)	-0.611*** (0.025)	1.387*** (0.064)
Lerner*Crisis	1.049*** (0.141)	-0.778*** (0.091)	0.005 (0.037)	-0.707*** (0.109)
Constant	3.878*** (0.083)	-5.715*** (0.079)	-1.867*** (0.052)	-10.185*** (0.110)
R-sq.	0.286	0.209	0.20	0.19
Observations	48327	48372	48368	42863
Number of countries	25	25	25	25
Time*country dummies	Yes	Yes	Yes	Yes

Note: The table provides information on the influence of crisis period on the competition and bank stability link. Column 1 displays the results when ln (Z-score) is the dependent variable with the volatility of profits calculated using full sample period. The Z-score is decomposed, and ln (sd (ROA)) and ln (equity-to-assets ratio) are used in columns 2 and 3, respectively, as dependent variables. Column 4 employs ln (NPL/ (100-NPL)) as a dependent variable. Robust standard errors are in parentheses. * p<0.10, ** p<0.05, *** p<0.010

column 3. Therefore, the decomposition of the Z-score indicates that banks with higher market power remained stable during the crisis period through having lower profit volatility, but not through capitalization ratios. Ln (NPL) is used as an alternative indicator for bank stability in column 4, and it is confirmed that the financial crisis period (2007-2009) increases credit risk, but the destabilizing effect is reversed for banks that possess higher market power.

5.4 Robustness tests

As indicated in earlier sections in this chapter, the results are robust using different indicators of bank stability, which are the standard deviation of profits, equity-to-asset ratio, non-performing loan ratio and the Z-score with the standard deviation of profits calculated over a full sample period.

Further robustness tests are conducted which confirm the findings. These tests include: i) using alternative market power measure, which is HHI, ii) employing another alternative bank stability measure, which is the Z-score with the standard deviation of profits measured using five-year rolling windows, iii) running regressions where country and year fixed effects are included (separate fixed effects rather than their interaction) and iv) using other country development and corporate governance controls from the World Bank World Development Indicators and Worldwide Governance Indicators databases, such as depth of credit information index, stocks traded to listed, credit to private sector, strength of legal rights and rule of law. None of these settings has a different impact on the findings.

Another concern in the analysis is the disproportionately large number of US banks in the sample. Therefore, the weighted least squares analysis is performed by multiplying each observation with the inverse of the number of banks in a country, which verifies that the findings are solely originated from the countries that have the highest share of the sample. The results, not reported here, but available upon request, are robust and confirm the main findings. Another way to limit overrepresentation of US banks would be decreasing the number of banks in the US sample. Therefore, the US sample is decreased by including the largest 100 US banks for each period and 900 random US banks. The results are again robust with this restricted sample.

CHAPTER 6

CONCLUSION

This thesis explores the link between competition and bank stability and whether there is any nonlinearity in this relationship for developed countries. It is then investigated how bank regulation and supervision variables such as stringency in capital requirements, restricted bank activities, and the power of supervisory authority, influence bank stability directly and interact with competition in forming the risk behavior of banks. Finally, the effect of the financial crisis period 2007-2009 on bank stability and whether competition is more detrimental to bank stability during this period is examined.

The findings indicate that the competition-fragility view holds for developed countries, consistent with theoretical arguments stating that competition deteriorates the stability of the banking sector by reducing banks' franchise values (Keeley, 1990; Suarez, 1994; Bolt & Tieman, 2004). Decomposition of the Z-score indicates that the decrease in stability under competition arises from both more volatile profits and lower capitalization ratios. There is no indication of non-linearity of competition, inconsistent with the predictions of Martinez-Miera & Repullo (2010).

Next, the impacts of bank regulatory variables on bank stability are considered and it is deduced that capital requirements appear to be a very successful regulatory tool in increasing bank stability both directly and indirectly through interacting with market power. The finding is consistent with the theoretical literature that underlines that higher capital requirements place bank equity under risk and reduce incentives for risk-taking, and diminish the moral hazard problem (Furlong & Keeley, 1989; Keeley, 1990; Keeley & Furlong, 1990). The result is also consistent with the empirical findings of Barth et al.

(2004), Agoraki et al. (2011) and Berger & Bouwman (2013), among others. The decomposition of the Z-score reveals that more stringent capital requirements lead to less risky behavior through both more stable profits and higher bank equity ratios.

Lower activity restrictions is another effective regulatory instrument for decreasing the overall bank risk for any level of market power, but they increase bank stability more for banks with low market power, i.e., under competitive environments. The finding is consistent with the theoretical literature that points out that economies of scale are achieved by fewer bank activity restrictions which bring more efficiency and diversification benefits (Baumol et al., 1982; Saunders & Walter, 1994; Claessens & Klingebiel, 2001). The result is also in line with the empirical findings of Barth et al. (2004), Beck et al. (2006a) and Beck et al. (2006b). It is observed that banks in countries with higher activity restrictions engage in excessive risk-taking mainly through more volatile profits.

Lower supervisory power emerges as another useful tool for increasing bank stability by decreasing overall bank risk, regardless of the intensity of market power. This is a finding consistent with theoretical predictions of the private interest view, which states that supervisors may not always have incentives for fixing the market failures in banking; instead, they may try to maximize their own welfare (Boot & Thakor 1993; Shleifer & Vishny, 1998; Barth et al., 2004). Decomposition of the Z-score again indicates that banks in countries with higher supervisory power engage in excessive risk-taking mainly through more volatile profits.

It is finally observed that the 2007-2009 financial crisis has a negative and a significant direct effect on bank stability by increasing volatility of profits and

decreasing the bank capitalization ratio. However, banks with higher market power remained stable during the crisis period, owing to lower profit volatility.

Overall, the findings emphasize the importance of regulations and competitive environment for bank stability. Competition is detrimental to stability in banking, and the decrease in stability arises from both more volatile profits and lower capitalization ratios, and regulations may help mediate the trade-off between competition and stability. It is shown that for a comprehensive investigation of the influence of regulations on bank stability, the level of competition in the market needs to be considered. More accurate inferences about the net impact of regulations on bank stability are achieved by considering the interactions between regulations and competition. For example, while capital requirements increase bank stability directly, the positive effect is exacerbated in less competitive environments. Additionally, less stringent activity restrictions increase bank stability, with the positive impact more prevalent under competition. Supervisory power, on the other hand, is a more direct tool for achieving bank stability with lower supervisory power increasing bank stability irrespective of the level of competition.

The findings offer some implications for the recent debate in the US on whether bank regulations under the Dodd-Frank law have become too tight and whether lifting some regulations is necessary. Regulators may be able to improve bank stability by softening some regulations on activity restrictions and supervisory power. However, capital requirements are found to increase bank stability, and any decrease in these requirements has to be considered cautiously. It is suggested that future research in this area should explore the impact of different bank regulations on the competition-stability relationship.

APPENDIX A

EMPIRICAL LITERATURE REVIEW ON COMPETITION AND STABILITY RELATIONSHIP

	Dataset	Bank Stability measures	Competition proxy	Supporting view	Findings
Panel A: Single-country studies					
Keeley (1990)	Large US BHCs between 1971-1986	Capital-to-asset ratio, interest cost CD's	Tobin's Q	Competition-fragility	The increase in competition erodes franchise values, reduces the capital cushions and decreases stability.
Demsetz et al. (1996)	100 US banks between 1986-1994	Stand. Dev. of stock returns	Tobin's Q	Competition-fragility	Franchise value and stock-return volatility are inversely correlated.
Salas and Saurina (2003)	21 Spanish banks for the period 1968- 1998	Capital-to-asset ratio, NPL	Tobin's Q	Competition-fragility	Banks with higher charter values are observed to be more stable.
Bofondi and Gobbi (2004)	729 Italian banks between 1986-1996	Loan default rate	Market share	Competition-fragility	Loan losses rise as the banks in a market increases.
Jimenez et al. (2013)	107 Spanish banks from 1988-2003	NPL	Lerner index, CR5 and HHI	Nonlinear	There is evidence of a nonlinear relationship.
Panel B: Cross-Country Studies					
Beck, Demirguc-Kunt & Levine (2006)	69 countries from 1980 to 1997	Banking systemic crisis dummy	CR3	Competition-fragility	A lower probability of a crisis is faced by more concentrated banking industries.
Boyd et al. (2006)	2,500 U.S. banks in 2003& 2,700 banks in 134 countries between 1993-2004	Z-Score	HHI	Competition-stability	More concentrated banking industries face a higher probability of default.
Levy Yeyati& Micco (2007)	8 Latin American countries from 1993-2002	Z-Score NPL	H-Statistic, CR3, CR5	Competition-fragility	Competitive banking systems are more fragile.
Berger et al. (2009)	8,235 banks in 23 developed nations between 1999–2005	Z-Score, NPL, equity-to-asset ratio	Lerner index, HHI	Both	While concentrated banking systems have less risk, market power, however, increases credit risk.
Schaek et al. (2009)	38 countries over the period from 1980 to 2003.	Banking systemic crisis dummy	H-Statistic, CR3	Competition-stability	Competitive banking environments are more stable.
Turk-Ariss (2010)	821 banks from 60 developing economies from 1999 to 2005.	Z-Score, Risk-adjusted ROA and ROE	Lerner index	Competition-fragility	Bank stability is improved with more market power.
Agoraki et al. (2011)	546 banks in 13 Central and Eastern European countries over the period 1998–2005	Z-Score, NPL	Lerner index	Competition-fragility	Competition increases fragility. Capital requirements reduce risk independently and the interaction of higher activity restrictions and market power reduce bank risk. Higher supervisory power significantly reduces bank risk.

	Dataset	Bank Stability measures	Competition proxy	Supporting view	Findings
Beck et al. (2013)	17,000 banks from 79 developed & developing countries over 1994-2009	Z-Score	Lerner index	Competition-fragility	The negative effect of bank competition on bank stability is more prevalent in countries with lower systemic fragility, greater activity restrictions, higher deposit insurance, improved credit information sharing and more developed stock exchanges.
Soedarmono et al. (2013)	11 emerging countries in Asia over the period 1994-2009	Equity-to-assets ratio, Standard dev. of ROA, Z-score	Lerner index	Competition-stability	Market power deteriorates income volatility and increases default risk of banks.
Schaeck and Cihak (2014)	3,325 banks from 10 European countries for the years 1995-2005	Z-Score	Boone indicator	Competition-stability	Competition is stability-enhancing and that efficiency is the channel.

Note: The table briefly displays the review of the empirical literature on the relationship between competition and bank stability. While Panel A reviews single-country studies, Panel B presents cross-country studies in the empirical literature.

APPENDIX B

CORRELATIONS

	Lerner index	Size	Loan to Asset	Sh. of wholesale funding	Nonint. inc. to gross rev.	Loan loss prov. to int. inc.	Growth of TA	Real GDP p.c. growth	Inflation	Capital stringency	Activity restrictions	Supervisory power
Lerner index	1											
<i>Bank Controls</i>												
Size	0.0910*	1										
Loan to Asset	-0.0205*	-0.0016	1									
Share of wholesale funding	0.0166*	0.4245*	-0.0792*	1								
Nonint. income to gross rev.	0.0600*	0.0210*	-0.0220*	0.0210*	1							
Loan loss prov. to int. income	-0.1168*	0.0335*	0.0298*	0.0069	-0.0005	1						
Growth of Total assets	-0.0077	0.0116*	-0.0009	0.0003	-0.0034	-0.0039	1					
<i>Country Controls</i>												
Real GDP per cap. growth	0.1717*	0.0147*	-0.0558*	-0.0417*	0.0006	-0.0619*	-0.0256*	1				
Inflation	0.0293*	-0.0739*	0.0191*	0.0213*	-0.0066	-0.0134*	0.0228*	0.1726*	1			
Capital stringency	0.0900*	-0.3109*	-0.0011	-0.2050*	-0.0061	-0.0455*	-0.0168*	0.2549*	-0.0213*	1		
Activity restrictions	0.1003*	-0.3769*	0.0532*	-0.2741*	-0.0178*	-0.0540*	-0.0194*	0.2855*	-0.0549*	0.6560*	1	
Supervisory power	-0.0918*	-0.4870*	0.1285*	-0.2651*	-0.0268*	0.0136*	0.0217*	-0.2114*	0.0611*	0.2265*	0.2230*	1

* significance at 0.01

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