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Econometric Analyses of Banking Stability: Three Essays

by

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To my dear parents and grandparents

Abstract

This thesis focuses on the macro- and the microeconomics of banking stability. To this end, four different lines of research are pursued in this thesis. We start with an investigation of the impact of competition among financial institutions upon the likelihood and timing of systemic crises. Second, we extend our analysis to the bank level and examine how increased competitive conduct among banks affects their capital ratios. Following this, we take the point of view of a deposit insurance agency and use an innovative estimation procedure to help differentiate the determinants of particularly costly bank failures from less expensive failures. Finally, we examine bank liability structure and propose in the remaining analysis an alternative way of testing the efficacy of market discipline.

Using different econometric approaches and different samples, we present robust evidence for a positive link between bank competition and bank soundness. In particular, competitive conduct not only goes hand in hand with increased bank soundness on the systemic level, but banks also hold higher capital ratios when operating in a competitive environment. The subsequent analysis of bank liability structure and the drivers of costly bank failures to the deposit insurer suggests that previously employed econometric methods provide inappropriate inferences regarding the drivers of losses. Moreover, we also offer support for the view that insured depositors are a source of market discipline.

The empirical results give rise to numerous important public policy implications. The robustly positive association of competition with bank soundness suggests that there is no negative trade-off between competitive conduct of banks and their soundness. As a consequence, there is no compelling reason to curtail competition to achieve or sustain banking stability. In addition, the finding that deposit insurer's losses incurred from costly failures are particularly driven by the composition of the loan portfolio highlights that the lending portfolio deserves even greater regulatory scrutiny. Furthermore, the results regarding the effect of bank liability structure on time to failure of financial institutions indicate that banks that are increasingly relying on short-term unsecured credits tend to fail faster. Such institutions might have to be subject to additional means of prompt corrective action by regulatory authorities. Finally, important omissions in the new Basel Capital Accord regarding bank liability structure are pointed out.

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Chapter I

INTRODUCTION

1. AIMS

This thesis aims to offer new insights into banking stability. To this end, this research provides two distinctive analyses of the relationship between bank market structure, competition among financial institutions, and bank soundness. A subsequent and unique analysis of the nexus between bank liability structure, market discipline and the deposit insurer's loss (given bank default) concludes this work.

1.1. OVERVIEW

Financial crises have resulted in sizeable output losses in developed and developing economies in the past few decades. As a result, financial stability has become a major policy concern in recent years (Borio, 2006). Motivated by this increased public policy interest in financial stability, an accelerating consolidation in banking systems within national boundaries, and increasing cross-border mergers of financial institutions, this empirically driven research aspires to uncover the linkages between bank market structure, individual bank behaviour and, ultimately, banking stability.

In order to achieve this ambitious goal, this work focuses on four different phenomena. First, using systemic banking crises as 'point of departure', this work contributes to the enhanced and deeper understanding of the macro- and the microeconomics of bank soundness employing a broad variety of econometric techniques and a number of different samples. It not only analyses the nexus between market structure, competition and systemic risk, but also extends this analysis by adding a whole new dimension to this literature in that it models the relationship between competition and bank capital ratios. It is important to note that competition is defined as bank pricing power throughout this thesis. Second, the thesis extends previous research on the link between market structure and bank stability by disentangling measures of concentration and competition, thereby also providing new and interesting insights for bank regulation and supervision. Third, using an innovative estimation procedure, the thesis investigates whether the factors that drive costly bank failures exhibit systematic differences from the factors that drive moderate and low-cost bank failures. Fourth, this research presents an alternative way of testing the efficacy of market discipline, thus assessing the role of depositor discipline in curtailing risk-taking behaviour of bank managers. In doing so, this work not only offers

insights for public policy debates for reforming deposit insurance but also suggests a further critical assessment of the new Basel Capital Accord, especially with respect to Pillar III.

Certainly, the relationship between bank market structure, the level of competition within banking systems, and banking stability is of more than purely theoretical interest. Diamond (1984) and Boyd and Prescott (1986) have shown that banks play a pertinent role in the process of effectively helping to mobilise and allocate society's savings by serving as intermediaries between borrowers and lenders. As a consequence, research on the implications of competitive conduct of banks and bank market structure for banking stability bears important public policy considerations. Furthermore, supranational initiatives to harmonise bank regulation and core principles for regulatory oversight have shaped the competitive environment which banks operate in. While many of these policy initiatives aim to achieve and maintain financial stability, they have received widespread criticism from the academic community (e.g. Danielsson et al., 1999; Pennacchi, 2005) and consequently necessitate a thorough investigation. Finally, public policy discussions about the adequate design of deposit insurance systems and reform thereof, in particular in the US, recommend a detailed analysis of the links between bank balance sheet structure and deposit insurers' losses. In sum, all these considerations confer the key rationale for the three distinctive lines of research presented in this thesis.

1.2. STRUCTURE OF THIS THESIS

This thesis is structured along two distinctive public policy debates in banking, whereby one problem is further decomposed into two different subsets. As a result, one chapter is devoted to each one of the three different lines of research. What is common to these three distinct lines of research is their ultimate focus on banking stability.

Chapter II contains the starting point for the analysis of the relationship between bank market structure, competition and bank soundness using data for 38 countries. Following a detailed review of the vast body of literature on systemic banking crises, the association between bank market structure and competition, and recent studies that examine bank concentration and crises, this chapter empirically tests the hypothesis if greater competition in banking systems gives rise to i) a higher probability of observing systemic

banking crises and b) shorter survival time of banking systems when the level of competition increases. This chapter presents robust evidence for an inverse association of competition with systemic crises and for a positive link between competition and time to banking crises.

Chapter III builds upon the initial findings of the preceding chapter and extends the analysis of bank market structure, competition, and bank soundness to the bank level for a large dataset for ten European countries. To this end, this chapter contains an empirical examination of the hypothesis that competition provides incentives for banks to hold higher capital ratios as buffers against default. The results confirm the previous finding of a positive effect of competition on bank soundness in that we provide robust evidence for a positive association between capital ratios and competition.

Chapter IV takes a different approach to analysing banking stability and focuses on bank liability structure and depositor discipline. This chapter introduces an innovative econometric technique, quantile regression, into the banking literature to evaluate whether costly failures of banks are driven by the same factors that drive low and moderate-cost failures. No evidence is found for a systematic difference among explanatory variables that capture the failed banks' liability structure. However, significant differences exist for variables that capture asset structure. In addition, employing a large dataset for the US banking market, this chapter tests the effect of bank liability structure on time to failure, thus offering a new way of assessing the efficacy of market discipline. Indeed, the results of this exercise offer evidence that both insured and uninsured creditors are a source of market discipline.

Chapter V provides an overall summary to this thesis and reiterates the important policy implications arising from it. It also acknowledges the limitations of the presented research and highlights avenues for future research, some of them already undertaken by the author. The subsequent section presents a brief summary of each chapter.

Chapter II Are More Competitive Banking Systems More Stable?

This chapter presents an empirical analysis of the relationship between bank market structure, the level of competition in the respective banking system, and systemic risk. While previous research in this area relies heavily on measures of concentration, such as

the Herfindahl-Hirschman index and the 3-bank concentration ratio to proxy competition, this chapter disentangles the effect of concentration and competition. Using the Panzar and Rosse (1987) H-Statistic as a measure for competitive conduct, Chapter II presents the first empirical analysis of a non-structural measure of competition in banking systems and banking system fragility on a cross-country level. Both logit and duration models suggest that higher levels of competition are associated with increased banking system soundness. This finding is robust to a broad array of sensitivity checks using different samples and alternative sampling periods. In addition, this result is also confirmed when additional variables that shape the competitive and institutional environment are controlled for. Furthermore, the findings indicate that the positive link between concentration and banking system soundness no longer holds. These results not only provide evidence that concentration and competition describe different characteristics of banking systems but also cast some doubt on policy implications regarding restrictions on banks' competitive conduct presented in the established literature on banking regulation.

Chapter III **Bank Competition, Concentration, and Bank Soundness: New Evidence from the Micro-Level.**

Chapter III makes further important contributions to the literature on banking stability. This chapter adds a whole new dimension to the analysis of the nexus between bank market structure, competition and bank soundness and tests the hypothesis if higher levels of competition, as measured by the Panzar and Rosse (1987) H-Statistic, offer incentives for banks to hold higher levels of capital as buffer against default. In addition, it addresses the endogeneity between measures of market structure, competition, and stability, a phenomenon that has to the best of my knowledge not been recognised in previous work. Moreover, the use of a model for panel data in this chapter not only permits exploiting cross-sectional but also time-series variation of financial institution's competitive conduct. Finally, this chapter contains further evidence that concentration and competition capture different characteristics of banking systems. Chapter III finds robust evidence that banks tend to hold higher levels of capital when operating in a more competitive environment. This finding is insensitive to a broad range of robustness tests with, *inter alia*, alternative samples, an alternative dependent variable, and alternative H-Statistics. Several extensions

substantiate this baseline result as the finding is corroborated when characteristics of the wider financial system such as interindustry competition and depth of the banking system are accounted for. A further extension that controls for design features of the regulatory and institutional environment also reiterates the result indicative for a positive effect of competition on bank capital ratios. In terms of policy implications, these findings highlight that the previously contemplated negative trade-off between competition and bank soundness may not hold for the European countries in the sample. In sum, the results suggest that there is no compelling evidence that would justify bank regulation that curtails bank competition.

Chapter IV Bank Liability Structure, FDIC Loss, and Time to Failure: A Quantile Regression Approach.

Chapter IV considers two separate, but equally important issues of pertinent interest to deposit insurers and regulators. First, this chapter uses quantile regression, to the best of my knowledge not previously used in the banking literature, to disentangle the factors that drive costly bank failures from the factors that drive low and moderate-cost bank failures. This reflects that deposit insurers are particularly concerned about costly bank failures that might pose a systemic threat to the banking system and the deposit insurance fund. Using a dataset of more than 1,000 bank failures in the US during the period 1984 - 1996, the results indicate significant differences between costly and less costly failures for variables that capture composition of the loan portfolio. However, no significant differences are detected for the variables that contain information on the failed banks' liability structure. Furthermore, this chapter uses duration analysis in order to assess the efficiency of market discipline by estimating the effect of different types of liabilities on time to failure for depositories operating in the US during the period 1982 - 1996. To the best of my knowledge, duration analysis has not yet been used for the analysis of market discipline. Importantly, the findings suggest that uninsured deposits such as Fed funds tend to decrease time to failure, thereby providing evidence for the presence of market discipline. Moreover, a number of different types of deposit categories that also embrace insured deposits shorten failure time. This result is indicative for depositor discipline arising from insured depositors, a finding aligned with recent evidence in the literature

(Davenport and McDill, 2006). The policy implication is that bank liability structure deserves greater regulatory scrutiny.

Chapter V Summary, Conclusions, and Future Research

A global summary and concluding remarks that also acknowledge the limitations of this work are presented in Chapter V. An outline of a number of intellectually appealing avenues for future research is finally presented at the end of this thesis.

Chapter II

ARE MORE COMPETITIVE BANKING SYSTEMS MORE STABLE?

ARE MORE COMPETITIVE BANKING SYSTEMS MORE STABLE?

ABSTRACT

This chapter provides the first empirical analysis of the relationship between a direct measure of competitive conduct of financial institutions and banking system fragility on a cross-country level. Using the Panzar and Rosse H-Statistic as a measure for competition in 38 countries during the period 1980 - 2003, we present evidence that more competitive banking systems are less prone to experience a systemic crisis and that time to crisis increases in a competitive environment. Our results hold when concentration and the regulatory and institutional environment are controlled for and are robust to different methodologies, different sampling periods and alternative samples.

2. INTRODUCTION

Bank regulators are concerned that fierce competition among financial institutions is conducive to the build up of banking system vulnerabilities. This is the key rationale for our research on the implications of financial institutions' competitive conduct for the likelihood and timing of systemic banking crises.

While some theoretical studies argue that competition erodes profits and tends to motivate banks to embark upon risky investments (Smith, 1984), others take a diametrically opposite view and argue that banks in uncompetitive, monopolistic markets with intermediate monitoring costs are prone to originate risky loans that set the stage for subsequent problems in the system (Caminal and Matures, 2002). However, due to the absence of sufficiently large datasets on financial institutions' competitive behaviour, hardly any empirical research has been dedicated to this subject matter in a cross-country setting. Consequently, both researchers and policymakers around the world have drawn heavily upon bank concentration as a proxy for competition.

On the other hand, Claessens and Laeven (2004, 2005) argue that competitiveness cannot be captured by concentration as it is an inappropriate measure to gauge the degree of competition.[1] Indeed, they find no supportive empirical evidence for the intuitively anticipated inverse relationship between concentration and competition, and conclude that competition and concentration describe different characteristics of banking systems.[2] Likewise, Cetorelli (1999) reports that competition in banking cannot be determined by simply looking at market structure, since bank behaviour can only be measured accurately through direct empirical analysis of individual bank data. Moreover, relying on concentration as a measure of bank competition gives rise to misleading inferences and measurement problems since concentration measures such as the Herfindahl-Hirschman Index and the 3-bank concentration ratio tend to exaggerate the level of concentration in

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[1] Claessens and Laeven (2004) refer to evidence in the industrial organization literature that underscores that measures of market structure such as the number of institutions and concentration ratios are not necessarily related to the level of competitiveness in an industry.

[2] A growing body of empirical evidence highlights that concentration is a poor proxy for competition. Demirgüç-Kunt et al. (2004) underscore that using national bank concentration measures may be inappropriate to proxy for the competitive environment in the banking industry, and Beck et al. (2006, forthcoming) state that increased concentration and greater contestability are inversely related to the probability of systemic banking crises. They therefore infer that concentration measures something else besides market power.

small sized countries and are increasingly unreliable when the number of banks is small (Bikker, 2004). Therefore, the recent literature according to Berger et al. (2004) differentiates between competition and concentration. However, none of these studies specifically tests for the relationship between competitive conduct of financial institutions and its implications for systemic risk.

In order to address the important questions whether competitive bank behaviour decreases banking system fragility and how the regulatory environment impacts upon the likelihood and timing of systemic banking problems, we analyze empirically the effect of competitive conduct of financial institutions on banking system fragility in a cross-country setting. We argue that the conflicting predictions in the extant literature are largely attributable to the way competition is measured in many previous studies. These studies are often based upon the structure-conduct-performance (SCP) paradigm, which assumes that a certain market structure is related to competitive conduct.[3] In fact, competition is frequently proxied by the degree of concentration in banking systems with the implicit assertion of an inverse relationship between competition and concentration. As highlighted above, this assertion based on the SCP paradigm is however challenged by recent empirical work. In addition, much of the previous literature views both stability and competition as outcomes, determined by the structure of the banking system. However, this study aims to investigate if increased competition gives rise to increased systemic risk. Given that i) concentration is an inappropriate measure for competitive conduct, and ii) assuming that concentration and competition describe different characteristics of banking systems, we therefore argue that it is pertinent to test for the effect of competition on systemic risk, whilst simultaneously considering the impact of the degree of concentration in banking systems.

Our research contributes to the literature in the following four distinctive ways: First, using data for 38 countries over the period 1980 - 2003, we provide the first cross-country investigation of the implications of competitive bank conduct, as measured by the Panzar and Rosse (1987) H-Statistic, on banking system fragility. This method is considered superior to previously used proxies for the degree of competition in the empirical

[3] A detailed overview on the early studies on the linkages between bank market structure and competition is provided by Gilbert (1984).

literature since it describes competitive behaviour of financial institutions using comparative static properties of reduced-form revenue equations based on cross-sectional data. Second, we introduce a methodological advancement in the literature on financial fragility by estimating parametric duration models with time varying covariates in order to examine the timing of systemic banking crises whilst the institutional and regulatory setting is controlled for. While several studies employ discrete choice models based on logit and probit analysis (Eichengreen and Arteta, 2000; Demirgüç-Kunt and Detragiache, 1998, 2005) that compute the probability of observing a crisis at some unspecified point in time, the duration model offers an additional advantage in that it yields estimates for the time until a crisis is observed. Moreover, using time-varying covariates in the duration model accurately accounts for multiple observations per country and can be considered to be more appropriate for the panel data structure of our dataset than commonly utilized discrete choice models. We consider these two modelling techniques to be complementary and believe an evaluation of the hypotheses with two different estimation procedures sheds more light on the relationship between competition and crises than using only one technique on its own. Third, our analysis helps to further disentangle the relationship between competition and concentration by simultaneously incorporating explanatory variables that capture competitive bank conduct and concentration. Previous studies provide evidence for a significant bearing of the level of concentration on the probability of observing systemic crises without testing explicitly for competition. Our research reinvestigates the concentration-fragility nexus and explores whether concentration and competition measure different characteristics of banking systems. Fourth, independently of the investigation of the relationship between competition, fragility and the timing of systemic crises, we analyze the extent to which the regulatory setting impacts on the timing of systemic crises. Incorporating regulatory variables not only provides an additional robustness check for the relationship between competition and fragility, but also sheds light on the impact of the regulatory environment on banking system soundness.

Our findings suggest that competitive behaviour of financial institutions, as measured by the Panzar and Rosse (1987) H-Statistic, not only significantly decreases the probability of systemic banking problems but also provide evidence for increased survival time of

banking systems. We view our results as initial empirical substantiation of the 'competition-stability' view in the theoretical literature. The results for the probability of experiencing a systemic crisis and for time to crisis hold when the level of concentration in the banking system is controlled for, and are robust to a set of robustness checks involving i) alternative samples, ii) different sampling periods, iii) first differences rather than levels for the macroeconomic control variables, and iv) fitting additional variables that capture competition from financial markets and depth of the banking system more directly. Our core result for the positive effect of competitive conduct in banking systems is also robust to controlling for a set of institutional and regulatory variables, which furthermore confirms the evidence indicative for the 'competition-stability' camp in the literature. We find no empirical support for the 'competition-fragility' view, i.e. the view that more competitive systems are more fragile.

The virtual absence of empirical work in a cross-country setting on the relationship between competitive conduct of financial institutions and fragility necessitates that we qualify our results. First, the measure of competitiveness, the Panzar and Rosse (1987) H-Statistic, gauges competition by examining bank behaviour for the period 1994 - 2001. Thus, competitive behaviour is measured in some instances after a crisis surfaced. We therefore utilize different sampling periods and different sample coverage but the results reiterate our finding that more competition is correlated with more banking system stability. Clearly, future research is necessary to shed further light on this relationship. Second, the H-Statistic assumes long-run equilibrium. To evaluate the impact of exogenous shocks in the environment banks operate in, we therefore drop EU countries from the sample to account for such effects. However, omitting countries where the regulatory environment did experience changes does not change our inferences. Third, caution has to be exercised when interpreting the results on the findings obtained in the regressions that control for the regulatory environment. This information has been collected towards the end of the sampling period. However, this only mildly affects the outcome of the H-Statistic on fragility as we obtain largely identical results when excluding regulatory variables. Fourth, the dating scheme for banking crises is important. We therefore utilize an updated version of the widely employed root source for the classification of systemic banking problems provided by Demirgüç-Kunt and Detragiache

(2005). Fifth, the employed duration model assumes a constant hazard rate. To evaluate the sensitivity of our results to this assumption, we use alternative setups for the duration model and again confirm our inferences. Sixth, the analysis presented here does not allow making firm conclusions on causality, i.e. whether competition increases stability in a causal sense; we therefore abstain from interpreting the results in such a way.

The remainder of the chapter is organized as follows. We review the relevant literature on the links between competition, concentration and fragility in Section 2.1. A detailed exposition of the methodology, including the computation of the Panzar and Rosse (1987) H-Statistic and the parametric duration model with time varying covariates is presented in Section 2.2. Section 2.3. provides an overview of the dataset and summary statistics. We report the results and a variety of robustness tests in Section 2.4. Section 2.5 offers concluding remarks.

2.1. LITERATURE REVIEW

Our review of related studies on the question of competition versus stability draws from several strands in the literature. We first focus on the link between concentration and competition. Second, we review studies on concentration and stability. Third, we discuss theoretical and empirical studies on the relationship between competition and stability. The final section briefly surveys the literature on the implications of the regulatory and institutional environment for financial system soundness.

2.1.1. CONCENTRATION AND COMPETITION

The empirical literature on the direct relationship between competitive conduct of financial institutions and its bearing for concentration is comparatively short.[4] This is surprising, given that issues of competition and concentration in the banking industry are

[4] We constrain our review on the key studies that focus on the direct link between measures of competition and concentration. A variety of other studies on the relationship between concentration and competition in a wider sense exists and is reviewed in detail by Berger et al. (2004). For example, Berger and Hannan (1989) and Neumark and Sharpe (1992) examine the effect of concentration on the pricing of banking services, whereas Berger (1995) and Frame and Kamerschen (1997) consider concentration to be a function of scale and X-efficiencies. DeYoung et al. (2004) and Berger and Udell (2002), among others, discuss the role of different types and sizes of institutions for their competitive conduct. The ownership-competition nexus is explored in depth by DeYoung and Nolle (1996), Berger et al. (2000), Claessens et al. (2001) and Berger, Hasan and Klapper (2004). Petersen and Rajan (1995) review the consequences of competition and concentration for credit availability and economic growth and further empirical work on this link is presented by, among others, Jayaratne and Strahan (1996, 1998), Cetorelli (2003), and Berger, Hasan and Klapper (2004).

heavily debated by policymakers. Bikker (2004) underscores that concentration may impact on competition and that increasing size of financial firms has substantial bearing for financial stability. Following an approach pursued in the industrial organisation literature, he proposes that competition can be measured by the Panzar and Rosse (1987) H-Statistic. In order to test the effect of concentration on competition, Bikker and Haaf (2002) regress the H-Statistic on a variety of concentration indices and the number of banks in a sample of 23 industrialized countries and find that increasing concentration significantly decreases competition across a number of different model specifications. Contrary to these results, drawing upon a sample of 50 countries, Claessens and Laeven (2004) use four different models to compute the H-Statistic and report that their analysis provides empirical support for a positive association of concentration and competition. Their findings are robust to the incorporation of regulatory variables that capture contestability of the banking systems in the countries under consideration. Claessens and Laeven (2004) conclude that the degree of concentration may be a poor indicator for the competitive environment banks operate in. Likewise, Staikouras and Koutsomanoli-Fillipaki (2006) report that EU countries have experienced a substantial increase in competition (measured by the Panzar and Rosse (1987) H-Statistic) during the period 1998 - 2002, while they simultaneously find evidence for higher levels of concentration in European banking systems. Carbo et al. (2006) compare different measures of market power in European banking and reiterate that there is little relationship between measures of market structure, such as the Herfindahl-Hirschman Index, and the H-Statistic. Thus, measures of competition cannot be substituted by measures of concentration. Finally, drawing upon simplified numerical examples, Cetorelli (1999) shows that merger activity among banks can break up collusive arrangements, thereby restoring market competition. Using Italian bank data, he also highlights that increases in concentration measures give rise to seriously misleading inferences regarding the exercise of market power. This is supported by his empirical results which contradict the SCP paradigm regarding the inverse relationship between concentration and competition.

Consequently, the case for using concentration as a proxy for competition can be seriously disputed. This is critical for the inference of policy implications since concentration does not necessarily imply the lack of competition as factors other than competition may drive

concentration. For instance, regulatory initiatives to increase capital may spark off a wave of mergers that considerably increases the level of concentration in the industry.

2.1.2. CONCENTRATION AND STABILITY

Two distinct strands in the literature reflect contrasting views on the relationship between concentration and stability. In theoretical models, Allen and Gale (2000, 2004) exemplify that financial crises are more likely to occur in less concentrated banking systems. This is due to the absence of powerful providers of financial products that can reap benefits from high profits that serve as a cushion against asset deterioration. A similar view is taken by Boot and Greenbaum (1993) who highlight that increasing bank charter values arising from increased market power create incentives for bank managers to act prudently thereby contributing to higher bank asset quality. These institutions are also considered to be easier to monitor from a regulatory perspective.

These theoretical studies have been substantiated by empirical work. Paroush (1995) argues that increases in market power arising from diversification benefits of bank mergers suggest higher bank stability. Benston et al. (1995) also investigate bank mergers in the US and report that pre-merger variance of target bank earnings and the pre-merger covariance between target and acquiring bank earnings show a negative association with bid prices, thereby underlining the hypothesis that increases in market power contribute to financial stability. Similar results for mergers of US banks are obtained by Craig and Santos (1997), who analyze post-merger profitability and post-merger risk. Recent work by Beck et al. (2006, forthcoming) using a cross-country dataset on 69 jurisdictions provides strong empirical evidence that is consistent with the 'concentration-stability' view. They report that increases in national bank concentration do not feed into increased fragility of the banking system and that the results are robust subject to a broad array of sensitivity tests. In addition, they show that less contestable markets, approximated by a set of regulatory variables such as activity restrictions for banks, are more prone to experience episodes of systemic crises. However, while this study provides suggestive evidence that regulatory policies that impede competition are undesirable from a financial stability viewpoint, the study falls short in presenting evidence for the effect of financial institutions' competitive behaviour on banking system stability. An analysis of the underlying mechanisms substantiates that concentration cannot be considered as a proxy for less competition as

their results hold when controlling for institutional and regulatory variables supportive of contestable markets (Beck et al., forthcoming).

Contrary to this 'concentration-stability' view, Boyd and de Nicoló (2005) allow for competition in loan markets and illustrate that institutions' ability to charge higher interest rates increases in more concentrated markets. This implies higher borrower default rates, a phenomenon that is amplified by moral hazard on the part of the borrowers, who themselves then increasingly engage in risky projects. Boyd and de Nicoló (2005) show that the effect from the lending market dominates and ultimately gives rise to greater vulnerabilities. Mishkin (1999) also holds that more concentration increases systemic risk. He contemplates that banking systems with a limited number of large institutions are more likely to be subject to regulators' 'too big to fail' policies that encourage risk-taking behaviour of banks.

Research by de Nicoló and Kwast (2002) scrutinizes the correlation between Large and Complex Banking Organizations (LCBOs) in the US to draw inferences about correlated exposures and hence the presence of systemic risk. The authors detect increasing return correlations during the sampling period 1988 - 1999 and interpret this as a sign for increased systemic risk. This view is subsequently substantiated by de Nicoló et al. (2004). Using an alternative measure for systemic risk, an aggregate Z-index that gauges the joint probability of failure of the five largest banking firms in a country for the period 1993 - 2000 and drawing upon a cross-country dataset, the study presents evidence for a positive relationship between concentration and banking system fragility. Boyd and Graham (1991, 1996) also provide weak support for this view by examining failures of large financial institutions in the US and test whether large banks fail more frequently than smaller institutions. They report that large banks failed more often than smaller banks over the entire sampling period of 1971 - 1994. However, splitting the sample in different sub-samples gives rise to a more mixed picture such that it becomes difficult to establish firm conclusions.

2.1.3. Competition and Stability

In a similar vein to the studies on concentration and fragility where the two conflicting views hold that concentration either increases or decreases stability, we observe a similar

pattern in the literature on competition and stability. Carletti and Hartmann (2003) provide an in-depth survey of this literature.

Matutes and Vives (1996) argue that instabilities can arise in any kind of market structure as depositors' propensity to run is determined exogenously by their expectations in the sprit of the Diamond and Dybvig (1983) model. In contrast, Smith (1984) puts forward a theoretical exposition of how increasing competition for bank deposits gives rise to vulnerabilities in the system. Besanko and Thakor (1993) illustrate that banks decide on risky portfolio strategies when competition stiffens. Taking the design of deposit insurance schemes into consideration, Cordella and Yeyati (1998) show that risk-based deposit insurance restrains risk-taking behaviour of financial institutions even in the presence of increased competition whereas fierce competition in an environment with flat-fee deposit insurance translates into higher risk in the system. Similarly, Matutes and Vives (2000) also investigate bank risk-taking behaviour and deposit insurance. They additionally consider social costs associated with bank failures and find that excessive competition gives rise to maximal bank risk in the absence of risk-based deposit insurance. Likewise, Hellman et al. (2000) contemplate that accelerating competition makes financial institutions embark upon riskier investments but that capital requirements and deposit rate ceilings can help restore prudent bank behaviour.

With exception of the study by Matutes and Vives (1996) all the aforementioned theoretical studies imply a positive association between competition and fragility, and we therefore refer to this strand as 'competition-fragility' literature. Using a model of mean-shifting investment technologies, Koskela and Stenbacka (2000) demonstrate however that there need not be a trade-off between competition and stability. They show that permitting competition in loan markets reduces lending rates and generates higher investments without a simultaneous rise in the equilibrium borrower default rate. Caminal and Matures (2002) illustrate that monopoly banks with intermediate monitoring costs can be more prone to originate risky loans that give rise to higher probability of subsequent failure. Similarly, Nagarajan and Sealey (1995) illustrate that forbearing regulatory policies are likely to decrease the quality of bank assets. Using a dynamic duopolistic model, Perotti and Suarez (2002) investigate potential failure of financial firms due to competition and argue that the failed institution can be either closed or merged with another agent.

They show that an active merger policy by the regulatory agency which encourages takeovers of failed institutions contributes to banking stability. This is due to the fact that the surviving bank will benefit from the failure if no new competitor enters the market. This consequence is referred to as the 'last bank standing' effect. The effect strengthens the institution's incentive to act prudently as higher rents can be generated if the competitor fails. The three latter studies can thus be assigned to the 'competition-stability' strand in the literature.

Allen and Gale (2004) however argue that the relationship between competition and financial stability is multifaceted and that a mere consideration of the trade-off between competition and stability is inappropriate. Rather, they identify the efficient levels of both competition and stability by reviewing a number of different theoretical models and conclude that different models yield different answers. Allen and Gale (2004) maintain that perfect competition propels the socially optimal level of stability if financial markets and contracts between customers and intermediaries are complete. In a number of other instances however, where deposit insurance is present or where institutions compete heavily for deposits due to increasing returns to scale, competition tends to weaken bank soundness. Finally, they highlight that fragility also depends on the structure of the interbank market: Contagion effects arising from small liquidity shocks in a perfectly competitive interbank market where all institutions are price takers can force all the banks to liquidate assets. Similar to Allen and Gale (2004), Boyd et al. (2004) also put forward that the probability of observing a banking crises does not only dependent on the degree of competition. Rather, monetary policy is a major determinant as well. Monopolistic banking systems are found to be more fragile if the rate of inflation is below a certain threshold, whereas more competitive banking markets are more vulnerable if inflation is above this threshold.

The empirical literature is largely characterized by studies that focus on one or two individual countries. Influential work by Keeley (1990) finds a highly significant relationship between the erosion of bank charter values in the US and increased competition and hence offers empirical support for the 'competition-fragility' hypothesis. Bordo et al. (1995) embark on a comparison of the Canadian and US banking system between 1920 and 1980 and report that Canadian banks failed less often than US

institutions, a finding they assign to the oligopolistic structure of the Canadian banking system. Capie (1995) reviews stability and efficiency in the UK banking market between 1840 and 1940 and concludes that a less competitive environment contributed to a period during which no major disruptions surfaced. Hoggarth et al. (1998) contrast the German and UK banking systems over the past few decades and report that profits in the UK were higher, but also more variable than in Germany and infer that the less competitive German system can be perceived to be more stable. Finally, Staikouras and Wood (2000) run similar analyses for Greece and Spain and find that Spanish institutions are more profitable and more stable than Greek banks.

Assigning the empirical studies to either the 'competition-fragility' literature or to the 'competition-stability' literature is more ambiguous than for the theoretical research. The work by Keeley (1990), Capie (1995), Bordo et al. (1995) and Hoggarth et al. (1998) can be classified into the 'competition-fragility' literature suggesting a possible trade-off between competition and stability, while the paper by Staikouras and Wood (2000) is a prime example of empirical analysis finding no such trade-off.

2.1.4. Regulation, Supervision and Stability

Fischer and Chenard (1997) explore the link between liberalization, regulation, and stability. They offer both theoretical and empirical evidence that banking system deregulation increases systemic risk which they attribute to, *inter alia*, intensified competition in the aftermath of deregulation and the increased contestability of the banking systems under consideration. Similarly, Drees and Pazarbasioglu (1998) state that the Nordic banking crises coincided with a period of liberalization in the respective countries' financial systems that gave rise to unsustainable behaviour by lenders and borrowers. By contrast, Barth et al. (2004) draw on a large database on financial regulation and supervision to investigate the regulatory environment that sets the stage for systemic banking crises, and document that less contestable banking systems with higher entry barriers and activity restrictions exhibit higher degrees of fragility, a finding corroborated by Beck et al. (2006, forthcoming). Barth et al. (2004) hypothesize that the lower propensity to suffer systemic problems in more contestable markets with fewer restrictions imposed upon institutions is attributable to higher levels of efficiency of financial institutions operating in such an environment. This finding suggests that contestability of

markets and the supervisory framework play a role in the likelihood of observing systemic problems. However, the variables that aim to capture contestability of the market in these studies may not adequately control for the legal and institutional environment that financial institutions operate in. This would explain the contradicting conclusions drawn by Fischer and Chenard (1997) on the one hand and by Barth et al. (2004) on the other. Thus, little agreement has been reached as to whether contestability and strengthening of the regulatory framework of banking systems contributes to banking stability. We therefore consider the findings that more contestable markets and fewer restrictions are supportive of financial stability as tentative in nature. In fact, related research by Podpiera (2004) that investigates the relationship between compliance with Basel Core Principles for Effective Banking Supervision and banking sector performance as measured by nonperforming loans and net interest margins puts forward that greater compliance with Basel Core Principles significantly improves bank asset quality, even after controlling for the level of development of the country and the macroeconomic setting. However, his study does not account for the contestability of the banking systems under consideration.

In summary, the review of several related studies on the links between concentration and competition, regulation, and stability indicates that neither theoretical work nor empirical research provides clear-cut answers to the question whether competition increases or decreases financial stability. The assertion of trade-offs between competition and financial stability is challenged by recent advancements in the theoretical literature. In addition, empirical research to date is largely dominated by studies on individual countries and the virtual absence of cross-country studies involving more than two jurisdictions renders the literature and the findings to be far from conclusive.

2.2. METHODOLOGY

We utilize two different estimation procedures to assess the relationship between competition and stability, and also provide an exposition of the Panzar and Rosse (1987) measure of competition.

2.2.1. DURATION ANALYSIS

First, we introduce a parametric duration model with time-varying covariates to investigate the timing of systemic banking crises. While duration analysis has been used on the micro

level to estimate the 'time until failure' of banks (Lane et al., 1986; Whalen, 1991) we are not aware of any macro level studies that draw upon this methodology. We therefore review some key characteristics of duration analysis.

Our duration model measures the time to transition from a sound banking system to the occurrence of a systemic crisis. The crucial difference from the frequently employed logit models (Demirgüç-Kunt and Detragiache, 1998, 2005) presented in the subsequent section is as follows: Logit models yield the unconditional probability of observing a banking crisis in a certain jurisdiction and all observations are 'stacked' such that the panel data structure is not appropriately accounted for. By contrast, duration models with time-varying covariates, if interpreted in the proportional hazards metric, provide the conditional probability of observing a banking crisis at point t, given that no such crisis has occurred in the country until period t.

The time until a crisis is observed can be formalized as a probability density function of time t. A convenient way of describing survival of a banking system past time t is through its survivor function

$$S(t) = P(T \geq t) \tag{1}$$

which equals one minus the cumulative distribution function of T. Therefore, we can compute the conditional probability of leaving the state of being a sound banking system within the time interval t until $t + h$, given survival until time t, as

$$P\{t \leq T \langle t \langle t + h | T \geq t\}. \tag{2}$$

This probability can be divided by h, to calculate the instantaneous rate of failure, i. e. the average probability of leaving per unit time period over the interval t until $t + h$ such that the hazard function can be written as

$$\lambda(t) = \lim_{h \downarrow 0} \frac{P\{t \leq T \langle t \langle t + h | T \geq t\}}{h} = \frac{-d \log S(t)}{dt} = \frac{f(t)}{S(t)} \tag{3}$$

In the econometric literature, researchers frequently assume a proportional hazards specification, where

$$\lambda(t, X(t), \beta) \lim_{h \downarrow 0} \frac{P\{t \leq T \leq t + h | T \geq t, X(t), \beta\}}{h} = \lambda_o(t) \exp(\beta' X_t) \tag{4}$$

whereby X denotes our time-varying explanatory variables, β is the vector of parameters to be estimated, $\lambda_0(t)$ is the baseline hazard function and $\exp(\beta' X_t)$ provides a convenient interpretation of the coefficients due to its non-negativity. The baseline hazard $\lambda_0(t)$ determines the shape of the hazard function with respect to time. We estimate the duration model based on the exponential distribution. This form assumes a constant hazard rate over time. This is justified given that countries, contrary to individuals or firms, do not exhibit a life cycle. Thus, the hazard of experiencing a systemic banking crisis does not depend on the 'age' of a country. Previously employed duration models in the finance literature frequently use constant covariates from the beginning of the measurement period t_0 to the time of the measurement $T = t$. This is a problem as it would be inappropriate to assume that the macroeconomic setting remains constant during the entire sampling period. In order to overcome this limitation, we further expand the methodology by using time-varying covariates (Petersen, 1986). The model is then estimated using the maximum likelihood estimation technique.

We observe 38 countries over the period 1980 - 2003. A country's duration is determined by the number of spans it remains in the dataset. Thus, the minimum duration is $t = 1$ if the banking crisis was experienced in the first span and the maximum duration is $t = 23$ if the crisis occurred in 2003 or if the country never records a crisis.[5] In addition, in countries that have never experienced a systemic crisis, our duration data are 'right censored', in the sense that the studied event has not occurred during the sampling period. The initial setup of our dataset with up to 23 time spans per country is well suited for duration analysis with time-varying covariates as the hazard function is modelled as a step function with different values for the covariates through the intervals between $t = 0$ and $t = t_i$, the terminal value of the observation, at which either censoring or exit takes place.

Coefficients can be reported in the accelerated failure time metric or in the proportional hazards metric when estimating exponential duration models since they can be parametrized in the form

[5] Since duration analysis focuses on time spans for each country rather than 'physical' observations, the estimator utilizes data from the end of the first span and consequently disregards the values of the first observation.

$$\ln(t_j) = \beta_0 + x_j\beta_x + \varepsilon_j \tag{5}$$

as accelerated failure time model or in the corresponding hazard metric as

$$h(t|x_j) = h_0(t)\exp(\beta_0 + x_j\beta_x) \tag{6}$$

Since we are interested in time to failure, we report our coefficients in the accelerated failure time metric. These models are called 'accelerated failure time models' (AFT) because the effect of the independent variables is to accelerate or decelerate time to crisis. In accelerated failure time models, a distribution is assumed for

$$\tau_j = \exp(-x_j\beta_x)t_j \tag{7}$$

and $\exp(-x_j\beta_x)$ is usually referred to as the acceleration parameter. We can rearrange (7) such that

$$t_j = \exp(x_j\beta_x)\tau_j \tag{8}$$

and therefore write

$$\ln(t_j) = x_j\beta_x + \ln(\tau_j). \tag{9}$$

The exponential accelerated failure time model assumes $\tau_j \sim$ Exponential{exp(β_0)} with mean exp(β_0) such that

$$\ln(t_j) = x_j\beta_x + \ln(\tau_j) \tag{10}$$

$$\ln(t_j) = \beta_0 + x_j\beta_x + u_j \tag{11}$$

where u_j follows the extreme-value distribution. Transforming the proportional hazards metric to the accelerated failure time metric in an exponential duration model is thus merely one of flipping the signs of regression coefficients (Cleves et al., 2004).

2.2.2. LOGISTIC PROBABILITY ANALYSIS

Second, we also estimate a more commonly used logit probability model that takes the form

$$LnL = \sum_{t=1\ldots T}\sum_{i=1\ldots n}\{P(i,t)\ln[F(\beta'X(i,t))] + (1-P(i,t))\ln[1-F(\beta'X(i,t))]\} \tag{12}$$

where $P(i,t)$ is a dummy variable that takes on the value one when a systemic banking crisis is observed or zero otherwise. The parameter β is the vector of coefficients to be estimated and the explanatory variables are denoted by $X(i,t)$. Due to the common use of this model, we refrain here from a more detailed exposition of this estimator and refer the interested reader to the work by Demirgüç-Kunt and Detragiache (1998, 2005). In terms of comparability between the two modelling techniques, it has to be recognized that the duration model draws on a fewer number of crisis observations due to the fact that it focuses on spans of time and disregards the values of the first observation per country. We do not consider this as a major impediment to our analysis, as we regard the two methodological approaches as complementary, which is corroborated by our findings.

2.2.3. PANZAR AND ROSSE (1987) H-STATISTIC

The H-Statistic, frequently used in the 'new empirical industrial organization literature,' is designed to discriminate between competitive, monopolistically competitive, and monopolistic markets. Claessens and Laeven (2004, 2005) argue that the H-Statistic is a more appropriate measure for the degree of competition than previously used proxies for competitive conduct. Studies by Shaffer (1982, 2004b), Molyneux et al. (1994, 1996), Vesala (1995), Nathan and Neave (1989), DeBandt and Davis (2000), Bikker and Haaf (2002), Coccorese (2004), Staikouras and Koutsomanoli-Fillipaki (2006), Al-Muharrami et al. (2006), Carbo et al. (2006) and Trivieri (forthcoming) also use this approach.[6] Shaffer (2004a) argues that the analytical strength and superiority of the H-Statistic over previously used measures of competition in the empirical banking literature is based on its formal derivation from profit-maximizing equilibrium conditions. Moreover, the statistic is robust with respect to the market since it only draws upon characteristics of reduced-form revenue equations at the firm level. Its limitation lies in the fact that the statistic assumes long-run equilibrium. However, it is important to note that a resulting disequilibrium does not necessarily invalidate the results obtained with this methodology. Rather, rejection of equilibrium indicates that the industry is developing dynamically during the sampling period (Shaffer, 2004b).

[6] Staikouras and Koutsomanoli-Fillipaki (2006) provide a summary of the literature of the studies that employ the Panzar and Rosse (1987) methodology and their main findings.

The measure is based on a general banking market model which determines equilibrium output and the number of institutions by maximizing profits at the firm and at the industry level. Precisely, bank i maximizes profit when marginal revenue equals marginal cost

$$R_i'(x_i, n, z_i) - C_i'(x_i, w_i, t_i) = 0 \tag{13}$$

whereby R_i' denotes revenues and C_i' refers to costs of bank i. Output of bank i is denoted by x_i and n characterizes the number of institutions. The term w_i is the vector of m input prices for bank i and z_i and t_i are vectors of exogenous variables that shift the banks' revenue and cost functions respectively. Adopting similar line of reasoning for the market level yields the following equation such that the zero profit condition constraint is maintained

$$R_i^*(x^*, n^*, z) - C_i^*(x^*, w, t) = 0 \tag{14}$$

where the asterisks denote equilibrium values. Under perfect competition, increases in input prices cause marginal costs and total revenues to increase by the same amount as the costs increase. By contrast, under monopoly condition, increases in input prices raise marginal cost, reduce equilibrium output, and thereby reduce total revenue. The H-Statistic measures market power by the extent to which a change in factor input prices, (dw_{k_i}), translates into equilibrium revenues, (dR_i^*), earned by bank i. In short, the H-Statistic is a measure of the sum of the elasticities of the reduced-form revenues with respect to factor prices and it is computed as

$$H = \sum_{k=1}^{m} \frac{\partial R_i^*}{\partial w_{k_i}} \frac{w_{k_i}}{R_i^*}. \tag{15}$$

Vesala (1995) has shown that the H-Statistic is an increasing function of the demand elasticity, suggesting that as H increases the less market power is exercised on the part of the banks.[7] This implies that the H-Statistic is not only useful in rejecting certain types of market behaviour, but that the magnitude of the H-Statistic can serve as a measure for the degree of competition. As a consequence, a continuous interpretation is appropriate (e.g. Vesala, 1995; Bikker and Haaf, 2002; Claessens and Laeven, 2004, 2005; Carbo et al.,

[7] Claessens and Laeven (2005) also underscore that the magnitude of the H-Statistic can be interpreted as an inverse measure of the degree of monopoly power (or, alternatively, as a measure of the degree of competition).

2006). Thus, the magnitude of H can be perceived as a measure of competition and interpretation is straightforward:

$H \leq 0$	indicates monopoly equilibrium[8]
$0 < H < 1$	indicates monopolistic competition
$H = 1$	indicates perfect competition

2.3. DATA AND SUMMARY STATISTICS

We focus on a set of 38 countries during the period 1980 - 2003 for the empirical analysis. The sample is slightly smaller than in previous studies on systemic banking problems since we have to constrain the sample to countries for which the H-Statistic as computed by Claessens and Laeven (2004) is readily available. Descriptive statistics for the entire set of variables are presented in Table 2.1. A detailed explanation of the variables and their sources is provided in the Data Appendix to Chapter II.

[8] In addition, a negative value for the H-Statistic can also indicate a perfectly colluding oligopoly or a conjectural variations short-run oligopoly (assumptions about firms' expectations towards price and quantity reactions to strategic moves of competitors are called conjectural variations) since increases in input prices under these conditions will increase marginal costs, reduce equilibrium output and finally reduce total revenue of the banking firm (Molyneux et al., 1994, 1996). However, it is noteworthy to mention that we never find negative values for the H-Statistic, neither in Chapter II nor in Chapter III of this thesis.

Table 2.1. Descriptive Statistics

	N	Mean	Std.Dev.	Minimum	Maximum
GDP growth (real)	798	3.20	3.13	-13.13	14.82
Real interest rate	738	1.59	25.49	-558.91	48.86
Inflation	798	16.67	83.40	-16.33	2076.79
Terms of Trade	718	-0.72	33.98	-607.00	622.00
Depreciation	798	19.14	116.21	-320.37	2421.59
M2/Reserves	677	10.06	9.37	0.78	59.48
Credit growth (real)	730	73.76	171.60	-256.35	1421.95
Moral hazard index	762	1.41	0.72	0.00	2.03
Concentration	798	0.47	0.13	0.16	0.69
H-Statistic	798	0.67	0.12	0.41	0.92
British legal origin	798	0.16	0.36	0	1
French legal origin	798	0.51	0.50	0	1
German legal origin	798	0.03	0.17	0	1
Scandinavian legal origin	798	0.02	0.15	0	1
Activity restrictions	774	9.36	2.59	5	15
Capital regulatory index	774	5.94	1.45	3	9
Government ownership	750	0.47	0.34	0	1
Foreign ownership	510	0.18	0.24	0	0.95
Entry restrictions	759	7.48	0.70	6	9
Accounting index	585	61.98	10.55	36	78
Rule of law	662	4.16	1.62	1.25	6

GDP growth is the rate of real growth of the Gross Domestic Product. Real interest rate is the nominal interest rate minus the rate of inflation. Inflation is the rate of change of the GDP deflator. Terms of trade is the change in net barter terms of trade. Depreciation is a measure of the change of the exchange rate. M2/Reserves measures the ratio of broad money over international reserves. Credit growth (real) is the rate of growth of domestic credit divided by the GDP deflator. Moral hazard index is the first principal component of a variety of deposit insurance design features as detailed in the Data Appendix to this chapter. Concentration measures the proportion of assets held by the three largest institutions in a country, averaged over the sampling period 1980 - 2003. H-Statistic is a measure of competitiveness in the banking industry. British, French, German and Scandinavian legal origin are dummies that take on the value one if a country's legal system has British, French, German or Scandinavian origin or zero otherwise. Activity restrictions is an index variable that measures barriers to entry into different banking activities (securities, insurance, real estate and ownership of non-financial firms). Capital regulatory index is a variable that captures capital stringency in the industry. Government and foreign ownership measure the proportion of ownerships rights held by the government and foreign entities respectively. Entry restrictions captures the contestability of the banking system and the accounting index is a proxy for the level of information disclosure to shareholders. Rule of law is a measure for the strength of the institutional environment.

Our crisis variable is a dummy that takes on the value one if a systemic banking crisis surfaced in the particular year of observation or zero otherwise. We use the widely employed Demirgüç-Kunt and Detragiache (2005) dating scheme as source for episodes of systemic banking problems. Accordingly, one of the following criteria has to be met by a country to be classified as having experienced a systemic crisis: i) emergency measures such as deposit freezes or bank holidays are implemented; ii) large-scale bank nationalizations take place; iii) non-performing assets reach at least 10 percent of total assets; iv) fiscal cost of the rescue operations reach 2 percent of GDP. Following these classifications and depending on the model specification, we record up to 28 systemic crises between 1980 and 2003 that can be utilized for the logit model. We present an

overview of these countries in Table 2.2. The number of counts for the duration analysis is slightly lower, depending on the model specification because the duration model focuses on the span of time between two records rather than actual 'physical' observations. Thus, the estimator captures the information at the end of the span and therefore disregards values of the first observation per country in the initial dataset. The differing number of observations between the duration and the logit model is entirely due to the different setup of the data for the duration model.[9] The dependent variable in the duration models is the log of the time to crisis, whereby the crisis dating follows the exposition provided above.

Information on the H-Statistic as measure for competitiveness is taken from Claessens and Laeven (2004). They derived the statistic along the lines presented in Section 2.2.3. and also test for long-run equilibrium. Using data for the period 1994 - 2001, Claessens and Laeven (2004) compute this competitiveness measure and include all commercial, savings, co-operative banks and bank holding companies across a sample of 50 countries. Note that computation of the H-Statistic involves the inclusion of bank-specific control variables such as the ratio of capital to total assets and the ratio of loans to total assets that aim to capture bank risk.[10] This is important as the measure of competitiveness would otherwise be subject to omitted variable bias.[11]

We use their sample as a starting point and exclude countries for which we do not have a sufficient number of observations for the explanatory variables and transition economies as including them would distort estimation. We record 38 countries that satisfy our sampling criteria. Table 2.2. suggests that monopolistic competition is the most appropriate way of describing the level of competition in the countries of study. While our sample tracks back until 1980, the information on the measure of competitiveness is only available for the more recent period and we therefore assume it to be constant over the sampling period. This is justified, given the following five arguments: First, no dataset other than the one by Claessens and Laeven (2004) offers information on a sufficiently

[9] For details on the setup of the data and the different notion of 'sample size' in duration modelling see Cleves et al. (2004).

[10] See also Molyneux et al. (1996).

[11] Employing four different estimation techniques and averaging the results provides close estimates of the H-Statistic for each jurisdiction, see Claessens and Laeven (2004). We refer the interested reader to the work by Claessens and Laeven (2004) and the literature cited therein for additional details.

large cross-country sample that can be utilized for the purpose of our study. Second, the regulatory and supervisory environment, found to be a major determinant for the degree of competition by Claessens and Laeven (2004), has not undergone major changes according to Barth et al. (2001) in the aftermath of banking problems. By extension, we therefore argue that the level of competition has likewise not seen much change over time. Third, Beck et al. (forthcoming) contemplate that in instances where the regulatory environment has changed, it was modified towards less rather than more regulation. This therefore biases our results against finding a positive relationship between competition and systemic banking fragility. Fourth, recent work by Barth et al. (2005) indicates that no considerable alterations in the regulatory environment have taken place since the initial survey by Barth and his co-authors in 1999. This reinforces our assumption that the competitive environment has likewise remained stable over time. Fifth, we perform a variety of sensitivity tests using alternative sampling periods and alternative samples that confirm our conjecture that the H-Statistic can be assumed to be constant over time as our inferences are insensitive to these alternative specifications.

Table 2.2. Banking Sector Crises†

Country	Crisis Episodes	H-Statistic	Standard Error
Argentina	1980-82, 1989-90, 1995, 2001-02*	0.73	0.06
Australia		0.80	0.11
Austria		0.66	0.04
Bangladesh		0.69	0.13
Belgium		0.73	0.05
Canada		0.67	0.07
Colombia	1982-85, 1999-00	0.66	0.08
Costa Rica	1994-97 *	0.92	0.05
Denmark		0.50	0.05
Ecuador	1995-02*	0.68	0.09
France		0.69	0.02
Germany		0.58	0.02
Greece		0.76	0.07
Honduras		0.81	0.11
Hong Kong, China		0.70	0.07
India	1991-94**	0.53	0.04
Indonesia	1992-95**, 1997-02 *	0.62	0.06
Italy	1990-95	0.60	0.03
Japan	1992-02*	0.47	0.17
Kenya	1993-95	0.58	0.11
Luxembourg		0.82	0.04
Malaysia	1997-2001	0.68	0.06
Mexico	1982, 1994-97	0.78	0.10
Netherlands		0.86	0.06
Nigeria	1991-95	0.67	0.06
Norway	1987-93	0.57	0.08
Pakistan		0.48	0.13
Panama	1988-89	0.74	0.09
Paraguay	1995-99	0.60	0.22
Philippines	1981-87, 1988-02 *	0.66	0.05
Portugal	1986-89	0.67	0.06
South Africa	1985	0.85	0.05
Spain		0.53	0.03
Switzerland		0.67	0.03
Turkey	1982, 1991, 1994, 2000-02 *	0.46	0.21
United Kingdom		0.74	0.04
United States	1980-92	0.41	0.01
Venezuela	1993-97	0.74	0.07

†Episodes for the occurrence of systemic banking crises are taken from Demirgüç-Kunt and Detragiache (2005). * indicates that the crisis is still going on as at 2005. A four-year duration of a crisis is indicated by **.

The fact that previous studies rely upon concentration as a proxy for competition and report a significantly negative association between concentration and the likelihood of suffering systemic crises suggests that we enter concentration into our regression equations. While this may give rise to multicollinearity problems, it is a way to investigate if the contemplated link between concentration and fragility holds when competitive conduct of financial institutions is included in the equations.[12] Earlier empirical results on the concentration-fragility nexus would have to be re-evaluated, if concentration is not longer found to be significant in our analyses. Furthermore, this would lend empirical support to the assertion that concentration and competition are two different concepts.

[12] The correlation between concentration and the H-Statistic is 0.15; see Appendix 2.A., Panel A.

We therefore use a concentration variable obtained from Beck et al. (2006, forthcoming) who retrieve information on the market share of the three largest institutions in each country in their sample from BankScope and average it for the period 1988 - 1997 to smooth out coverage problems. Following this approach, we moreover incorporate concentration ratios using additional data for the years 1998 - 2003 to widen the coverage.

We also include the following commonly employed macroeconomic control variables in the model specifications: GDP growth (real), the real interest rate, the rate of inflation, changes in the terms of trade, changes in the foreign exchange rate, the ratio of M2 to gross foreign reserves and credit growth (real). To avoid simultaneity problems, we lag all these macroeconomic variables by one period. We also account for the finding by Demirgüç-Kunt and Detragiache (2002) that generously designed deposit insurance schemes tend to weaken bank stability and incorporate their moral hazard index. This index is computed as the first principal component of eight deposit insurance design features that are modelled using dummy variables that capture coinsurance, foreign and interbank deposit coverage, type and source of funding, management, membership and the level of explicit coverage. We also consider regressors that capture origin of a country's legal system. This is due to the fact that La Porta et al. (1998) contemplate that legal origin is a major determinant for the legal protection of creditor rights which, in turn, play a key role for the financial system of a country. Furthermore, Beck et al. (2003) argue that these proxies ought to be controlled for when analyzing the performance of banking systems since legal origin helps explain cross-country differences in financial development.

To provide additional robustness tests for the relationship between competition and fragility, we also test for the effect of including a variety of regulatory and institutional variables. If consideration of these variables diminishes the significance of the H-Statistic in our results, we could conclude that the relationship between competition and fragility may be spurious and attributable to the failure to control for the regulatory and institutional environment. Moreover, as we are also interested in learning whether or not the timing of banking crises depends on the design features of the regulatory environment, we incorporate variables that capture the regulatory and institutional setting in which banks operate in. As a consequence, we investigate the effect of proxies for the degree of contestability of banking markets such as entry restrictions, activity restrictions and a

capital regulatory index. In addition, we control for the strength of institutions, as measured by the rule of law, and for an accounting index that captures average information disclosure as a proxy for market discipline. This reflects that the new Basel Capital Accord highlights in Pillar 3 the importance of market discipline for curtailing risk-taking behaviour of financial institutions (Nier and Baumann, 2006). Detailed explanations for these regulatory variables are provided in the Data Appendix to Chapter II and by Barth et al. (2004). While information on the regulatory environment was collected towards the end of the 1990s, Barth et al. (2001, 2004) put forward that the regulatory environment has not undergone substantial change over time. The assertion by Barth et al. (2001, 2004) is also substantiated by Podpiera (2004) who argues that the application of core principles of supervision and regulation is unlikely to change bank performance in the short run as there is a considerable time lag between changes in regulation and supervision and when they are observable in banking system performance.

Subsequently, we consider the implications of the regulatory and institutional variables in terms of their impact upon survival time of banking systems. Since the relationship between the probability of suffering a crisis and these regressors is reversed, we do not discuss this here for brevity. An index of activity restrictions obtained from Barth et al. (2004) that captures banks' potential to engage in securities, insurance, and real estate activities and whether they can own non-financial firms is utilized to check if banks can gain market power by offering a vast array of services. Increasing values of this index indicate more activity restrictions and we anticipate an inverse relationship between competition and activity restrictions that is likely to translate into increased survival time of banking systems. However, if fewer activity restrictions enable banks to better diversify risk, a negative relationship between these restrictions and time to crisis is also possible. An index for entry restrictions is also obtained from Barth et al. (2004) to explicitly test for the contestability of the banking systems in our study. The index provides information on what types of legal documents are required to establish a bank, whereby higher values indicate higher barriers to entry. We assume again an inverse relationship between competition and entry restrictions that would be reflected in a positive effect on survival time. As highlighted above, if however greater contestability encourages banks to operate more efficiently, a negative association is equally possible. We also examine a capital

regulatory index as a proxy for the entry requirements imposed by regulators on the capital of institutions. The higher the index value, the higher the entry barrier. We assume a negative association of the capital regulatory index with the degree of competition and also a positive relationship between the capital regulatory index and time to crisis. On the other hand, since lower capital requirements would increase competition and assuming competition boosts efficiency, a negative association between the capital regulatory index and survival time might be detected. Demirgüç-Kunt and Detragiache (2002) suggest that the strength of the institutional environment also plays an important rule for the soundness of a banking system. Hence, we include the rule of law as a proxy for the strength of the institutional environment as additional variable in our regressions and assume that stronger institutions will contribute to increased survival time of banking systems. In order to gauge the effect of the level of information disclosure to the public, we use an accounting index obtained from La Porta et al. (1998). This index captures the extent of information provided to shareholders. It serves as a proxy for market discipline since shareholders have an incentive to monitor risk-taking behaviour by banks. We assume that a higher level of information disclosure, reflected in a higher index value will increase survival time of banking systems.[13] To capture the effect of ownership structure in the countries' banking systems, we include the proportion of bank assets controlled by foreign entities, obtained from Barth et al. (2001) and the degree of government ownership, taken from La Porta et al. (2002). Higher degrees of foreign ownership are interpreted as a sign for a more competitive environment and are therefore anticipated to shorten survival time. By contrast, if foreign ownership improves efficiency of the banks operating in this environment, it could however also increase time to crisis. Large degrees of government ownership, on the other hand, are likely to impede competitive behaviour of financial institutions and we therefore anticipate a positive relationship between government ownership and time to crisis. However, empirical work by Barth et al. (2004) suggests a weakly positive association between government ownership and bank fragility.

[13] For additional details on bank risk-taking behaviour and information disclosure see Nier and Baumann (2006).

2.4. RESULTS

We report the main results obtained from the duration and logit models in Section 2.4.1. and numerous robustness tests in Section 2.4.2. A detailed examination of the effect of regulatory and institutional variables on banking system soundness is presented in Section 2.4.3.

2.4.1. MAIN RESULTS

We present the main results of our analyses in Table 2.3. The coefficients obtained from the duration model are reported in Specification (1) - (4) and we re-examine the findings from the duration analysis with the more commonly utilized logit model in Specification (5) - (8). The number of observations in the duration models is smaller than in the logit models since the dataset has to be set up differently for analyzing duration data. When interpreting results, it is important to consider that the signs for the coefficients are reversed between the two different modelling techniques: A positive sign in the duration model indicates increased time to crisis and can therefore be interpreted as contributing to increased stability whereas a positive sign in the logit model implies a greater probability of experiencing a systemic crisis. Specification (1) and (5) are our canonical models that include previously used explanatory variables, whereby we additionally incorporate three dummy variables for origin of the legal system (British, French, and Scandinavian legal origin) since it is a major determinant for differences in the development of financial systems. We capture German legal origin in the intercept to avoid perfect collinearity. In Specifications (2) and (6) we include the H-Statistic in the equations and the averaged 3-bank concentration ratio additionally enters the equations in Specification (3) and (7). The final Specifications (4) and (8) include an interaction term between the H-Statistic and concentration to control for possible nonlinear relationships.

In the duration model, the H-Statistic enters Specification (2) and (3) positively and significantly at the one and five percent level respectively. The positive sign for the coefficient implies that time to crisis increases as the degree of competitive behaviour among financial institutions increases and therefore does not support the view that competitiveness gives rise to banking system vulnerabilities. This core result will persist throughout the remainder of the chapter with only minor changes observed. Moreover, our finding for the positive effect of the level of competition for banking system soundness

also holds when the level of concentration is controlled for.[14] The effect of concentration on time to crisis remains insignificant. Neither competition nor concentration assumes significance when the interaction term between the two is included in Specification (4). This analysis provides suggestive evidence that competitive behaviour contributes to increased survival time of banking systems.

[14] We additionally include the variable GDP (real) per capita as a proxy for the economic environment and also test for the effect of macroeconomic volatility, using the standard deviation of GDP growth (real) as an additional control variable. These results again confirm the significantly positive relationship between the H-Statistic and the timing of banking crises and the significantly negative relationship between competition and the probability of suffering a crisis. These additional results are reported in Appendix 2.B.

Table 2.3. Competitiveness, Timing, and Probability of Systemic Banking Crises

	Duration Models				Logit Models			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	4.6754	1.3642	0.6574	7.5960	-5.4307	-1.1953	-0.6020	-2.8211
	(0.6350)***	(1.4922)	(1.9292)	(5.0860)	(0.7062)***	(1.4726)	(1.8109)	(4.3279)
GDP growth (real)	-0.0702	-0.0268	-0.0236	-0.0157	0.1315	0.0787	0.0719	0.0709
	(0.0845)	(0.0945)	(0.0962)	(0.0935)	(0.0817)	(0.0922)	(0.0935)	(0.0920)
Real interest rate	-0.0121	-0.0140	-0.0124	-0.0107	0.0219	0.0253	0.0235	0.0231
	(0.0137)	(0.0187)	(0.0168)	(0.0158)	(0.0100)**	(0.0130)*	(0.0130)*	(0.0130)*
Inflation	-0.0023	-0.0017	-0.0009	0.0004	0.0053	0.0043	0.0036	0.0033
	(0.0016)	(0.0020)	(0.0023)	(0.0026)	(0.0031)*	(0.0037)	(0.0039)	(0.0038)
Terms of trade	-0.0025	-0.0029	-0.0026	-0.0026	0.0002	0.0001	-0.0000	-0.0001
	(0.0017)	(0.0017)*	(0.0017)	(0.0017)	(0.0027)	(0.0035)	(0.0032)	(0.0033)
Depreciation	-0.0040	-0.0025	-0.0028	-0.0032	0.0002	-0.0010	-0.0008	-0.0007
	(0.0015)***	(0.0018)	(0.0016)*	(0.0014)**	(0.0023)	(0.0020)	(0.0019)	(0.0018)
M2/Reserves	0.0044	0.0106	0.0206	0.0169	0.0057	-0.0020	-0.0110	-0.0080
	(0.0257)	(0.0267)	(0.0287)	(0.0284)	(0.0239)	(0.0262)	(0.0326)	(0.0320)
Credit growth (real)	-0.0014	-0.0018	-0.0019	-0.0022	0.0010	0.0016	0.0017	0.0018
	(0.0004)***	(0.0004)***	(0.0005)***	(0.0006)***	(0.0008)	(0.0008)**	(0.0008)**	(0.0008)**
Moral hazard index	-0.0462	0.2243	0.2030	-0.0018	0.3375	0.0299	0.0601	0.1363
	(0.2122)	(0.2657)	(0.2880)	(0.3181)	(0.3417)	(0.3690)	(0.3683)	(0.3984)
British origin	-0.4882	-0.4057	-0.2254	-0.7165	1.1127	1.1103	1.0450	1.2049
	(0.6430)	(0.7490)	(0.8314)	(0.8584)	(0.8397)	(0.9437)	(0.9338)	(0.9193)
French origin	-1.0952	-1.5076	-1.2918	-1.2332	1.6562	2.2597	2.1015	2.1036
	(0.5938)*	(0.5663)***	(0.5323)**	(0.6013)**	(0.6230)***	(0.6465)***	(0.5998)***	(0.6185)***
Scandinavian origin	-1.1093	-1.0441	-1.4652	-1.1950	1.2795	1.2279	1.5485	1.4447
	(0.5347)**	(0.5091)**	(0.7081)**	(0.7069)*	(1.1575)	(1.1414)	(1.2624)	(1.2846)
H-Statistic		4.4118	3.5723	-7.8459		-5.8513	-5.2130	-1.7627
		(1.6551)***	(1.8195)**	(8.1229)		(1.7523)***	(1.8819)***	(6.2430)
Concentration			2.2986	-13.0830			-1.8366	2.9196
			(2.5360)	(11.0227)			(2.4980)	(8.6863)
H-Statistic * Concentration				26.1815				-7.8430
				(18.6797)				(13.1666)
Observations	546	546	546	546	567	567	567	567
Number of crises	21	21	21	21	28	28	28	28
Type I Error in %	n/a	n/a	n/a	n/a	39.33 %	31.91 %	30.98 %	31.73 %
Type II Error in %	n/a	n/a	n/a	n/a	25.00 %	28.57 %	25.00 %	25.00 %
AIC	0.173	0.169	0.172	0.172	0.400	0.387	0.390	0.393
Pseudo R square	n/a	n/a	n/a	n/a	0.091	0.132	0.135	0.136

We estimate duration models with time varying covariates for the period 1980 - 2003 in column (1) - (4) and logit models in column (5) - (8). The dependent variable is the log of time to crisis in the exponential duration models. The observations are right hand censored if no crisis surfaced during the observation period. If a crisis runs over multiple years, the years following the onset of a crisis are deleted from the dataset. If a country experienced multiple crises, subsequent episodes are included. The number of crises in the duration model setup is smaller since duration analysis focuses on time spans for each country and exploits information in the data at the end of each span. The dependent variable in the logit models is a dummy variable that equals one if a crisis is observed or zero otherwise. All explanatory variables are lagged in the models by one period to avoid simultaneity problems. The Data Appendix to this chapter provides detailed information on the explanatory variables. Specifications (1) and (5) are our baseline models that include covariates used in previous studies, whereby we capture German legal origin in the intercept. Specifications (2) and (6) include the H-Statistic as measure for the competitiveness of the industry and Specification (3) and (7) incorporate the level of concentration as measured by the three bank concentration ratio, averaged over the sampling period. To control for nonlinear relationships between the degree of competitiveness and the level of concentration, we include an interaction term of these two variables in Specification (4) and (8). Standard errors are given in parentheses for Specification (1) - (4) and White's heteroskedasticity consistent standard errors are given in parentheses for Specification (5) - (8). Type I and Type II Error are calculated as the total number of crisis observations (28) divided by the number of observations in the sample (567); this yields a cut-off point of 0.0494. Significance levels of 1, 5 and 10 percent are indicated by ***, ** and *.

The control variable for terms of trade change is weakly significant at the ten percent level in Specification (2) indicating an inverse relationship between changes in terms of trade and time to crisis. While this appears counterintuitive, it may be due to sample composition. The impact of terms of trade on time to crisis is largely determined by the countries' dependency on primary commodity exports. If no such dependency is prevalent in our sample, we are unlikely to discover the anticipated positive sign. Moreover, previous studies also fail to consistently find the expected pattern. While Demirgüç-Kunt and Detragiache (2005) find no significant relationship with changing signs across different regressions, Beck et al. (2006) report a negative association between the probability of observing a systemic crisis and adverse terms of trade shocks which would result in a positive relationship between changes in terms of trade and time to crisis in a duration model. Consistent with theory, the rate of depreciation exhibits a negative sign and enters the equations significantly in Specification (1), (3) and (4) since currency devaluations often pose a threat to bank profitability (Demirgüç-Kunt and Detragiache, 1998). Moreover, our model provides strong evidence for the 'boom and bust' hypothesis across the four specifications in that it highlights that strong credit growth shortens survival time of banking systems. The significant dummy for French legal origin enters throughout negatively and significantly suggesting that time to crisis is shorter in countries with French legal origin. This may be driven by weak law enforcement and comparatively less protection of creditor rights in countries with French legal origin than in countries with British legal origin as illustrated by La Porta et al. (1998). The dummy for Scandinavian legal origin is likewise significant and negative across the different regressions, which may be again attributable to the fact that less emphasis is placed on the protection of creditor rights in Scandinavian countries than in jurisdictions with British legal origin (Levine, 1998). The lack of significance of some of the macroeconomic control variables may be attributable to multicollinearity as underscored by Detragiache and Spilimbergo (2001). We nevertheless keep them in the equation to test our hypothesis regarding competitive behaviour of financial institutions while the macroeconomic setting is controlled for.[15]

[15] We also analyze if our results are sensitive to using different techniques for the specification of the duration model and estimate a semiparametric Cox proportional hazards model with time-varying covariates that does not assume any parametric form for the baseline hazard function. This analysis produces very similar results with respect to the contribution of the H-Statistic to increased banking

To investigate as to whether our findings are sensitive to different methodological approaches, we re-run Specification (1) - (4) with the more widely used logit model and report the results in Specification (5) - (8). This modelling technique corroborates the findings obtained with the duration model. The H-Statistic enters Specifications (6) and (7) negatively and significantly at the one percent level.[16]

We compute the impact of an increase of a one standard deviation in the H-Statistic (0.12) using the marginal effect (-0.1498) rather than the coefficient from the logit model reported in Specification (7), evaluated at the mean, on the probability of observing a crisis (0.12*-0.1498=-0.0180) to illustrate that a one standard deviation increase in competitiveness decreases the probability of observing a crisis by 1.8 percent.[17] The effect is considerable given that the overall probability of observing a crisis in the sample is below 5 percent.[18] This underscores that more competitive banking systems are more resilient to crises. The effect of competitive conduct is greater than the impact of increased concentration in the industry. Although insignificant in Specification (7), we compare the two results for illustrative purposes and also calculate the effect of a one standard deviation increase in concentration (0.13) upon fragility, using again the marginal effect (-0.0528). This would decrease the probability of suffering a systemic crisis by 0.53 percent (-0.53=0.13*-0.0528). When the interaction between concentration and competitiveness is controlled for in Specification (8), these two variables are not longer significant.

Among the control variables, we find evidence that increases in real interest rates give rise to banking vulnerabilities according to Specification (5) - (8). The positive and significant

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system soundness. However, since the Cox model does not permit making inferences about the baseline hazard as it is left unestimated, and, given that we obtain more efficient estimates with the parametric duration model, we only report these results in Appendix 2.C. Additionally, we re-estimated the duration models using the Weibull distribution, which assumes $\lambda_0(t)=\lambda\alpha t^{\alpha-1}$ and allows for positive duration dependence if $\alpha>1$ and negative duration dependence if $\alpha<1$. We applied a Wald test to investigate if $\ln(\alpha)=0$, which is equivalent to testing $\alpha=1$. Across the four specifications, we cannot reject this hypothesis and conclude that it is justified assuming a constant hazard rate. The exponential model is nested within the Weibull model as the case $\alpha=1$. The results are presented in Appendix 2.C.

[16] The H-Statistic is also significant when including the years following the onset of a crisis in both the duration and in the logit model, see Appendix 2.B.

[17] The results for the computation of marginal effects for the logit model are presented in Appendix 2.D.

[18] The overall probability of observing a crisis in the sample is 0.0494 (=28 crises/567 observations), see Table 2.3, Logit Models.

coefficient for inflation in Specification (5) furthermore underscores that inflation is a precursor for banking problems. We again find evidence for the 'boom and bust' story in the literature in Specifications (6) - (8) where credit growth enters with a significant and positive sign. The dummy for French legal origin is now positively signed and significant across the logit models, indicating that countries with French legal origin are more prone to experience a crisis which confirms the results from the duration model.

The logit models provide additional information in terms of the classification accuracy. Only between 31 and 39 percent of the crises in the sample are misclassified according to the results of the Type I Error. The predictive power is aligned with previous studies and we therefore regard these results as satisfying. The Akaike Information Criterion (AIC) suggests that Specification (2) and (6) which additionally incorporate the H-Statistic, are the most parsimonious model setups. However, since we want to perform our robustness tests when concentration is controlled for, we use Specifications (3) and (7) for the robustness tests in Sections 2.4.2 and 2.4.3. Note that we find in neither of our two methodological approaches evidence that competitive behaviour of banks increases banking system fragility. Moreover, the results indicate that concentration and competitive behaviour are of distinct character and that concentration does not significantly impact banking system soundness when the effect of competition is explicitly tested in the models.

2.4.2. Robustness Tests

We perform several robustness tests using the duration approach and the logit model in Table 2.4. whereby we omit the period 1994 - 2001 during which the H-Statistic is measured by Claessens and Laeven (2004) to account for the fact that the measure of competition assumes long-run equilibrium. We furthermore employ different samples in terms of the country coverage and with respect to the sampling period. In addition, we use first differences of the macroeconomic control variables rather than levels to capture the behaviour of the macroeconomic environment more dynamically and we also take the effect of competition from the stock market and depth of the financial system into account. Finally, we cluster the errors to control for intra-group correlation and also correct the standard errors of the H-Statistic using a bootstrapping procedure with 1,000 replications. Since we are not specifically interested in the behaviour of our control

variables, we constrain the subsequent discussion to the H-Statistic and the 3-bank concentration ratio.

Table 2.4. Robustness Tests for Competitiveness and Timing and Probability of Crises

Panel A: Duration Models

	(1)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Constant	0.1340	1.8114	-1.6913	-1.4797	-1.0423	0.5884	-7.8240	0.0062	0.6574	1.5645
	(2.7300)	(2.0006)	(1.9607)	(2.7227)	(3.0214)	(1.6651)	(6.0335)	(2.0994)	(1.9292)	(1.7768)
GDP growth (real)	0.0773	-0.0280	0.0701	0.0323	-0.0678	0.0774	-0.4145	-0.0172	-0.0236	-0.0315
	(0.1492)	(0.0869)	(0.1070)	(0.0818)	(0.1065)	(0.0845)	(0.3483)	(0.0975)	(0.0962)	(0.0949)
Real interest rate	-0.0093	-0.0118	-0.0204	-0.0109	-0.0130	-0.0067	0.0657	-0.0115	-0.0124	-0.0115
	(0.0213)	(0.0175)	(0.0239)	(0.0158)	(0.0148)	(0.0048)	(0.0473)	(0.0165)	(0.0168)	(0.0158)
Inflation	-0.0018	-0.0004	0.0011	0.0023	-0.0011	-0.0019	-0.0442	-0.0003	-0.0009	-0.0007
	(0.0028)	(0.0021)	(0.0025)	(0.0024)	(0.0030)	(0.0025)	(0.0496)	(0.0026)	(0.0023)	(0.0023)
Terms of trade	-0.0429	-0.0026	-0.0262	-0.0029	-0.0019	-0.0010	-0.0092	-0.0023	-0.0026	-0.0025
	(0.0317)	(0.0016)*	(0.0198)	(0.0016)*	(0.0017)	(0.0016)	(0.0058)	(0.0015)	(0.0017)	(0.0017)
Depreciation	-0.0050	-0.0016	-0.0033	-0.0035	-0.0035	-0.0082	-0.0101	-0.0027	-0.0028	-0.0034
	(0.0024)**	(0.0021)	(0.0015)**	(0.0015)**	(0.0016)**	(0.0016)***	(0.0032)***	(0.0016)*	(0.0016)*	(0.0016)***
M2/Reserves	-0.0051	-0.0069	0.0385	0.0002	0.0268	-0.0258	-0.0195	0.0090	0.0206	0.0204
	(0.0241)	(0.0245)	(0.0406)	(0.0134)	(0.0407)	(0.0323)	(0.0290)	(0.0217)	(0.0287)	(0.0278)
Credit growth (real)	-0.0012	-0.0014	-0.0028	-0.0020	-0.0020	-0.0018	-0.0095	-0.0019	-0.0019	-0.0019
	(0.0010)	(0.0005)***	(0.0004)***	(0.0007)***	(0.0006)***	(0.0004)***	(0.0042)**	(0.0005)***	(0.0005)***	(0.0005)***
Moral hazard index	0.4143	0.1018	0.6467	-0.1542	0.0010	0.5653	-3.1231	0.1980	0.2030	0.1023
	(0.5889)	(0.2623)	(0.3483)*	(0.3467)	(0.2735)	(0.3357)*	(2.0461)	(0.2727)	(0.2880)	(0.2932)
British legal origin	-0.0506	-0.2099	-0.3165	-1.4050	0.1324	-0.3669	-2.5205	-0.3576	-0.2254	-0.2736
	(1.1344)	(0.7194)	(1.4888)	(0.7572)*	(1.0045)	(0.7729)	(2.7221)	(0.9142)	(0.8314)	(0.7934)
French legal origin	-1.0261	-1.4700	-1.9659	-1.2497	-1.0570	-1.5184	-5.8952	-1.1462	-1.2918	-1.1272
	(0.6847)	(0.4442)***	(1.0375)*	(0.6386)*	(0.4320)**	(0.5809)***	(3.6111)	(0.5337)**	(0.5323)**	(0.5800)**
Scandinavian legal origin	-1.7236	-0.8951	-3.1000	-2.2846	-1.8150	-1.2374	-1.1053	-1.7039	-1.4652	-1.6225
	(0.7682)**	(0.6574)	(0.9117)***	(1.0248)**	(0.9140)**	(0.6499)*	(0.5094)***	(0.7203)**	(0.7081)**	(0.7517)***
H-Statistic	5.8286	3.3662	4.9035	3.8766	4.7027	4.4598	40.0332	3.4765	3.5723	1.9834
	(2.8271)**	(1.6044)**	(2.1925)**	(1.9088)**	(1.8789)**	(2.3183)*	(22.5561)*	(1.6565)**	(1.8195)**	(1.6630)
Concentration	-0.0917	0.4290	5.0138	7.1421	4.8551	0.2198	-3.5123	3.0144	2.2986	2.8880
	(2.3753)	(2.7681)	(3.3297)	(4.2624)*	(3.6361)	(2.3654)	(9.0893)	(2.5477)	(2.5360)	(2.5019)
Stock market turnover/GDP							2.4108			
							(1.1171)**			
Credit/GDP								0.0059		
								(0.0087)		
Observations	373	378	464	386	431	517	220	545	546	546
Number of Crises	13	19	18	19	19	20	8	21	21	21
Type I Error in %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Type II Error in %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
AIC	0.244	0.215	0.161	0.202	0.225	0.163	0.161	0.175	0.172	0.190
Pseudo R square	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Panel B: Logit Models

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Constant	-0.6283	-2.1609	1.2728	-0.5482	-1.6922	-0.1077	6.2426	0.6196	-0.6020	-1.6226
	(2.0577)	(1.8673)	(2.0310)	(2.3351)	(2.1225)	(1.5718)	(5.8164)	(2.1315)	(1.7287)	(1.4554)
GDP growth (real)	0.0472	0.0402	0.0208	0.0442	0.1236	0.0381	0.0692	0.0560	0.0719	0.0841
	(0.1129)	(0.0885)	(0.0922)	(0.0860)	(0.1134)	(0.0545)	(0.2002)	(0.0925)	(0.1044)	(0.0903)
Real interest rate	0.0319	0.0186	0.0194	0.0224	0.0188	0.0066	0.0829	0.0223	0.0235	0.0217
	(0.0162)**	(0.0110)*	(0.0120)	(0.0124)*	(0.0116)	(0.0069)	(0.0656)	(0.0126)*	(0.0126)*	(0.0122)**
Inflation	0.0046	0.0025	0.0019	0.0020	0.0052	0.0091	0.0268	0.0026	0.0036	0.0035
	(0.0043)	(0.0040)	(0.0038)	(0.0039)	(0.0038)	(0.0074)	(0.0333)	(0.0039)	(0.0028)	(0.0037)
Terms of trade	-0.0085	0.0011	-0.0069	0.0012	0.0012	-0.0009	0.0063	0.0002	-0.0000	-0.0000
	(0.0193)	(0.0030)	(0.0195)	(0.0031)	(0.0027)	(0.0015)	(0.0038)*	(0.0024)	(0.0028)	(0.0033)
Depreciation	-0.0023	-0.0013	-0.0013	-0.0003	0.0007	-0.0023	-0.0024	-0.0008	-0.0008	-0.0003
	(0.0018)	(0.0028)	(0.0020)	(0.0027)	(0.0023)	(0.0017)	(0.0022)	(0.0018)	(0.0007)	(0.0019)
M2/Reserves	0.0134	0.0284	-0.0420	0.0189	0.0261	0.0968	0.0259	0.0073	-0.0110	-0.0111
	(0.0317)	(0.0339)	(0.0410)	(0.0227)	(0.0310)	(0.0537)*	(0.0316)	(0.0332)	(0.0363)	(0.0315)
Credit growth (real)	0.0016	0.0010	0.0022	0.0015	0.0016	-0.0019	0.0040	0.0018	0.0017	0.0015
	(0.0010)*	(0.0008)	(0.0008)***	(0.0008)*	(0.0009)*	(0.0014)	(0.0051)	(0.0008)**	(0.0005)***	(0.0008)**
Moral hazard index	0.1299	0.1035	-0.2290	0.2941	-0.1667	-0.3183	1.9264	0.0774	0.0601	0.1674
	(0.6033)	(0.3191)	(0.3858)	(0.4034)	(0.3807)	(0.3445)	(1.7945)	(0.3490)	(0.2313)	(0.3746)
British legal origin	1.3083	0.8407	1.5321	1.6726	0.3548	0.9322	0.5825	1.2003	1.0450	1.1046
	(0.9805)	(0.9464)	(1.3384)	(1.0142)*	(1.0511)	(0.8757)	(2.3227)	(0.9248)	(0.6595)	(0.9063)
French legal origin	1.8543	2.4502	2.6649	2.1876	1.7188	2.1162	5.2112	1.8188	2.1015	1.9242
	(0.6281)***	(0.6095)***	(1.0304)***	(0.8611)**	(0.6112)***	(0.6474)***	(2.2600)**	(0.6658)***	(0.4547)***	(0.6355)***
Scandinavian legal origin	1.6483	0.8860	2.5702	1.8351	1.8959	1.6513	1.7789	1.9942	1.5485	1.7319
	(1.2757)	(1.3069)	(1.3581)*	(1.3383)	(1.3465)	(1.2313)	(1.5949)	(1.2891)	(0.5973)***	(1.2770)
H-Statistic	-6.5980	-4.8235	-6.1835	-4.6403	-4.3798	-5.2564	-34.5232	-5.0351	-5.2130	-3.3488
	(1.9158)***	(1.9754)**	(2.2136)***	(1.8596)**	(2.3654)*	(2.1689)**	(20.1489)*	(1.7751)***	(1.4913)***	(1.7527)**
Concentration	-0.1835	0.9264	-3.8898	-3.4827	-0.8001	-1.0092	11.6855	-3.3608	-1.8366	-2.5821
	(2.7772)	(3.1215)	(2.7648)	(3.7023)	(3.0274)	(1.9934)	(10.9045)	(2.6991)	(2.0742)	(2.4635)
Stock market turnover/GDP							-1.5550			
							(2.1071)			
Credit/GDP								-0.0094		
								(0.0086)		
Observations	395	398	481	404	452	538	230	567	567	567
Number of crises	20	26	25	25	21	25	12	28	28	28
Type I Error in %	30.13 %	40.59 %	30.92 %	38.26 %	30.39 %	28.65 %	30.73 %	31.23 %	30.98 %	30.25 %
Type II Error in %	25.00 %	19.23 %	12.00 %	20.00 %	23.81 %	32.00 %	23.10 %	25.00 %	25.00 %	25.50 %
AIC	0.418	0.49	0.395	0.470	0.397	0.379	0.422	0.391	0.390	0.390
Pseudo R square	0.134	0.13	0.176	0.137	0.108	0.129	0.268	0.143	0.135	0.153

We perform several robustness tests using Specification (3) and (7) from Table 2.3. We omit in Specification (1) the period 1994 - 2001 for which Claessens and Laeven (2004) estimated the H-Statistic. Specification (2) omits EU countries and Specification (3) excludes low income economies as defined by the World Bank (Bangladesh, India, Kenya, Nigeria, and Pakistan). We omit G10 countries in Specification (4). The sampling horizon is constrained to the period 1985 - 2003 in Specification (5) and Specification (6) uses first differences for the macroeconomic control variables. The level of stock market turnover/GDP is additionally controlled for in Specification (7), and Specification (8) includes the ratio of credit provided by the banking sector to GDP. In Specification (9), we cluster the errors to control for intra-group correlation and Specification (10) uses bootstrapping to correct the standard errors of the H-Statistic with 1,000 replications. Standard errors (Panel A) and robust standard errors (Panel B) are reported in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

Panel A in Table 2.4. depicts the results for ten robustness tests obtained with the duration models and Panel B presents the results for the logit models. In order to capture the effect of concentration, we employ Specifications (3) and (7) from Table 2.3. for all our sensitivity tests. The results obtained with the logit models corroborate our previous finding of a positive effect of competition on banking system soundness, and the positive effect on time to crisis is confirmed in nine out of ten duration models.

Regressions (1) in Panel A and Panel B omit the period 1994 - 2001 for which Claessens and Laeven (2004) measure the H-Statistic. This approach helps account for the fact that the H-Statistic assumes long-run equilibrium. Given that crises, consolidation and a changing environment challenge this restrictive assumption we investigate whether dropping the period during which the H-Statistic was measured affects our inferences. Both the duration and the logit model reiterate the significant relationship between competitive conduct and banking system soundness. Given that EU countries experienced a period of deregulation and liberalization due to the Second Banking Coordination Directive, enacted in 1989, which aims to create a level playing field for bank competition in Europe, we drop EU countries in Setup (2). Omitting these countries does however not change our inferences regarding the effect of the H-Statistic on bank soundness.

To test for robustness of our results with respect to the level of development of the financial system in question, we perform two additional tests. First, we exclude low income economies as classified by the World Bank (Bangladesh, India, Kenya, Nigeria and Pakistan) from the sample in Specification (3). In both panels, the H-Statistic enters significantly and shows the anticipated sign, suggesting that our results are not driven by sample selection. Second, we exclude G10 countries in Specification (4). The H-statistic retains the anticipated sign and also remains significant, confirming that there is no sample bias.

We also examine whether our results hold for the sampling period 1985 - 2003.[19] Specification (5) in Panel A and B indicates again a significant relationship between banking system soundness and the degree of competition. However, the level of significance declines to the ten percent level in Panel B. We again cannot reject the

[19] We also considered shortening the sampling period further, but this substantially decreases the number of crisis observations in the sample. Thus, we constrain this robustness test to the period 1985 - 2003.

hypothesis that concentration has no independent effect on fragility when competitive conduct of banks is controlled for.

In order to capture whether a more dynamic measurement of the behaviour of the macroeconomic control variables impacts the link between competitiveness and fragility, we use first differences for the macroeconomic variables rather than levels in Specification (6). We again find a positive and significant association between competitive bank behaviour and time to crisis in Panel A and the anticipated inverse relationship between the probability of observing a systemic crisis and competitiveness in Panel B. The results of the impact of concentration on fragility remain unchanged in these regressions.

We also test more specifically for the impact of financial sector development on the timing and probability of suffering systemic crises and include as an additional control variable the ratio of stock market total value traded to GDP in Specification (7). This is due to the fact that a well-developed stock market may change the competitive environment banks operate in. Corporations can raise funds directly at the stock market, since such funds are close substitutes for bank loans. For instance, Dinç (2000) highlights that capital market competition makes banks lower their threshold levels according to which they originate loans and commit to supporting even lower quality borrowers. However, including this variable does not alter our inferences. We confirm the significantly positive association between the H-Statistic and the timing of crises in the duration model in Panel A and the significant and negative relationship between the measure of competitiveness and crises in the logit model in Panel B. Specification (8) considers the depth of the banking system as a precise measure of the level of banking sector development, captured by the ratio of domestic credit provided by the banking sector to GDP. Including this additional control variable does not adversely affect the H-Statistic in either Panel A or Panel B.

Finally, we test whether our results are affected by clustering the error terms and we also correct the standard errors of the H-Statistic using a bootstrapping procedure with 1,000 replications. This helps us account for the fact that the H-Statistics obtained from Claessens and Laeven (2004) are estimated with a standard error. Specification (9) reports the results with the clustered error terms. The findings on the impact of the H-Statistic are virtually unchanged in these regressions. When we use bootstrapping in Specification (10),

the H-Statistic is rendered insignificant in the duration model. However, this finding is not confirmed in the logit model. The H-Statistic enters in Panel B with a negative and significant sign at the five percent level, reiterating the positive effect of competition on banking system soundness.

Thus, both the duration analysis and the logit model confirm that the impact of competitiveness on banking system vulnerabilities is insensitive to alternative samples, different sampling periods, the consideration of more dynamic effects of the macroeconomic environment, and it is also robust to controlling for competition from stock markets and to controlling for the depth of the banking system. Importantly, our results presented in various regressions do not support the view that concentration is conducive to banking system stability once competitive conduct is directly accounted for, which suggests a reconsideration of the findings reported by Beck et al. (2006, forthcoming).[20] They put forward that bank concentration boosts banking stability but do not test for the effect of banks' competitive conduct.

2.4.3. COMPETITIVENESS, REGULATION AND SYSTEMIC CRISES

Undoubtedly, the regulatory and institutional environment has an important impact on the degree of competitiveness in the banking industry (Claessens and Laeven, 2004). As an additional robustness test, we therefore investigate and report in Table 2.5. the impact of competition on banking system soundness while controlling for a set of regulatory and institutional variables. As alluded to previously, if incorporation of these variables diminishes the significance of the H-Statistic, we could conclude that competition does not have an independent effect on banking system vulnerability. Moreover, an analysis of the design features of the regulatory environment on the timing of systemic problems appears independently beneficial. We again constrain the following discussion to the H-Statistic and the 3-bank concentration ratio.

[20] Notice that concentration remains insignificant in all but two specifications in our robustness tests.

Table 2.5. Regulatory Environment and the Timing and Probability of Crises

Panel A: Duration Models

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	1.8798	-4.0271	1.4892	-8.6089	-1.9452	1.2922	1.2036
	(2.6419)	(3.6337)	(2.2359)	(4.1043)**	(2.3287)	(1.9027)	(2.1527)
GDP growth (real)	0.0008	0.0092	-0.0151	0.0128	0.0378	-0.0237	0.0421
	(0.0899)	(0.0959)	(0.0947)	(0.0878)	(0.0921)	(0.0949)	(0.0781)
Real interest rate	-0.0128	-0.0160	-0.0150	-0.0127	-0.0122	-0.0139	-0.0154
	(0.0184)	(0.0183)	(0.0192)	(0.0169)	(0.0201)	(0.0173)	(0.0171)
Inflation	-0.0004	0.0005	-0.0006	0.0013	0.0015	-0.0006	0.0019
	(0.0022)	(0.0031)	(0.0024)	(0.0028)	(0.0026)	(0.0024)	(0.0029)
Terms of trade	-0.0308	-0.0146	-0.0320	-0.0082	-0.0352	-0.0022	-0.0025
	(0.0164)*	(0.0157)	(0.0173)*	(0.0157)	(0.0176)**	(0.0015)	(0.0020)
Depreciation	-0.0032	-0.0053	-0.0039	-0.0055	-0.0019	-0.0027	-0.0029
	(0.0018)*	(0.0017)***	(0.0016)**	(0.0026)**	(0.0025)	(0.0016)*	(0.0020)
M2/Reserves	0.0146	0.0384	0.0183	0.0168	0.0020	0.0192	0.0038
	(0.0279)	(0.0355)	(0.0282)	(0.0200)	(0.0241)	(0.0284)	(0.0223)
Credit growth (real)	-0.0021	-0.0019	-0.0018	-0.0032	-0.0019	-0.0018	-0.0020
	(0.0005)***	(0.0006)***	(0.0005)***	(0.0007)***	(0.0005)***	(0.0005)***	(0.0006)***
Moral hazard index	0.0886	-0.0109	0.2975	0.9635	0.1952	0.1529	0.2907
	(0.3339)	(0.4000)	(0.2685)	(0.7556)	(0.3568)	(0.3007)	(0.4183)
British legal origin	-0.0072	-0.3306	-0.1428	-0.8541	0.3201	-0.4238	-0.5173
	(0.7323)	(0.7479)	(0.7593)	(0.8967)	(0.6699)	(0.7998)	(0.8760)
French legal origin	-1.0003	-1.1800	-1.3285	-0.2801	-0.6247	-1.1566	-1.1904
	(0.5199)*	(0.5822)**	(0.5998)**	(0.8722)	(0.4319)	(0.5452)**	(0.8539)
Scandinavian legal origin	-1.6131	-1.9532	-1.8468	-3.4112	-2.8268	-1.4895	
	(0.6357)**	(0.9071)**	(0.7506)**	(1.1704)***	(1.0630)***	(0.6612)**	
H-Statistic	3.5739	2.4267	3.7695	5.6773	2.2191	2.9485	3.7261
	(2.0543)*	(2.0520)	(1.8709)**	(4.2488)	(2.7397)	(1.7564)*	(3.0781)
Concentration	2.0759	3.0217	2.6762	3.1512	4.7610	2.5757	0.9864
	(2.3810)	(2.6462)	(2.2451)	(3.6368)	(3.1027)	(2.3556)	(2.8853)
Activity restrictions	-0.1174						
	(0.0946)						
Entry restrictions		0.6929					
		(0.3298)**					
Capital regulatory index			-0.2181				
			(0.2267)				
Accounting disclosure				0.1043			
				(0.0277)***			
Rule of law					0.2817		
					(0.1145)**		
Government ownership						-0.6358	
						(0.5564)	
Foreign ownership							-2.1901
							(1.5342)
Observations	526	519	526	437	471	525	358
Number of crises	21	19	21	16	19	21	17
Type I Error in %	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Type II Error in %	n/a	n/a	n/a	n/a	n/a	n/a	n/a
AIC	0.176	0.178	0.176	0.175	0.171	0.180	0.206
Pseudo R square	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Panel B: Logit Models

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	-4.9799	-0.0573	-3.0022	1.7731	4.0292	-1.3376	-1.3500
	(2.4183)**	(2.4356)	(2.7640)	(2.0367)	(3.2401)	(1.9407)	(2.2551)
GDP growth (real)	0.0517	0.0583	0.0750	0.0583	0.0671	0.0743	0.1005
	(0.0940)	(0.0928)	(0.0931)	(0.0885)	(0.0835)	(0.0909)	(0.1049)
Real interest rate	0.0194	0.0231	0.0235	0.0182	0.0200	0.0255	0.0186
	(0.0118)*	(0.0134)*	(0.0133)*	(0.0122)	(0.0120)*	(0.0141)*	(0.0108)*
Inflation	0.0031	0.0032	0.0033	0.0014	0.0017	0.0034	0.0038
	(0.0036)	(0.0038)	(0.0038)	(0.0039)	(0.0038)	(0.0039)	(0.0045)
Terms of trade	0.0027	-0.0044	0.0025	0.0090	-0.0027	0.0001	0.0007
	(0.0165)	(0.0203)	(0.0182)	(0.0188)	(0.0225)	(0.0028)	(0.0026)
Depreciation	-0.0030	-0.0007	-0.0008	-0.0039	-0.0017	-0.0009	-0.0023
	(0.0021)	(0.0024)	(0.0020)	(0.0024)*	(0.0027)	(0.0018)	(0.0019)
M2/Reserves	0.0042	-0.0159	-0.0043	0.0267	-0.0317	-0.0100	0.0117
	(0.0290)	(0.0337)	(0.0341)	(0.0397)	(0.0360)	(0.0327)	(0.0316)
Credit growth (real)	0.0018	0.0017	0.0012	0.0013	0.0022	0.0015	0.0018
	(0.0008)**	(0.0009)**	(0.0010)	(0.0009)	(0.0009)**	(0.0008)*	(0.0008)**
Moral hazard index	0.4106	0.2078	-0.1026	0.2381	-0.1657	0.1471	-0.1588
	(0.3922)	(0.4398)	(0.3518)	(0.4714)	(0.7559)	(0.3767)	(0.4431)
British legal origin	0.8659	1.0339	1.0683	0.5112	1.7638	1.1645	1.1377
	(0.9335)	(0.9469)	(0.9937)	(1.1165)	(0.9977)*	(0.9181)	(0.9607)
French legal origin	2.0962	1.8615	2.6471	1.4734	1.5993	2.0279	1.9056
	(0.6855)***	(0.5989)***	(0.9376)***	(0.6233)**	(0.8790)*	(0.6499)***	(0.8421)**
Scandinavian legal origin	2.2131	1.5475	2.4852	4.0116	2.5792	1.5452	
	(1.2881)*	(1.2903)	(1.4984)*	(1.5352)***	(1.3816)*	(1.2417)	
H-Statistic	-5.7529	-4.4645	-5.4366	-2.1799	-5.2941	-4.3336	-5.3887
	(2.3421)**	(2.0005)**	(2.0885)***	(2.3851)	(2.6151)**	(2.0670)**	(2.9989)*
Concentration	-0.4683	-2.3954	-2.4233	-5.0411	-3.1411	-2.0229	-0.2124
	(2.3656)	(2.5965)	(2.2404)	(3.1842)	(2.6627)	(2.4477)	(3.2036)
Activity restrictions	0.3427						
	(0.1514)**						
Entry restrictions		-0.1010					
		(0.3055)					
Capital regulatory index			0.4580				
			(0.3995)				
Rule of law				-0.4783			
				(0.1590)***			
Accounting disclosure					-0.0559		
					(0.0272)**		
Government ownership						0.3385	
						(0.6596)	
Foreign ownership							0.9981
							(1.7759)
Observations	547	539	547	489	452	545	371
Number of crises	28	26	28	23	26	28	20
Type I Error in %	34.30 %	30.21 %	29.87 %	26.57 %	30.02 %	32.11 %	28.77 %
Type II Error in %	17.86 %	30.77 %	25.00 %	13.04 %	19.23 %	17.86 %	25.00 %
AIC	0.393	0.395	0.401	0.395	0.388	0.404	0.432
Pseudo R square	0.163	0.122	0.1435	0.183	0.213	0.138	0.151

Using specification (3) and (7) from Table 2.3. and utilizing the sample for 1980 - 2003, we control for the regulatory and institutional environment. We estimate exponential duration models in Panel A and logit models in Panel B. The equations additionally include variables that capture activity restrictions (1), entry restrictions (2), and a capital regulatory index (3). The strength of institutions is measured by the rule of law in Specification (4), and we include a proxy for accounting disclosure in Specification (5). We also incorporate regressors to analyze the impact of government ownership and foreign bank ownership in Specifications (6) and (7). The Data Appendix to this chapter provides detailed information on the explanatory variables. Standard errors are given in parentheses in Panel A and robust standard errors are reported in Panel B. Type I and Type II Error are calculated as the total number of crisis observations divided by the number of observations in the sample. Significance levels of 1, 5 and 10 percent are indicated by ***, ** and *.

Panel A and B in Table 2.5. present the results for both the duration and the logit models respectively. To avoid collinearity problems, we enter the additional variables for the regulatory environment one-at-a-time.[21] Even when controlling for barriers to entry such as entry restrictions, a capital regulatory index, constraints imposed on banks in terms of activity restrictions, the level of disclosure and ownership structure, our core result that competition goes hand in hand with banking system soundness is confirmed in the logit model and only weakened in the duration model in certain circumstances. The H-Statistic is rendered insignificant in the duration model in Panel A when entry restrictions, strength of institutions, the level of disclosure, and foreign ownership are controlled for.

Entry restrictions enter the duration model in Specification (2) in Panel A positively at the five percent level, indicating that less contestable banking systems are less vulnerable. This finding indicates that impediments to market entry might enable incumbent banks to enjoy a 'quiet life' and pursue low risk strategies as argued in Boot and Greenbaum (1993). The accounting standard index from La Porta et al. (1998) also enters the duration model significantly with a positive sign, indicating that greater disclosure can increase time to crisis. This highlights that disclosure is indeed beneficial for increasing banking system soundness, a finding that is aligned with the work by Nier and Baumann (2006) on the bank level. Rule of law enters also significantly with a positive sign, highlighting that a stronger institutional environment is conducive to a sound banking system. In Panel B, we find that the probability of observing a systemic crisis increases when bank activities are restricted in Specification (1), a finding consistent with Barth et al. (2004) and Beck et al. (2006, forthcoming). Aligned with the results from the duration setup, rule of law and the accounting index enter now with the corresponding negative signs in Specifications (4) and (5), reiterating the importance of a strong institutional environment and the positive impact of market discipline on curtailing systemic risk.

The negative coefficient for the H-Statistic across all but one logit model underscores again that banking systems with higher degrees of competition are more resilient to systemic crises and that including additional variables that shape the competitive environment of a banking system does not markedly impact our conclusions. The inference to be drawn is that the regulatory and institutional environment *may* play a less

[21] See Appendix 2.A., Panel A for correlation between the regulatory and institutional variables.

important role for the likelihood of systemic banking problems than previously contemplated. Only in the duration model, the results are slightly weakened. Moreover, we again do not find supportive evidence to substantiate the findings by Beck et al. (2006, forthcoming) that increased concentration contributes to banking system stability since concentration remains insignificant across all specifications in the duration and in the logit models in Section 2.4.3.

In sum, our results offer robust evidence that competitive behaviour of financial institutions neither gives rise to systemic risk nor shortens time to crisis, even if contestability of banking markets, strength of the institutional environment, market discipline and ownership structure are controlled for. At worst, competition is not found to have an independent effect on the likelihood and timing of systemic problems. Hence, our findings do not support theoretical studies of the 'competition-fragility' literature. Rather, we find support for the 'competition-stability' view. Our results furthermore complement the work by Barth et al. (2004) and Beck et al. (2006, forthcoming) on the relationship between regulatory and supervisory policies and banking system soundness.

2.5. Concluding Remarks

This chapter provides the first empirical study of the relationship between bank competition as measured by the Panzar and Rosse (1987) H-Statistic and banking system stability. Using a cross-country dataset comprising 38 countries with up to 28 systemic banking crises for the period 1980 - 2003 we find that higher degrees of competition in banking systems decrease the risk of suffering a systemic crisis. Moreover, we present evidence that survival time of banking systems tends to increase in a more competitive environment. A broad set of robustness tests using alternative samples, different methodological approaches for the coding of the macroeconomic environment, and alternative sampling periods reiterates our core finding that more competitive banking systems are more resilient to banking problems, even when the level of concentration in the industry is controlled for.

Thus, our results offer empirical support for the 'competition-stability' theory and do not conform to the 'competition-fragility' literature. This bolsters the view that competition and soundness generally go hand in hand (even though a perfectly competitive system does not 'guarantee' absence of failures). While we qualify the conclusions in a number of

aspects, the initial findings presented in this chapter imply that banking systems with higher values of the Panzar and Rosse (1987) H-Statistic are i) less likely to experience a banking crisis and ii) exhibit longer time to observing an episode of systemic problems. Restricting the sample size by excluding low income economies, excluding G10 countries, excluding EU countries, examining the period 1985 - 2003, omitting the period during which the H-Statistic is measured, testing for the effect of competition from the stock markets, controlling for the depth of the banking system, and using first differences for the macroeconomic control variables rather than levels in both the duration analysis and in the logit model does not change the findings of our analysis. Our results for the logit model also hold when controlling for a set of regulatory and institutional variables that capture contestability of banking systems, strength of the institutional environment, and ownership structure of banks. These findings are only marginally weakened in the duration model. As an important side result, our results offer some evidence that a more restrictive institutional environment is conducive to the build up of banking vulnerabilities, which is in line with previous research.

An additional contribution of this chapter is its examination of the likelihood and timing of suffering a systemic crisis when the degree of concentration is accounted for. In this context, our results reject the view that concentrated banking systems are significantly less prone to suffer a crisis. Therefore, the findings provide further empirical evidence in a cross-country setting that competition and concentration are distinct from each other and that only competitive behaviour of banks impacts upon the probability of suffering a systemic banking crisis whereas concentration does not.

Although beyond the scope of this thesis, we argue that further research is needed to investigate in more detail the nature of the relationship between competition and stability in banking. It appears valuable to examine if alternative (non-structural) measures of competitive behaviour such as the Iwata (1974) model confirm our initial results and which levels of competition, if any, may be optimal to maintain a stable banking system.[22] Our ongoing research draws upon bank level data in a cross-country sample and controls for the institutional and regulatory environment to explore this link further. Likewise, the

[22] See also Carbo et al. (2006) who argue that the choice of the competition measure can make differences with respect to the inferences drawn.

exact transmission mechanism between competition and stability is an important subject matter. For instance, an analysis of the effects of competition in the short and in the long run may yield different outcomes for stability. Finally, as a complement to the 0/1 (crisis/no crisis) measure of financial fragility used in this chapter, one could use more continuous measures, such as distance to default, provided that practical problems associated with these measures (e.g. reliability of stock price data in shallow markets) are addressed.

Data Appendix

Variable	Definition	Source
Crisis	Dummy variable that takes on the value one if a systemic crisis is observed or zero otherwise	Demirgüç-Kunt and Detragiache (2005)
H-Statistic	Variable that captures the competitiveness of the banking industry whereby $H \leq 0$ indicates monopoly equilibrium; $0 < H < 1$ indicates monopolistic competition and $H = 1$ indicates perfect competition	Claessens and Laeven (2004)
Concentration	Proportion of total assets held by the 3 largest institutions in a country, averaged over the period 1980 - 2003.	Beck et al. (2006) and BankScope
GDP growth (real)	Rate of growth of the gross domestic product	World Bank Development Indicators
Real interest rate	Nominal interest rate minus the rate of inflation	International Financial Statistics
Inflation	Rate of change of the GDP deflator	World Bank Development Indicators
Terms of trade	Change in the net barter terms of trade	World Bank Development Indicators
Depreciation	Change in the foreign exchange rate	International Financial Statistics
M2/Reserves	Ratio of M2 to gross foreign reserves	World Bank Development Indicators
Credit growth	Rate of growth of domestic credit to the private sector, adjusted for inflation with GDP deflator	International Financial Statistics
Stock market value traded/GDP	Ratio of the value of total shares traded to average real market capitalization, the denominator is deflated.	Beck et al. (2000)
Credit/GDP	Ratio of domestic credit provided by the banking sector to GDP	World Bank Development Indicators
Moral hazard index	Indicator that measures generosity of design features of deposit insurance schemes calculated as the first principal component of the following design features: co-insurance, coverage of foreign currency and interbank deposits, membership, management, type and source of funding and level of explicit coverage.	Demirgüç-Kunt and Detragiache (2002)
British legal origin	Dummy variable that takes on the value one if the country's legal system is of British origin or zero otherwise	La Porta et al. (1998)
French legal origin	Dummy variable that takes on the value one if the country's legal system is of French origin or zero otherwise	La Porta et al. (1998)
German legal origin	Dummy variable that takes on the value one if the country's legal system is of German origin or zero otherwise	La Porta et al. (1998)
Scandinavian legal origin	Dummy variable that takes on the value one if the country's legal system is of Scandinavian origin or zero otherwise	La Porta et al. (1998)
Activity restrictions	Activity restrictions index for securities, insurance, real estate and ownership of non-financial firms that takes on values between 4 and 16, whereby greater values indicate more restrictions.	Barth et al. (2004)
Entry restrictions	The indicator is constructed as an index and takes on values between (1) and (8), whereby a higher index value indicates greater entry restrictions arising from legal requirements.	Barth et al. (2004)
Capital regulatory index	Summary index for overall capital stringency calculated as the sum of initial capital stringency and overall capital stringency.	Barth et al. (2004)
Foreign ownership	Proportion of bank assets owned by foreign entities.	Barth et al. (2001)
Government ownership	Proportion of bank assets owned by government.	La Porta et al. (2000)
Rule of law	Measure for the strength of the institutional environment. The index is increasing in the quality of the institutional environment and ranges between zero and six.	Beck et al. (2000)
Accounting index	Accounting standard index, created by examining and rating annual reports for the omission or inclusion of certain items. The index is increasing in the level of disclosure.	La Porta et al. (1998)

Appendix 2.A. Correlation Matrix

Panel A: Concentration, Competition, Regulatory and Institutional Variables

	Moral hazard index	British origin	French origin	Scandinavian origin	German origin	H-Statistic	Concentration	Activity restrictions	Entry restrictions	Capital regulatory index	Rule of law	Accounting disclosure	Government ownership	Foreign ownership
Moral hazard index	1.00													
British origin	-0.32***	1.00												
French origin	0.20***	-0.44***	1.00											
Scandinavian origin	0.14***	-0.07*	-0.15***	1.00										
German origin	0.04	-0.08**	-0.18***	-0.03	1.00									
H-Statistic	-0.26***	-0.06*	0.31***	-0.14***	-0.01	1.00								
Concentration	0.05	0.07**	-0.31***	0.25***	0.28***	0.15***	1.00							
Activity restrictions	-0.29***	0.04	0.19***	-0.14***	-0.16***	-0.04	-0.06	1.00						
Entry restrictions	0.25***	-0.14***	0.19***	0.12***	0.13***	0.16***	0.15***	0.08**	1.00					
Capital regulatory index	0.10***	0.03	-0.17***	-0.10***	0.01	-0.11***	0.09**	0.07**	0.12***	1.00				
Rule of law	0.15***	-0.33***	-0.16***	0.18***	0.20***	0.08**	0.03	-0.58***	0.30***	-0.26***	1.00			
Accounting	-0.47***	0.39***	-0.58***	0.20***	0.12***	0.08*	0.07*	-0.38***	0.02	-0.26***	0.39***	1.00		
Government ownership	0.17***	-0.22***	0.34***	0.01	-0.14***	-0.04	-0.02	0.51***	-0.06	0.19***	-0.48***	-0.66***	1.00	
Foreign ownership	0.01	-0.26***	0.48***	0.00***	-0.08*	0.14***	-0.46***	-0.20***	0.12**	-0.10**	-0.20***	-0.43***	0.11**	1.00

Panel B: Macroeconomic Variables

	GDP growth	Real interest rate	Inflation	Terms of trade	Depreciation	M2/Reserves	Credit growth	Stock market turnover/GDP	Credit/GDP
GDP growth	1.00								
Real interest rate	0.11***	1.00							
Inflation	-0.12***	-0.87***	1.00						
Terms of trade	0.02	-0.01	0.00	1.00					
Depreciation	-0.08**	0.06	0.00	-0.01	1.00				
M2/Reserves	-0.09**	-0.01	-0.08**	-0.01	-0.12***	1.00			
Credit growth	0.12***	-0.11***	0.11***	-0.03	-0.05	-0.02	1.00		
Stock market turnover/GDP	0.01	0.01	-0.22***	-0.02	-0.01	-0.07	0.05	1.00	
Credit/GDP	-0.10***	0.02	-0.13***	0.02	-0.17***	0.53***	-0.10***	0.17***	1.00

Appendix 2.B. Further Robustness Checks (GDP per Capita, Macroeconomic Volatility, and Years following the Onset of a Crisis)

	Duration Models			Logit Models		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-0.8773	1.0932	-2.1888	1.1268	-0.9692	4.6065
	(2.1163)	(1.2576)	(1.4921)	(2.0291)	(1.7610)	(1.0747)***
GDP growth (real)	0.0077	0.0145	0.0532	0.0292	0.0500	-0.1074
	(0.0899)	(0.0662)	(0.0282)*	(0.0899)	(0.0822)	(0.0346)***
Real interest rate	-0.0109	-0.0100	-0.0006	0.0222	0.0227	0.0064
	(0.0175)	(0.0123)	(0.0008)	(0.0133)*	(0.0123)*	(0.0095)
Inflation	0.0006	0.0044	0.0046	0.0018	0.0018	-0.0046
	(0.0023)	(0.0015)***	(0.0038)	(0.0039)	(0.0039)	(0.0039)
Terms of trade	-0.0019	-0.0050	-0.0010	0.0004	0.0005	0.0000
	(0.0012)	(0.0018)***	(0.0011)	(0.0021)	(0.0042)	(0.0020)
Depreciation	-0.0027	-0.0054	-0.0002	-0.0011	-0.0003	0.0004
	(0.0014)*	(0.0020)***	(0.0002)	(0.0019)	(0.0019)	(0.0005)
M2/Reserves	-0.0006	-0.0216	0.0332	0.0147	0.0041	-0.0584
	(0.0186)	(0.0164)	(0.0194)*	(0.0241)	(0.0375)	(0.0174)***
Credit growth (real)	-0.0020	-0.0022	-0.0010	0.0018	0.0017	0.0009
	(0.0006)***	(0.0004)***	(0.0005)**	(0.0008)**	(0.0008)**	(0.0008)
Moral hazard index	0.0242	0.3767	-0.0531	0.3319	-0.0094	0.1524
	(0.2861)	(0.2592)	(0.3315)	(0.3859)	(0.3624)	(0.2154)
British origin	-0.2758	0.2169	-0.5277	1.2359	0.8291	1.0095
	0.7892	(0.6309)	(0.6779)	(1.0108)	(0.9789)	(0.4196)**
French origin	-0.9286	-0.9227	-1.1972	1.7123	1.9564	1.7027
	(0.4951)**	(0.5003)*	(0.5293)**	(0.6424)***	(0.6659)***	(0.3225)***
Scandinavian origin	-4.0252	-2.2894	-1.7506	4.7855	1.7540	2.0237
	(1.4052)***	(0.5548)***	(0.5634)***	(1.8609)***	(1.2328)	(0.5620)***
H-Statistic	3.1125	6.0835	4.0767	-4.5651	-5.6360	-6.4997
	(1.6898)*	(1.6055)***	(1.7344)**	(1.8845)**	(1.8412)***	(1.3937)***
Concentration	5.2243	1.9233	3.7488	-5.5973	-1.6119	-5.1540
	(3.0155)*	(1.4629)	(1.6697)**	(3.2872)*	(2.4660)	(1.2214)***
GDP/capita	0.0001			-0.0001		
	(0.0000)**			(0.0000)***		
Standard deviation of GDP growth		-0.7139			0.2523	
		(0.1164)***			(0.2320)	
Observations	546	546	644	567	567	667
Number of crises	21	21	118	28	28	128
Type I Error in %	n/a	n/a	n/a	33.21 %	14.29%	71.61 %
Type II Error in %	n/a	n/a	n/a	21.43 %	29.68%	2.34 %
AIC	0.167	0.156	0.001	0.380	0.390	0.823
Pseudo R square	n/a	n/a	n/a	0.168	0.1433	0.201

Specification (1) and (4) include GDP/capita as an additional regressor. Specification (2) and (4) include the standard deviation of GDP growth to control for macroeconomic volatility, and Specifications (3) and (6) include the years following the onset of a crisis.

Appendix 2.C. Cox and Weibull Models

	Cox Models				Weibull Models			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	n/a	n/a	n/a	n/a	4.3990	1.7670	1.1743	6.5334
	n/a	n/a	n/a	n/a	(0.4925)***	(1.1920)	(1.4964)	(4.3113)
GDP growth (real)	0.0301	-0.0083	-0.0118	-0.0227	-0.0531	-0.0193	-0.0159	-0.0115
	(0.0693)	(0.0821)	(0.0856)	(0.0792)	(0.0621)	(0.0709)	(0.0717)	(0.0727)
Real interest rate	0.0082	0.0106	0.0079	0.0051	-0.0086	-0.0098	-0.0084	-0.0076
	(0.0157)	(0.0213)	(0.0186)	(0.0172)	(0.0090)	(0.0126)	(0.0116)	(0.0123)
Inflation	0.0009	0.0005	-0.0005	-0.0024	-0.0018	-0.0015	-0.0008	0.0002
	(0.0015)	(0.0015)	(0.0017)	(0.0022)	(0.0010)*	(0.0013)	(0.0016)	(0.0020)
Terms of trade	0.0027	0.0031	0.0028	0.0028	-0.0018	-0.0021	-0.0019	-0.0019
	(0.0026)	(0.0026)	(0.0027)	(0.0026)	(0.0015)	(0.0016)	(0.0015)	(0.0016)
Depreciation	0.0047	0.0032	0.0037	0.0041	-0.0032	-0.0021	-0.0023	-0.0027
	(0.0023)**	(0.0025)	(0.0021)*	(0.0019)**	(0.0013)**	(0.0015)	(0.0013)*	(0.0012)**
M2/Reserves	-0.0086	-0.0123	-0.0249	-0.0243	0.0000	0.0054	0.0136	0.0108
	(0.0283)	(0.0284)	(0.0303)	(0.0322)	(0.0210)	(0.0216)	(0.0229)	(0.0240)
Credit growth (real)	0.0012	0.0016	0.0016	0.0021	-0.0010	-0.0013	-0.0014	-0.0017
	(0.0004)***	(0.0005)***	(0.0005)***	(0.0006)***	(0.0004)**	(0.0005)***	(0.0005)***	(0.0006)***
Moral hazard index	0.0038	-0.2306	-0.1934	0.0302	-0.0479	0.1557	0.1401	-0.0155
	(0.2183)	(0.2858)	(0.3182)	(0.3572)	(0.1669)	(0.2235)	(0.2339)	(0.2546)
British origin	0.6096	0.5516	0.3289	0.9047	-0.3712	-0.2896	-0.1537	-0.5473
	(0.6381)	(0.7278)	(0.8496)	(0.8522)	(0.5472)	(0.6311)	(0.6910)	(0.7749)
French Origin	1.0133	1.3737	1.1011	1.0398	-0.8723	-1.1871	-1.0119	-1.0012
	(0.6070)*	(0.5800)**	(0.5666)*	(0.6306)*	(0.5254)*	(0.5402)**	(0.5140)**	(0.5771)*
Scandinavian origin	1.1899	1.1188	1.5903	1.2762	-0.9022	-0.8244	-1.1554	-0.9935
	(0.5580)**	(0.5591)**	(0.6731)**	(0.6934)*	(0.5115)*	(0.4945)*	(0.6415)*	(0.6228)
H-Statistic		-3.9589	-2.8165	10.3182		3.5029	2.8702	-5.9357
		(1.6414)**	(1.8152)	(8.8546)		(1.3546)***	(1.4400)**	(6.8191)
Concentration			-2.6591	15.1665			1.8287	-10.0536
			(2.5553)	(12.0245)			(1.9606)	(9.3203)
H-Statistic * Concentration				-30.4274				20.3337
				(20.5009)				(15.7024)
Observations	546	546	546	546	546	546	546	546
Number of crises	21	21	21	21	21	21	21	21
Type I Error in %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Type II Error in %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
AIC	0.281	0.279	0.281	0.280	0.176	0.173	0.175	0.175
Pseudo R square	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wald Test for H_0: $\alpha = 1$	n/a	n/a	n/a	n/a	1.070	1.010	1.020	0.860

Note: Signs in the Cox model are reversed as it yields the hazard of experiencing a crisis.

Appendix 2.D. Marginal Effects – Evaluated at the Mean

Variable	dy/dx	Std. Err.	Z	P>z
GDP growth (real)	0.0021	0.0027	0.7600	0.4490
Real interest rate	0.0017	0.0004	1.5900	0.1130
Inflation	0.0001	0.0001	0.8800	0.3770
Terms of trade	-1.18e-06	0.0001	-0.0100	0.9900
Depreciation	-0.0001	0.0001	-0.4300	0.6640
M2/Reserves	-0.0003	0.0009	-0.3500	0.7260
Credit growth (real)	0.0001	0.0001	1.9300	0.0540
Moral hazard index	0.0017	0.0106	0.1600	0.8700
British origin	0.0428	0.0503	0.8500	0.3950
French origin	0.07901	0.0270	2.9300	0.0030
Scandinavian origin	0.09204	0.1252	0.7400	0.4620
H-Statistic	-0.1498	0.0624	-2.4000	0.0160
Concentration	-0.0528	0.0686	-0.7700	0.4410

(*) dy/dx is for discrete change of dummy variable from 0 to 1.

Chapter III

COMPETITION, CONCENTRATION AND BANK SOUNDNESS: NEW EVIDENCE FROM THE MICRO-LEVEL.

COMPETITION, CONCENTRATION AND BANK SOUNDNESS: NEW EVIDENCE FROM THE MICRO-LEVEL.

ABSTRACT

We use cross-country data for more than 2,600 banks in Europe for the period 1999 - 2004 to empirically test the hypothesis that increased competition provides incentives for banks to hold higher capital ratios against default. A growing body of recent empirical evidence challenges the widely held view contemplating trade-offs between competition and banking system soundness. We extend this recent work to the bank level and distinguish explicitly between competitive conduct of small and large banks, measured by the Panzar and Rosse (1987) H-Statistic. Employing panel data techniques, we show that the consensus results regarding the trade-off between competition and stability can be easily reversed when taking account of the endogeneity between competition, concentration and bank stability, and when the measure of competition is derived from profit-maximising equilibrium conditions. Thus, our findings indicate that there need not be a trade-off between competition and bank risk-taking. Rather, banks tend to hold higher capital buffers when operating in a more competitive environment. This result is robust to a vast array of sensitivity analyses and also holds when controlling for the degree of concentration in banking systems, considering characteristics of the wider financial system, accounting for interindustry competition, and controlling for the regulatory and institutional environment.

3. INTRODUCTION

Competition in banking systems has always been subject to controversial debates amongst policymakers and regulators. Cross-border mergers, in particular in Europe, and consolidation within national boundaries have increasingly prompted concerns about greater market power enjoyed by banks, the impact on competition among financial institutions, and, ultimately, possibly arising adverse ramifications for financial stability (Mishkin, 1999; Group of Ten, 2001; International Monetary Fund, 2001; De Nicoló et al., 2004).

Much of the extant literature points towards trade-offs between competition and bank stability (e.g. Keeley, 1990). However, an increasing body of recent empirical research challenges this widely held perception that deeply influenced the regulatory and supervisory environment which financial institutions operate in (Vives, 2001; Carletti and Hartmann, 2003; Boyd and de Nicoló, 2005). Likewise, economic theory also makes countervailing predictions about the nexus between competition, bank market structure and banking stability. Whereas economic welfare theorems suggest that greater competition generally enhances efficiency of firms, which would be reflected in increased stability, entry barriers to the banking sector, information asymmetries and relationship lending give rise to frictions that hamper a straightforward application of these welfare theorems to banking.

This chapter assesses the impact of bank competition and concentration on bank stability. Specifically, we relate the Panzar and Rosse (1987) H-Statistic as a measure for competition to banks' capital ratios in a sample of banks from ten European countries for the period 1999 - 2004. We also consider each individual bank's market share and take account of the level of concentration in the banking systems under investigation. To this end, we employ commonly used concentration measures such as the 3-bank concentration ratio and the Herfindahl-Hirschman index. Moreover, we control for numerous characteristics of the wider financial system and the regulatory and institutional environment. As detailed further below, we take the effect of the number of financial institutions in a country, interindustry competition, strength of institutions, deposit insurance design features and bank ownership into consideration.

We focus attention on the European banking sector since the European banking market has been subject to extensive deregulation following the Second Banking Coordination Directive in 1989. This Directive was devised to enable a level playing field for competition among financial institutions by granting them a 'single passport' to operate across all member countries of the European Union whilst remaining subject to the regulations of their respective home country.[23]

Our approach complements and extends previous studies on the relationship between competition, concentration, and bank stability in a number of distinct aspects: First, this is to the best of our knowledge the first study that relates a direct measure of competitive bank conduct, the Panzar and Rosse (1987) H-Statistic, to individual bank stability using a cross-sectional time-series dataset for more than 2,600 banks with more than 8,500 bank-year observations over the period 1999 - 2004 in ten European countries. Second, this study helps disentangle the relationship between competition and concentration by simultaneously considering the effect of variables that capture both competition and concentration. Previous studies find a positive relationship between concentration and banking system soundness. Our research reinvestigates the concentration-fragility nexus and explores whether concentration and competition measure different characteristics of banking systems. Third, the setup as a panel using bank-level data permits exploiting both cross-sectional and time-series variation of competitive conduct of financial institutions. As a result, our approach has a considerably improved statistical power compared to previous cross-country studies that focus attention on systemic crises and estimate logit models where bank stability is assumed to be either present or absent (Beck et al, 2006, forthcoming; Demirgüç-Kunt and Detragiache, 2002, 2005). Fourth, unlike previous studies, we take account of the endogeneity of the contestability of banking systems, concentration, the individual bank's market share, and our measure of individual bank stability. This issue has not yet been recognised in previous work. Fifth, our study allows for the impact of competition arising from the conduct of other agents in the financial system and also considers the regulatory and institutional environment. Thus, the dataset

[23] Additional details regarding the institutional environment European banks operate in can be found in Mercieca et al. (forthcoming).

available to us permits drawing a rich set of conclusions regarding the relative effect of competitive bank conduct across different jurisdictions and time.

Using panel regression techniques, and differentiating between competitive conduct of small and large banks, our main results indicate that banks tend to hold higher levels of capital as a buffer against default when operating in a more competitive environment, as measured by the Panzar-Rosse (1987) H-Statistic. This finding holds when we control for competition arising from other agents in the financial system and when we take the regulatory and institutional environment into consideration. The effect of competition on capital ratios is however slightly dampened in circumstances when the overall level of economic development in a country is high and when the banking industry is more concentrated. Furthermore, we perform a vast array of robustness tests involving, *inter alia*, i) alternative H-Statistics, ii) alternative measures of concentration, iii) an alternative dependent variable, iv) the omission of bank level control variables, and, finally v) alternative samples excluding non EU-banks and non-Euro area banks. All sensitivity checks corroborate our result for the positive association of the H-Statistic with the capital ratio. Thus, our results provide empirical support for the view that competition is positively associated with bank soundness on the firm level, supporting economic theories that ascertain that more competition incentivizes bank managers to act more prudently. In terms of economic significance, we present evidence that the magnitude of the effect of competition on banks' capital ratios is sizeable. For instance, a one percent increase in the H-Statistic will increase the capital ratio for the median bank in our sample from 5.6 percent to 5.9 percent. However, we find no consistent relationship between the degree of concentration in banking systems and the level of capital held by financial intermediaries.[24] To this extent, our results suggest a re-evaluation of the positive link between concentration and banking stability proposed in previous work. Finally, our study also underscores that normative analyses concerning policy implications for regulation derived from the assumption that increased competition is an impediment to bank soundness ought to be seriously re-examined.

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[24] Nier and Baumann (2006) report that they do not find a significant relationship between the degree of concentration in banking systems and the level of capital held by individual financial institutions. Beck et al. (2006, forthcoming) report a positive association between the level of concentration in a country and banking system soundness.

The plan for the chapter is as follows: Section 3.1. presents the motivation for this study and offers a brief review of the literature. We elaborate in Section 3.2. on the variables, computation of the H-Statistic, and the econometric approach. This section also provides information about the sampling strategy and descriptive statistics. Section 3.3. contains our empirical analysis using a model for panel data. Section 3.4. extends the analysis by taking characteristics of the wider financial system into account and further expands the analysis to the regulatory and institutional environment banks operate in. Section 3.5. presents robustness tests. We offer concluding remarks and policy implications in Section 3.6.

3.1. MOTIVATION AND BRIEF REVIEW OF THE LITERATURE

Undoubtedly, an examination of the link between bank competition, market structure, and financial stability[25] is of more than just theoretical interest. Banks play a crucial role in the process of effectively helping to mobilize and allocate society's savings by intermediating between borrowers and lenders (Diamond, 1984; Boyd and Prescott, 1986). As a consequence, research on the implications for financial stability arising from competitive bank behaviour and the role of market structure bears important policy implications. However, theoretical and empirical studies provide countervailing predictions and contradictory evidence about the effect of competition and concentration on bank performance and, more importantly, banking stability.

Previous work, mostly focusing on the US banking market, implies an inverse relationship between competition for bank deposits and bank stability (Keeley, 1990).[26] Consequently, regulators have conventionally attempted to curb competition in banking to avoid excessive risk-taking by financial institutions (Vives, 2001; Carletti and Hartmann, 2003; Boyd and de Nicoló, 2005).[27] However, a growing body of recent empirical evidence suggests that higher levels of competition, greater degrees of concentration and sectors

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[25] Goodhart (2006) and Allen and Wood (2006) offer discussions of the definition what constitutes 'financial stability' and Cihak (2006) presents a detailed overview of central banks' increasing focus on financial stability by reviewing 160 financial stability reports published in 47 countries over a ten year period.

[26] Note that there is a related body of literature that links liberalisation and deregulation with banking system stability. These studies argue that liberalisation and deregulation enable banks to embark on new lines of business in which they have insufficient expertise and consequently run into financial difficulties. This literature concludes that this result is due to intensive competition in these new lines of business, see, for instance Fischer and Chenard (1997) and Drees and Pazarbasioglu (1998).

[27] Relatedly, the issue of the nexus between competition and stability on the one hand and the conduct of prudential bank regulation on the other hand is explored in greater detail by Vives (2001).

with greater contestability where banks face less activity restrictions are associated with increased stability (Schaeck et al., 2006; Beck et al., 2006, forthcoming; Barth et al., 2004).[28] Likewise, economic theory has thus far failed to consistently agree on the implications for bank stability arising from competitive behaviour among financial institutions. Whereas Matutes and Vives (1996) argue that instabilities are not related to market structure, Smith (1984) illustrates how increased competition for deposits tends to increase bank fragility. Similar predictions are made by Besanko and Thakor (1993), Cordella and Yeyati (1998), Hellman et al. (2000) and Repullo (2004). By contrast, Caminal and Matures (2002) demonstrate that monopoly banks with intermediate monitoring costs can be more prone to originate risky loans that give rise to higher probability of subsequent failure. Likewise, Perotti and Suarez (2002) propose a 'last bank standing' effect in a dynamic duopolistic model. According to this effect, prudent behaviour is encouraged following failure of the competing bank in the model since the surviving institution will benefit from the other bank's failure. Using a model of mean-shifting investment technologies, Koskela and Stenbacka (2000) are the first to show that allowing for competition in lending markets reverses the findings of the studies that contemplate a trade-off between competition and stability. This finding is subsequently confirmed by Boyd and de Nicoló (2005). Finally, Allen and Gale (2004) and Boyd et al. (2004) highlight that the relationship between competition and financial stability is multifaceted and that there is no simple trade-off between competition and stability.

Much of the empirical research is largely constrained to studies that compare individual countries' banking systems. For instance, Bordo et al. (1995) contrast the Canadian with the US banking system between 1920 and 1980 and report that Canadian banks failed less often than US institutions, a finding they assign to the oligopolistic structure of the Canadian banking system. Hoggarth et al. (1998) compare the German and UK banking systems and state that profits in the UK were higher, but also more variable than in Germany. They infer that the less competitive German system can be perceived to be more stable.

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[28] A comprehensive review on the several strands of literature related to the linkages between competition, concentration, regulation and bank fragility can be found in Schaeck et al. (2006). Berger et al. (2004) provide a detailed account for the evolution of research on bank concentration and competition.

We argue that the contradicting predictions are attributable to the way competition is measured in many previous studies as mentioned above. These studies are usually based on the structure-conduct-performance (SCP) paradigm, which assumes that a certain market structure is related to competitive conduct.[29] Indeed, competition is frequently proxied by the degree of concentration in a banking sector with the implicit assertion of an inverse relationship between concentration and competition.[30] A theoretical justification for this can be found in some oligopoly solution concepts such as the long-standing notion of Cournot oligopoly (Cowling and Waterson, 1976). While such optimistic and straightforward conclusion is convenient for policymaking, supervision and regulation, several issues have to be taken into consideration before this view can be accepted: First, a market must be defined which directly affects the measurement of the concentration variable (Shaffer, 2004b). However, it is widely accepted that the banking industry has become globalized (Vives, 2001), and that in particular large financial institutions compete internationally. Despite this fact, measures of concentration are frequently computed using country-level concentration ratios (Beck et al., 2006, forthcoming). In addition, Shaffer (2004b) argues that banking markets in smaller countries may extend beyond a single nation's boundaries. Consequently, the definition of a market applied in these previous studies may be seriously questioned. Second, the direction of causality running from structure to conduct is not clear (Tirole, 1988; Vesala, 1995). Game theoretic models do not assume a direct causal relation from structure to conduct but instead view market structure and conduct as endogenous. Third, it has been shown in the industrial organisation literature that measures of market structure such as the number of institutions and concentration ratios are not necessarily related to the level of competitiveness in an industry (Baumol et al., 1982).[31] This assertion is substantiated by a

[29] A detailed survey of the early studies on the linkages between bank market structure and competition can be found in Gilbert (1984).

[30] It is often argued that high levels of concentration are a signal for market power enjoyed by incumbent firms with uncompetitive behaviour that gives rise to inefficiencies (see Demirgüç-Kunt et al., 2004). However, an alternative view, the so called efficient-structure theory, stresses that more efficient banks tend to operate at lower costs and therefore increase market share (Demsetz, 1973). This phenomenon may be amplified by the presence of economies of scale (Diamond, 1984; Boyd and Prescott, 1986).

[31] For instance, Bikker (2004) argues that relying on concentration as a measure of bank competition gives rise to misleading inferences and measurement problems since concentration measures such as the Herfindahl-Hirschman Index and the 3-bank concentration ratio tend to exaggerate the level of concentration in small sized countries and are increasingly unreliable when the number of banks is small. In addition, Claessens and Laeven (2004) point out that bank performance measures such as

growing body of empirical evidence in the banking literature: Claessens and Laeven (2004) report a significantly positive association between concentration and a measure of competition in a large sample of 50 countries,[32] and Demirgüç-Kunt et al. (2004) underscore that using national bank concentration measures may be inappropriate to proxy for the competitive environment in the banking industry. Similarly, Beck et al. (2006, forthcoming) state that increased concentration and greater contestability are inversely related to the probability of systemic banking crises, and infer that concentration measures something else besides market power. In a recent study, Carbo et al. (2006) investigate if commonly used measures of concentration and competition in the banking literature contain the same information and present empirical evidence that there is little consistency between the Panzar and Rosse (1987) H-Statistic and the Herfindahl-Hirschman index, which is often used as a proxy for competition in banking studies (e.g. Boyd and de Nicoló, 2005; Beck et al., 2006, forthcoming). Therefore, they conclude that competition cannot be substituted by measures of concentration. Moving beyond these previous studies, Schaeck et al. (2006) distinguish explicitly between concentration and a measure of competition derived from profit-maximising conditions and find no statistically significant relationship between concentration and banking system fragility. By contrast, they present empirical evidence that increased competition is significantly positively associated with increased banking system stability. In line with Claessens and Laeven (2004), Schaeck et al. (2006) therefore conclude that competition and concentration are two concepts distinct from each other that describe different characteristics of banking systems. This suggests that the relationship between market structure and competition in banking systems is not trivial. Whereas concentration is indeed a measure of market structure, competition can be understood to measure competitive dynamics among financial institutions. In light of this evolving body of literature that distinguishes between concentration and competition, Berger et al. (2004) explicitly state that it is inappropriate

interest margins are also inappropriate to proxy for competition since macroeconomic performance, form and degree of taxation of financial intermediation, quality of a country's judicial system and bank-specific factors influence bank performance.

[32] Note that previous work by Bikker and Haaf (2002) provides countervailing evidence. However, their study fails to take account of the contestability of the banking market, and the regulatory and the institutional environment.

to solely rely on concentration to assess the degree of competition in banking and argue that

> *"More research is clearly needed on the topic of bank concentration and competition."*[33]

As a consequence, these important considerations complicate and limit the application of the SCP-paradigm to banking in general and for the purpose of this study in particular.[34] Moreover, much of the previous work based on the SCP-paradigm views both stability and competition as outcomes, determined by the structure of the banking system. However, our research aims to address the important policy consideration as to whether more competition among financial institutions adversely affects banking stability, whilst simultaneously taking the effect of concentration into account.

The growing body of empirical support for a positive link between concentration, contestability, and competition in the literature on systemic crises therefore suggests reconciling the evidence obtained in cross-country studies. To this end, we use bank-level data rather than focusing attention on systemic events. Our rationale is as follows: If the empirical evidence indicating that a) concentration is an insufficient measure for competition, and that b) concentration and competition measure distinctive features of banking systems, it is critical to test for the effect of competition on bank stability while simultaneously considering the impact of concentration in the banking system.

3.2. VARIABLES, ECONOMETRIC APPROACH AND SUMMARY STATISTICS

The empirical strategy pursued in this chapter is as follows: We test whether increased competition among banks affects their risk-taking behaviour to curtail insolvency risk. To this end, we investigate if competition among banks leads them to increase their capital ratio for given asset risk, whilst simultaneously controlling for concentration in the banking industry and other factors that are likely to impact upon capital ratios. Indeed, introduction of the Basel Capital Accord in 1988 and the advent of the new Basel Capital Accord have made banks increasingly focus on managing their capital base, which serves

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[33] See Berger et al. (2004), p. 445.

[34] A similar point is made by Goldberg and Rai (1996), who explicitly test the SCP hypothesis for eleven European countries for the period 1988 - 1991 and find no supportive evidence for a positive relationship between concentration and bank performance, proxied by profitability.

as a buffer to absorb idiosyncratic shocks to avoid the risk of default. Moreover, it is well known that default risk of financial institutions is directly related to the risk inherent in a bank's asset portfolio and the bank's level of capitalization (Merton, 1977; Martin, 1977).[35]

3.2.1. PANZAR AND ROSSE (1987) H-STATISTIC

We first describe the estimation procedure utilized to compute the Panzar and Rosse (1987) H-Statistic, our key explanatory variable. The statistic was proposed in the 'new empirical industrial organization literature', and is designed to discriminate between competitive, monopolistically competitive, and monopolistic markets. Claessens and Laeven (2004, 2005) argue that the H-Statistic is a more appropriate measure for the degree of competition than previously used proxies for competitive conduct. Likewise, Shaffer (2004a) highlights the analytical strength and superiority of the H-Statistic over other measures of competition since this measure is formally derived from profit-maximizing equilibrium conditions. Furthermore, the H-Statistic is robust with respect to the market since it only draws upon characteristics of reduced-form revenue equations at the firm level. It therefore comes as no surprise that an increasing body of empirical work employs this statistic to test for competition in banking (Shaffer, 1982, 2004b; Nathan and Neave, 1989; Molyneux et al., 1994, 1996; Vesala, 1995; Rime; 1998; De Bandt and Davis, 2000; Bikker and Haaf, 2002; Claessens and Laeven, 2004, 2005; Coccorese, 2004; Al-Muharrami et al., 2006; and Carbo et al., 2006).

The H-Statistic is based on reduced-form revenue equations and measures market power by the extent to which changes in factor input prices are reflected in revenue. Assuming long-run equilibrium, a proportional increase in factor prices will be mirrored by an equiproportional increase in gross revenue under perfect competition. However, under monopolistic competition, revenues will increase less than proportionally to changes in input prices. In the monopoly case, increases in factor input prices will be either not reflected in revenue, or will tend to decrease revenue.

Vesala (1995) shows that the H-Statistic is an increasing function of the demand elasticity, suggesting that as H increases, the less market power is exercised on the part of the

[35] Note that we use the capital ratio, defined as equity to total assets as dependent variable. Supervisory agencies use a different definition of capital, and typically focus on the capital adequacy ratio, defined as capital to risk-weighted assets.

banks.[36] Therefore, the magnitude of H can be perceived as a measure of competition and interpretation is straightforward:

$H \leq 0$	indicates monopoly equilibrium, perfectly colluding oligopoly or conjectural variations short-run oligopoly
$0 < H < 1$	indicates monopolistic competition
$H = 1$	indicates perfect competition

We estimate the H-Statistic using a setup similar to Nathan and Neave (1989), De Bandt and Davis (2000), Bikker and Haaf (2002) and Claessens and Laeven (2004, 2005). In addition, we split the sample into large and small institutions since potential differences in the way small and large banks compete would bias our measure of competition either upwards or downwards, depending on the proportion of small and large banks in the respective country. Small banks often operate on a locally constrained basis and tend to face stronger competition from other small banks in retail banking operations.[37] By contrast, large institutions compete in different lines of business, e.g. corporate and investment banking, and compete on a global level. We use a cut-off point of 450 million EUR to distinguish between small and large banks.[38] This cut-off point is aligned with the literature on community banks in the US (Stiroh, 2004a) and with the literature on small banks in Europe (Mercieca et al., forthcoming).

To obtain a value for the H-Statistic for each year, we use an approach similar to Molyneux et al. (1996) and estimate the following reduced-form revenue equation cross-sectionally for each country for small and large banks for the years 1999 - 2004.

$$\ln(R) = \alpha + \beta_1 \ln(W_1) + \beta_2 \ln(W_2) + \beta_3 \ln(W_3) \qquad (1)$$
$$+ \gamma_1 \ln(Y_1) + \gamma_2 \ln(Y_2) + \gamma_3 \ln(Y_3) + \gamma_4 \ln(Y_4) + \varepsilon$$

where R is the ratio of total revenue to total assets (as a proxy for the output price of loans and other services). This dependent variable includes total interest revenue, fee

[36] This implies that the H-Statistic is not only useful in rejecting certain types of market behaviour, but that the magnitude of the H-Statistic can serve as a measure for the degree of competition. As a consequence, a continuous interpretation is appropriate (Vesala, 1995; Bikker and Haaf, 2002; Claessens and Laeven, 2004, 2005; Carbo et al., 2006); see also Chapter II, Section 2.2.3.

[37] See Brunner et al. (2004) for additional details regarding European banks that operate within narrow regional boundaries.

[38] Stiroh (2004a) uses 300 million USD as a cut-off point for his research on small banks in the US, highlighting that this is a standard cut-off point in studies for small banks.

income, commission income and other operating income, which makes it a complete measure of the competitive conduct of financial institutions. This is due to the fact that boundaries between interest and non-interest income are blurring and this approach is further substantiated by the fact that competition is equally fierce for both types of revenue (De Bandt and Davis, 2000; Claessens and Laeven, 2004). The variable W_1 is the ratio of interest expenses to total deposits and money market funding (as a proxy for input price of deposits), W_2 is the ratio of personnel expenses to total assets (proxy for input price of labour), and W_3 denotes the ratio of other operating and administrative expense to total assets (proxy for input price of equipment and fixed assets). We control for a number of additional bank-specific factors to take account for risk-taking behaviour and bank size. Specifically, Y_1 captures the ratio of deposits to deposits and money market funding, Y_2 is the ratio of net loans to total assets, Y_3 is the ratio of equity to total assets and Y_4 captures bank size, measured as total balance sheet assets and ε is the error term. All variables enter the equation in logs. The measure of competition, the H-Statistic, is calculated as the sum of the coefficients $\beta_1 + \beta_2 + \beta_3$.[39]

For robustness tests performed in Section 3.5. below, we also calculate the H-Statistic with the ratio of interest revenue to total assets as dependent variable in Equation (1) and subsequently re-calculate the H-Statistics in another test where we omit the equity ratio to avoid any correlation between the H-Statistic and the equity ratio affecting our final inferences.

Shaffer (1982, 2004a) and Molyneux et al. (1994, 1996) point out that the H-Statistic assumes long-run equilibrium. We therefore perform the following analysis to investigate

[39] Note that applying the Panzar and Rosse (1987) H-Statistic to banking requires the working assumption that banks are to be treated as single product firms (De Bandt and Davis, 2000). This view is consistent with the intermediation approach for measuring bank output. The intermediation approach asserts that banks are intermediators of services rather than producers of deposit accounts and loans. Thus, the values of loans and investments are used as output measures, whereas labour and capital are inputs to the process of intermediation. Consequently, operating costs plus interest costs are relevant cost measures.

long-run equilibrium and estimate Equation (1) with the pre-tax return on assets as dependent variable.[40]

$$\ln(ROA) = \alpha + \beta_1 \ln(W_1) + \beta_2 \ln(W_2) + \beta_3 \ln(W_3) \qquad (2)$$
$$+ \gamma_1 \ln(Y_1) + \gamma_2 \ln(Y_2) + \gamma_3 \ln(Y_3) + \gamma_4 \ln(Y_4) + \varepsilon$$

The modified H-Statistic is the equilibrium statistic and it is again calculated as the sum of the coefficients $\beta_1 + \beta_2 + \beta_3$. We test if the equilibrium statistic $E = 0$, using an F-test. This test aims to establish whether input prices are uncorrelated with industry returns since a competitive system will equalise risk-adjusted rates of return across banks in equilibrium (Molyneux et al., 1996). If this hypothesis is rejected, the market is assumed to be in disequilibrium. It is important to mention that a resulting disequilibrium does not necessarily invalidate the results obtained with the Panzar and Rosse (1987) methodology. Rather, rejection of equilibrium indicates that the industry is developing dynamically during the sampling period (Shaffer, 2004b).

Calculation of the measure for competition, the H-Statistic, is presented in Section 3.2.1. We obtain H-Statistics for each country for each year depending on whether the bank is classified as either a large or small institution. Furthermore, we confirm our inferences in Section 3.5. below using alternatively computed H-Statistics and using the H-Statistics obtained from Claessens and Laeven (2004), who offer a comprehensive study of competition in 50 countries for the period 1994 - 2001.

3.2.2. Additional Explanatory Variables

We use BankScope data for all our bank-specific variables. BankScope is a commercial database for bank data based on financial statement information provided by Bureau van Dijk. BankScope has been extensively used for many cross-country studies in the banking literature and provides harmonized data templates that permit cross-country comparisons.[41] We calculate the 3-bank concentration ratio for each country for each year during the sampling period 1999 - 2004. Subsequently, we also use the Herfindahl-

[40] Following Claessens and Laeven (2004), we calculate the dependent variable $ROA' = \ln(1 + ROA)$ where ROA is the unadjusted return on assets, since return on assets can take on (small) negative values.

[41] For additional details on BankScope see Claessens et al. (2001, p. 894).

Hirschman index and the log of the ratio of the number of banks to the population in a country as alternative and additional measures for bank market structure respectively. While the Herfindahl-Hirschman index is also computed using BankScope data, the latter is not obtained from BankScope. All three tests confirm our results as detailed further below.

When examining the effect of competition on capital ratios, it is imperative to consider bank-level, regulatory, institutional and macroeconomic control variables that might have an effect on bank capital. This helps mitigate omitted variable bias.

Most importantly, prudent bank managers will take credit risk into consideration. Therefore, we control for the ratio of loan loss provisions to net loans as a measure for credit risk in the bank. Shrieves and Dahl (1992) and Flannery and Rangan (2004) report evidence for a positive association of bank asset risk with the capital buffer for the US. In addition, more profitable banks can be assumed to hold higher levels of capital. This is due to the fact that they can increase capital through retained earnings; this is aligned with the pecking order theory (Myers, 1984). Consistent with this theory, Flannery and Rangan (2004) report evidence that bank profitability is positively associated with capital ratios. Hence, we include the ratio of profit before tax to total assets to account for this finding. Numerous studies have examined the effect of market discipline on bank risk-taking in recent years. For instance, Park and Peristiani (1998), Maechler and McDill (2006), Nier and Baumann (2006) and Schaeck (2006)[42] present evidence that uninsured depositors can curb banks' risk-taking behaviour. Thus, the amount of uninsured deposits can be assumed to be positively related to the banks' capital ratio. We therefore include the interbank ratio as an additional control variable since deposit insurance does not normally cover such deposits.[43] This reflects the assertion that other banks are understood to have the ability to monitor their peers in the interbank market (Nier and Baumann, 2006). A further consideration concerns the effect of bank size. Ayuso et al. (2004) and Flannery and Rangan (2004) offer evidence that larger banks tend to hold lower levels of capital.

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[42] See also Chapter IV.

[43] The interbank ratio is the ratio of money lent to other banks divided by money borrowed from other banks. A ratio greater than one indicates that the bank is a net placer in the interbank market and is therefore more liquid. By contrast, if the ratio is below one, the bank is a net borrower in the interbank market and heavily reliant on interbank deposits to fund its assets.

This finding is aligned with Demsetz and Strahan (1997) who report that larger intermediaries are better able to reap benefits of diversification and therefore operate with lower capital ratios. Moreover, larger banks will also find it easier to raise capital on the stock market (Flannery and Rangan, 2004; Nier and Bauman, 2006). Consequently, we control for bank size, using the log of total assets, and anticipate an inverse relationship between bank size and the capital ratio. We also include the market share of each individual bank in our regressions. Banks that are large relative to the banking system might be subject to regulatory forbearance in case of financial difficulties and may therefore hold a low capital ratio (Mishkin, 1999). Since this variable is highly skewed to the left as many banks have very small market shares, we use a log transformation for the market share variable.

Since the level of capital held in financial institutions may also depend on macroeconomic conditions, we include GDP growth, inflation, and the real interest rate in our regression specifications. Capital ratios may be procyclical if banks use an expansionary macroeconomic environment to accumulate capital (Borio et al., 2001). We therefore anticipate a positive relationship between GDP growth and bank capital.[44] Controlling for inflation is also important as Hortlund (2005) finds an inverse association between inflation and bank capital. Hence, we expect a negative sign for the coefficient of inflation in our regressions. In addition, rising real interest rates tend to adversely affect borrowers' ability to repay their bank loans. This, in turn, can negatively impact on capital ratios if many borrowers default, a relationship that is well documented in the literature on systemic banking crises (Demirgüç-Kunt and Detragiache, 1998). Therefore, we expect a negative relationship between the real interest rate and the capital ratio. Finally, we incorporate GDP per capita as a control for the overall level of economic environment as we anticipate that a higher level of economic environment also proxies for more sophisticated procedures regarding regulatory and supervisory oversight of financial institutions (Demirgüç-Kunt and Detragiache, 1998; Demirgüç-Kunt et al., 2004). If this assertion holds, we anticipate a positive relationship between GDP per capita and bank capital.

[44] Note that an alternative view in the literature finds countervailing evidence for counter-cyclical behaviour of bank capital ratios, see Ayuso et al. (2004).

We augment our benchmark specifications and employ a large number of additional control variables that provide information on the wider financial system and the regulatory and institutional environment.

First, we incorporate a variety of measures for the characteristics of the wider financial system into the regressions. The level of non-performing loans to total loans in the banking system is a key measure for the overall stability of a country's banking system.[45] We hypothesize that the effect of competition on capital ratios may be larger in magnitude in countries with higher proportions of non-performing loans since bank charter values can be assumed to suffer. Consequently, incentives for banks to behave prudently will be less pronounced since declining bank charter values are commonly associated with increased risk (Keeley, 1990). Thus, if bank managers 'gamble for resurrection' in episodes of sustained stress in banking systems, this relationship is likely to be negative. However, if bank managers behave prudently, a higher level of non-performing loans in the system is likely to be associated with higher capital ratios.[46]

We also control for the effect of stock market development since a well-developed stock market may change the competitive environment banks operate in. Indeed, corporates can raise funds on capital markets and these funds are close substitutes for bank loans.[47] Importantly, Dinç (2000) shows that capital market competition tends to decrease the threshold level of borrowers' creditworthiness by which banks originate loans and commit to supporting even lower quality borrowers. Thus, a highly developed stock market provides corporates with an opportunity to raise funds directly by issuing shares rather than obtaining funds from banks. During such process of disintermediation, when the banks' role as mobilizers of savings from the non-financial sector is declining, they have an incentive to compete more heavily to retain customers. If banks therefore increasingly engage in risk-taking behaviour as a result of this process of disintermediation, their capital

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[45] The Financial Sector Assessment Programme (FSAP) jointly conducted by the World Bank and the International Monetary Fund frequently draws upon this ratio to assess the overall soundness of banking systems (The World Bank - International Monetary Fund, 2005; International Monetary Fund, 2004).

[46] Note that this may be influenced by regulatory initiatives aiming to bolster the banking system's soundness by raising mandatory minimum capitalisation levels for banks.

[47] Another reason, why the effect of stock market development is an important consideration, is that the banks' ability to raise equity capital will be limited in the absence of a sophisticated capital market. This is due to the fact that the cost of raising bank capital will increase if no well-developed stock market exists (Nier and Baumann, 2006).

ratios may be affected in a negative way. An inverse relationship between stock market development and capital ratios is therefore anticipated. This, however, can be reversed if bank managers remain prudent with respect to their risk-taking behaviour.

Likewise, the relative size of the banking sector to the stock market is likely to affect the capital ratio. Bikker (2004) offers evidence that the importance of traditional intermediation activities has been declining in Europe and that banks are therefore expanding into non-traditional lines of business. Consequently, they compete more fiercely by moving into new lines of business such as fee and commission income. This however may be a precarious strategy. Mercieca et al. (forthcoming) show that risk-adjusted performance measures are significantly inversely related to moving into non-interest income generating activities in small banks in Europe.[48] If bank performance is deteriorating and losses are sustained in these new lines of business, capital ratios may suffer ultimately. Consequently, an inverse relationship between this variable and the capital ratio can be anticipated. This association may however be reversed if bank managers remain prudent.

An important consideration is furthermore interindustry competition from life insurers since these institutions directly compete with banks for asset allocation (Claessens and Laeven, 2004). We hypothesize that a larger ratio of life insurance premiums collected divided by GDP signals more competition by life insurers. If so, banks will again engage in increased risk-taking behaviour unless they remain prudent. Thus, we expect a negative impact on the banks' capital ratios if our conjecture is substantiated by the data.

Similarly, we include the growth rate of domestic credit to the private sector to GDP. This variable captures information on how banks compete during boom times. Borio et al. (2001), Keeton (1999) and Lowe (2003) state that banks frequently accumulate credit risk when the economy is prospering. We therefore control for this effect and anticipate a negative relationship between this variable and the capital ratio since a favourable economic environment might lead to excessive lending without due regard to the assessment of borrower's creditworthiness (Bikker and Metzemakers, 2005; Ruckes,

[48] Stiroh (2004a, 2004b) and Stiroh and Rumble (2006) obtain similar findings for the US banking market.

2004; Dell'Ariccia and Marquez, 2006).[49] However, if banks remain prudent, the variable can enter the regression with a positive sign.

The density of banks is occasionally used as a measure for market structure (Claessens and Laeven, 2004; Bikker, 2004).We anticipate that a sector with a higher density of banks is more competitive and therefore include the log of the ratio of banks to population into our regressions. If the number of banks serves as proxy for competition and if the hypothesis by Keeley (1990) that competition adversely affects prudent behaviour by banks simultaneously hold true, we would expect an inverse relationship between the number of banks and the capital ratio. On the other hand, if an increasing number of banks stimulates competition but nevertheless stops bank managers from excessive risk-taking by encouraging prudent behaviour, this association may be positive.

Finally, we control for mean bank size. Beck et al. (forthcoming) argue that banking systems with, on average, larger banks are more stable and Demsetz and Strahan (1997) present empirical evidence that larger bank holding companies are better diversified than their smaller counterparts in the US. Demsetz and Strahan (1997) therefore maintain that banks frequently exploit benefits arising from increased size and diversification by holding lower capital ratios since more diversification enables them to better absorb idiosyncratic shocks.[50] Thus, we conjecture an inverse relationship between mean bank size and the capital buffer. However, if this assertion does not hold true, there may be a positive link between size and capital.

We also consider variables that provide information on the regulatory and institutional environment to control for national characteristics that previous research has identified as being closely related to banking sector performance. In particular, several studies highlight the linkages between the origin of a country's judicial system and financial sector development since substantial differences exist regarding protection of creditor rights. Such rights provide the critical underpinning for financial contracting (La Porta et al., 1998; Beck et al., 2003). According to this 'law and finance' view, countries with a legal

[49] Empirical evidence for this countercyclical view can be found in Logan (2000), who shows that loan growth is a good precursor of bank failure in the UK. However, an alternative view holds that a sound economic environment tends to reduce borrower defaults, whereas a downturn will have the opposite effect (Bikker and Hu, 2002; Laeven and Majoni, 2003).

[50] Similar lines of reasoning can be found in Flannery and Rangan (2004) and Ayuso et al. (2004).

system that protects elites and favors reallocation of resources to those elites will have less well developed, and less competitive financial systems. We therefore introduce three dummy variables that take on the value one if a country has French, Scandinavian, or British legal origin or zero otherwise. We omit the dummy for German legal origin to avoid perfect collinearity.

Similarly, the strength of the institutional environment might have an influence on the way banks manage their capital. Thus, strength of institutions is a further key ingredient for the well-functioning of financial systems. We therefore include the rule of law as a measure for the strength of the institutional environment (Demirgüç-Kunt and Detragiache, 2002). The index is increasing in the quality of institutions and ranges between zero and six. We hypothesize that capital ratios are higher in a stronger institutional environment.

Extensive research has been conducted on the effect of deposit insurance on bank risk. The majority of these studies argues that presence of explicit deposit insurance and extensive coverage of insured depositors undermines market discipline (Schaeck, 2006) and gives rise to moral hazard (Demirgüç-Kunt and Detragiache, 2002; Hovakimian et al., 2003). To account for this source of moral hazard, we introduce the moral hazard index taken from Demirgüç-Kunt and Detragiache (2002). This index is computed as the first principal component obtained from eight deposit insurance design features, with higher values indicating increased moral hazard. Thus, higher values of the moral hazard index are anticipated to be inversely related to capital ratios. However, recent work by Gropp and Vesala (2004) challenges this view and underscores that a positive link between deposit insurance and bank soundness is also possible. This can be due to the fact that explicit deposit insurance signifies a commitment that deposit insurance is limited to insured depositors only.

Furthermore, the level of capital held by banks will be obviously influenced by regulatory requirements. Therefore, we control for a capital regulatory index proposed by Barth et al. (2004). This index is a summary index calculated from initial capital stringency and overall capital stringency as detailed in the Data Appendix to Chapter III. It captures information whether the capital requirements reflect risk elements, if market value losses are to be deducted prior to the calculation of the capital adequacy ratio, and which types of funds may be employed to establish a bank. Higher levels of capital stringency are

anticipated to increase the capital buffer since greater stringency will encourage prudent behaviour by bank managers.

The capital ratio is also likely to depend on the influence exerted by shareholders (Nier and Baumann, 2006). Bank managers closely controlled by shareholders are expected to avoid excessive risk-taking behaviour and therefore have an incentive to act prudently. To account for the effect of shareholder rights, we use a shareholder rights index obtained from La Porta et al. (1998). Thus, in countries with well-developed shareholder rights, capital ratios can be expected to be higher. However, if the corporate governance systems in place closely align interests of managers with those of shareholders, managers will tend to avoid raising capital as this will dilute the stake of the existing holders of equity (Myers and Majluf, 1986).

Finally, previous studies by Berger et al. (2005) and Beck et al. (forthcoming) report that bank ownership structure matters for bank performance and bank stability.[51] We therefore incorporate two variables that capture government and foreign ownership obtained from La Porta et al. (2002) and Barth et al. (2001) respectively. Government-owned banks are known to exhibit higher proportions of non-performing loans (Berger et al., 2005). Due to their ownership structure, serious moral hazard is prevalent in such institutions, since these banks can anticipate to be bailed out in case of financial difficulties. Managers of government-owned banks may be less committed to prudent behaviour, and such banks will therefore tend to hold lower capital ratios. By contrast, foreign-owned institutions are usually considered to be more efficient in terms of their risk management procedures which is attributable to more sophisticated corporate governance systems (Bongini et al., 2001). Therefore, they can be expected to have higher capital ratios.

3.2.3. ECONOMETRIC APPROACH

We now turn to the description of the estimation procedure for the effect of competition on bank stability, proxied by the capital ratio.

As highlighted above, the previous literature on the nexus between concentration, competition, and stability neglects possible endogeneity of the measures for concentration

[51] Note that cross-ownership among banks may also play a role for competition, see Trivieri (forthcoming).

and competition. Such endogeneity can arise, for instance, when causality is reversed, i.e. when concentration and competition themselves depend on capital ratios. Similarly, an individual bank's market share is also likely to be endogenous. Precisely, reverse causality could arise if a large, well-capitalised bank decides to pursue a growth strategy and merges with another large bank, thereby increasing industry concentration and the individual bank's market share. This would imply a positive relationship between bank capital, the respective concentration measures, and the market share.[52] By contrast, a negative association between these variables is also possible. Demsetz and Strahan (1997) put forward that larger banks are better able to diversify and tend to operate with lower levels of capital whereas Flannery and Rangan (2004) highlight that larger banks have better access to wholesale markets, which allows them to hold lower levels of capitalization. Based on this argument, it can be assumed that lower capital ratios tend to be associated with greater degrees of concentration in banking systems. Similarly, banks with a low capital ratio can be assumed to have lower charter values and may be therefore more prone to engage in risk-taking behaviour by competing more fiercely (Keeley, 1990). This would be reflected in a negative association between the capital ratio and competition (as measured by the H-Statistic), a result that matches a widely held perception in the theoretical literature (Smith, 1984; Besanko and Thakor, 1993; Cordella and Yeyati, 1998, Matutes and Vives, 2000; Hellman et al., 2000; Repullo, 2004). However, a positive relationship can be anticipated if higher levels of capital provide bank managers with opportunities to embark upon new, non-traditional business activities such as investment banking, and insurance and real estate activities, thereby increasing competition.

In addition, Nier and Baumann (2006) argue that the level of deposits obtained from other banks is also likely to be endogenous. Thus, the interbank ratio has to be instrumented as well. Nier and Baumann (2006) highlight that banks holding little capital

[52] This is not far-fetched. Consider mergers between Union Bank of Switzerland and Swiss Banking Corporation in 1998 to form UBS, and the merger between Bank One and JP Morgan in the US in 2004. While the coverage in BankScope does not permit reconciling the effect of the merger between Union Bank of Switzerland and Swiss Banking Corporation, we illustrate the impact of the merger between Bank One and JP Morgan on the two concentration measures. While the US is not included in our sample, the effect of the merger between Bank One and JP Morgan is a particularly good example to illustrate the importance of merger activity on concentration measures. The merger between Bank One and JP Morgan increased the 3-bank concentration ratio from 23 percent in 2003 to 28 percent in 2004 and the Herfindahl-Hirschman index increased from 0.0272 in 2003 to 0.0370 in 2004. All calculations are based on BankScope data.

may have to rely on the interbank market to obtain funding. Since an increasing reliance on interbank deposits will decrease the interbank ratio, one could anticipate a positive relationship between bank capital and the interbank ratio. By contrast, if depositors consider a bank to be risky due to a low level of capital, banks could face higher cost for funding, which would decrease reliance on interbank deposits. This would imply an inverse association of bank capital with the interbank ratio.

The other variables used in this chapter are assumed to be less likely affected by endogeneity problems. However, since the H-Statistic, the concentration measures, and the interbank ratio are expected to suffer from endogeneity, a suitable estimation procedure is needed to avoid bias in the measurement of the effect of these variables. We therefore turn to instrumental variable techniques, using a two-stage-least-squares (2SLS) estimator (Verbeek, 2004). This technique predicts in the first stage values for the endogenous variables, the H-Statistic, the measures of concentration, the market share and the interbank ratio, using only exogenous information (obtained from the set of instruments). The second stage regression then uses the predicted values for these variables rather than the actual data. We employ entry restrictions, activity restrictions, and banking freedom as instruments to explain the H-Statistic, the concentration measures and the market share in the first stage. These variables are obtained from the database on financial regulation and supervision by Barth et al. (2001) and from the Heritage Foundation. The regulatory variables refer to the situation as at 1999 and are assumed to be constant over time whereas the instrument that captures banking freedom varies over time. Entry restrictions is an important measure for the contestability of a banking system. This variable is constructed as an index and takes on values between (1) and (8), whereby a higher index value indicates greater entry restrictions arising from legal requirements. Baumol et al. (1982) have shown that the mere threat of entry can cause firms to behave competitively. Activity restrictions are a further key determinant for the scope of a bank's business. This indicator is constructed as an index and takes on values between (1) and (4) for four categories that capture information as to whether banks can engage in securities, insurance, and real estate activities, and if they can hold stakes in non-financial institutions. The activities are classified as unrestricted (1), permitted (2), restricted (3), or prohibited (4), with possible index variation between four and sixteen.

Higher values indicate greater restrictions on bank activities and non-financial ownership and control. Finally, we use banking freedom as a broad indicator for the openness of a banking system. The index provides information on whether foreign banks are allowed to operate freely, the difficulties faced when setting up domestic banks, and on government influence over the allocation of credit. The indicator is constructed as a composite index ranging from (1) to (5), whereby higher values indicate fewer restrictions. Thus, these instruments directly affect the way banks compete with each other, but cannot be assumed to have an immediate impact upon the capital level.

We use bank level variables similar to those proposed by Nier and Baumann (2006) to instrument the interbank ratio. Specifically, we use the cost to income ratio[53], the ratio of pre-tax profit to total assets, and the log of total assets. These variables are unlikely to be controlled by a bank over a one-year horizon and can therefore be considered exogenous. We present correlation matrices for the instruments and the instrumented variables in Appendix 3.A. The first stage regressions for the four endogenous variables are reported in Appendix 3.B. All first stage regressions confirm the validity of our instruments.

In order to test our hypothesis if competition affects the size of the banks' capital ratios, we employ an econometric model for panel data. It is important to note that using a panel data estimator considerably improves upon the statistical power of previous studies, since it enables us to exploit both cross-sectional and time-series variation of competitive conduct of financial institutions. Thus, our approach allows adding an additional dimension to the study of the nexus between competition, concentration and financial stability. Precisely, we use a random-effects model for panel data and estimate the capital ratio y for bank i at time t as follows[54]

$$y_{it} = \mu + \beta_1 c'_{it} + \beta_2 x'_{it} + \alpha_i + \varepsilon_{it} \qquad (3)$$

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[53] The cost to income ratio is defined as the ratio of overhead cost divided by the sum of net interest revenue and other operating income.

[54] We also considered estimating a model for panel data with fixed effects. However, some of our explanatory variables do not vary over time and would be dropped by a fixed effects estimator. In particular, regressors that capture the regulatory and institutional environment that are key ingredient for our analysis would be disregarded using a fixed effects approach. Moreover, using a fixed effects approach suggests that the inferences would be conditional upon the values of the bank specific fixed effects. By contrast, the random effects approach is more appropriate when the objective of the study is to draw general inferences with respect to population characteristics. This is due to the fact that the random effects approach is not conditional on the individual bank specific effects (Verbeek, 2004). Consequently, the random effects model is our preferred estimator.

where $\varepsilon_{it} \sim i.i.d.(0,\sigma_{\varepsilon}^2)$; $\alpha_i \sim i.i.d.(0,\sigma_{\alpha}^2)$. The error term consists of the two components α_i and ε_{it}, the former denotes a bank-specific time-invariant component and the latter captures the remaining disturbance that is assumed to be uncorrelated over time. The measures of competition and concentration are captured by the vector c and the vector x contains information on the regulatory, institutional and macroeconomic control variables. The terms β_1 and β_2 denote the parameters to be estimated. We define the capital ratio as equity capital as a proportion of total bank assets. Nier and Baumann (2006) point out that a bank's capital ratio is directly controlled by managerial actions such as paying dividends and raising equity capital. Thus, our equation links managerial behaviour and risk-taking with capital ratios. For a robustness test reported in Section 3.5., we also use the inverse of the leverage ratio.[55]

As a consequence, our econometric approach gives rise to the following testable hypothesis: If bank managers behave prudently when competition stiffens, they will increase the capital buffer, ceteris paribus.

3.2.4. DATA AND SUMMARY STATISTICS

We obtain bank-level data from BankScope and draw upon a panel dataset for the period 1999 - 2004. The advantage of using panel data lies in the considerably augmented statistical power arising from such comprehensive dataset as it enables us to exploit both cross-sectional and time-series variation of financial institution's competitive conduct. In addition, we also employ macroeconomic variables obtained from the World Bank's Development Indicators and information on the regulatory and institutional environment to control for the environment banks operate in. This information is provided by Barth et al. (2001, 2004), Beck et al. (2000, 2006) and by the Heritage Foundation. The variables on regulation and market structure obtained from the databases provided by Barth et al. (2001, 2004) and Beck et al. (2000, 2006) typically refer to the beginning of our sampling period in 1999. This is however no caveat. We can rely on the stability of these variables since Barth et al. (2001) underscore that the regulatory environment has not undergone major changes over time. This is further substantiated by Podpiera (2004), who argues that the application of core principles of supervision and regulation does not change in the

[55] The inverse of the leverage ratio is defined as equity/liabilities.

short run and that there is a considerable time lag between changes in regulation until such alterations are observable in banking system performance. Further details on variable definitions and all data sources are given in the Data Appendix to this chapter and correlation matrices for the bank-level and country-level variables are reported in Appendix 3.C. and Appendix 3.D. respectively.

We use unconsolidated data and include all savings, co-operative and commercial banks. Our initial sample contains 24,955 bank-year observations for the EU 15 countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom) and Switzerland. We apply a number of selection criteria to mitigate sampling distortions arising from outliers and drop the 1st and 99th percentile of the distribution of the respective variables (Claessens and Laeven, 2004). To obtain accurate estimates of the H-Statistic, we further delete countries with data for less than 10 banks per year and per size category.[56] The final sample consists of 18,782 bank-year observations for ten countries (Austria, Belgium, Denmark, France, Germany, Italy, Luxembourg, United Kingdom, Sweden and Switzerland). Our panel is unbalanced, since we keep banks for which the time series is shorter than the six year sampling period in the sample.

The results for the averaged H-Statistics based on total revenue and interest revenue for the sampling period 1999 - 2004 for small and large banks, and the H-Statistics computed by Claessens and Laeven (2004) are presented in Table 3.1. We also report the averaged 3-bank concentration ratio, the number of institutions and the number of observations for each country and each size category in Table 3.1.[57]

[56] We therefore drop Spain, Netherlands, Ireland, Greece, Portugal and Finland from the initial sample.
[57] Details for the calculation of the different H-Statistics are presented in Appendix 3.F.

Table 3.1. H-Statistics

Country	Observations (all banks)	Observations (small banks)	Observations (large banks)	Average number of small banks	Average number of large banks	H1 (small banks)	H1 (large banks)	H2 (small banks)	H2 (large banks)	HCL	Average concentration ratio
Austria	621	306	315	73	37	0.80	0.61	0.24	0.40	0.66	0.51
Belgium	176	34	142	10	18	0.07	0.32	0.61	0.47	0.73	0.76
Denmark	424	330	94	46	10	0.35	0.67	0.28	0.76	0.50	0.80
France	1128	292	836	38	98	0.64	0.42	0.52	0.31	0.69	0.29
Germany	10650	4486	6164	731	763	0.72	0.68	0.45	0.51	0.58	0.40
Italy	2322	1182	1140	193	145	0.60	0.69	0.15	0.70	0.60	0.30
Luxembourg	575	99	476	23	60	0.93	0.75	0.74	0.82	0.82	0.24
Sweden	516	315	201	76	n/a	0.57	n/a	0.54	n/a	n/a	0.74
Switzerland	1980	1177	803	189	48	0.73	0.79	0.27	0.68	0.67	0.83
United Kingdom	390	94	296	21	22	0.75	0.51	0.61	0.11	0.74	0.39

H-Statistic (H1) is calculated with the total revenue as dependent variable; H-Statistic (H2) is calculated with interest revenne as dependent variable. HCL denotes the H-Statistics obtained from Claessens and Laeven (2004). The table reports averages for the H-Statistics (H1 and H2) and for the concentration ratio for the sampling period 1999 - 2004.

The H-Statistics indicate that the banking systems in the sample are characterized by monopolistic competition. While Belgium and Denmark exhibit comparatively low levels of competition, Austria, Luxembourg and Switzerland appear to have the most competitive banking systems in Europe. Moreover, the results for the H-Statistics indicate that it is important to distinguish between small and large banks. The H-Statistics between the two size categories differ considerably in magnitude in many countries. The 3-bank concentration ratios vary widely in our sample. Switzerland has the most highly concentrated banking system whereas France and Luxembourg exhibit lower levels of concentration.[58]

[58] The correlation coefficient between the H-Statistic and the 3-bank concentration ratio is 0.01 and insignificant, see Appendix 3.D. This simple test suggests that there is no unambiguous relationship between market structure and competitive bank conduct, a finding also reported in Claessens and Laeven (2005).

Table 3.2. Descriptive Statistics

Variable	N	Mean	Median	Min	Max	S.D.
Capital ratio	15649	0.084	0.056	-0.041	1.000	0.093
Leverage (inverse)	15615	0.114	0.060	-0.045	9.702	0.317
H-Statistic (H1)	13157	0.657	0.655	0.071	0.987	0.168
H-Statistic (H2)	13157	0.433	0.433	0.015	0.912	0.218
H-Statistic (H3)	13157	0.690	0.707	0.020	0.992	0.170
H-Statistic (Claessens and Laeven)	15145	0.612	0.580	0.500	0.820	0.059
Concentration	18782	0.446	0.399	0.238	0.828	0.169
Herfindahl-Hirschman index	15575	0.120	0.070	0.037	0.487	0.126
Banking freedom	18782	2.467	3.000	1.000	3.000	0.754
Entry restrictions	18782	7.313	7.000	6.000	8.000	0.579
Activity restrictions	18782	7.353	7.000	5.000	10.000	1.196
Pre-tax profit/Total assets	13187	0.008	0.005	-0.435	0.777	0.024
Interbank ratio	11661	1.260	0.683	0.000	9.964	1.662
Loan loss provisions/Net loans	12186	0.001	0.000	-0.068	0.515	0.013
Total assets, deflated (log)	13243	12.962	12.889	7.242	19.231	1.402
GDP growth	18782	0.017	0.018	-0.004	0.090	0.014
Inflation	18782	0.011	0.009	-0.007	0.042	0.010
Real interest rate	16024	0.066	0.081	0.005	0.104	0.026
GDP per capita	18782	24459.73	23332.33	17818.20	46659.27	5299.23
Market share	15252	0.001	0.000	0.000	0.096	0.004
Non-performing loans/Total loans	12213	0.046	0.047	0.003	0.078	0.015
Stock market cap/GDP	18782	0.819	0.567	0.127	3.220	0.668
Credit growth	11908	0.036	0.036	-0.568	3.113	0.262
Life insurance penetration	18782	0.026	0.024	0.008	0.064	0.013
Banks/Population (log)	18782	-4.559	-4.513	-5.551	-3.366	0.361
Mean bank size (log)	18782	12.950	13.074	11.230	14.061	0.514
British legal origin	18782	0.021	0.000	0.000	1.000	0.143
Scandinavian legal origin	18782	0.050	0.000	0.000	1.000	0.218
French legal origin	18782	0.224	0.000	0.000	1.000	0.417
Property rights index	18782	1.202	1.000	1.000	2.000	0.402
Government ownership	18207	0.312	0.364	0.000	0.504	0.106
Foreign ownership	16341	0.093	0.043	0.000	0.946	0.176
Moral hazard index	18266	1.670	1.674	1.575	1.851	0.046
Capital regulatory index	18207	5.910	6.000	2.000	8.000	0.880
Shareholder rights index	18207	0.560	0.000	0.000	4.000	0.827

H-Statistic (H1) is calculated with the total revenue as dependent variable; H-Statistic (H2) is calculated as the H-Statistics calculated with interest revenue as dependent variable; H-Statistic (H3) is calculated with the total revenue as dependent variable but this equation does not contain the bank equity ratio as control variable.

Table 3.2. presents summary statistics for all variables. The 3-bank concentration ratio has a mean value of 44 percent for the ten countries in the sample, indicating that concentration is relatively low for European countries. It is noteworthy to mention that the average bank has a market share of 0.1 percent, suggesting that these institutions do not appear to wield much market power. The maximum market share is 9.6 percent; still a

reasonably small proportion of a country's banking market. As alluded to previously, we perform a log transformation for the market share for the estimation procedure to account for the highly skewed distribution of this variable.

Finally, note that the number of observations varies considerably for the variables that are available for the econometric analysis. For instance, the interbank ratio, used as a bank-level control in all regressions reported below restricts the number of observations that can be employed for the 2SLS regressions to 11,661 observations, since this ratio is not available in BankScope for a number of banks. Since we lag our explanatory variables by one period to avoid problems arising from simultaneity, the number of observations decreases further to a maximum of 8,584 observations.

3.3. EMPIRICAL ANALYSIS

We present our main results in Table 3.3. for the 2SLS-regression of the capital ratio on the H-Statistic, concentration, and bank-specific and macroeconomic control variables. Setup (1) is our canonical model and we additionally include measures for concentration, the overall level of economic development, bank market share and a number of interaction terms in Setup (2) - (6). As highlighted in Section 3.2.3., the H-Statistic, the concentration ratio, and the market share are instrumented using entry restrictions, activity restrictions and banking freedom to account for endogeneity between the dependent variable and these variables that capture bank market structure and competition. The interbank ratio is also instrumented, and we employ the cost to income ratio, bank size (log), and the ratio of pre-tax return to total assets as additional instruments.

Table 3.3. Competition and capital ratio

	(1)	(2)	(3)	(4)	(5)	(6)
Pre-tax profit/Total assets	1.0450	0.9369	0.6551	0.8483	1.3263	1.9638
	(16.3060)***	(11.9135)***	(5.5637)***	(7.2218)***	(2.4190)**	(3.4065)***
Interbank ratio	0.0277	0.0422	0.0557	0.0654	-0.0283	-0.0594
	(6.2004)***	(7.1180)***	(5.6249)***	(6.4790)***	(0.5217)	(1.0740)
Loan loss provisions/Net loans	0.2858	0.3254	0.1920	0.3402	-0.3441	-0.3613
	(4.7079)***	(4.4908)***	(1.4377)	(3.2675)***	(0.6671)	(0.7791)
Total assets, deflated	-0.0062	-0.0024	-0.0087	-0.0167	0.2654	0.5761
	(6.9582)***	(1.8901)*	(3.6489)***	(0.9023)	(2.1619)**	(2.9316)***
GDP growth	0.9759	0.8477	1.7459	1.8286	16.9506	15.7177
	(6.8792)***	(4.9837)***	(5.8983)***	(5.0010)***	(3.3051)***	(3.4826)***
Inflation	0.9737	0.9839	2.7029	2.9439	24.0529	23.4934
	(4.6814)***	(3.9833)***	(5.3316)***	(4.5024)***	(3.2550)***	(3.4385)***
Real interest rate	-0.1289	0.3217	0.4313	1.2346	-5.9826	-11.0899
	(1.4551)	(2.4069)**	(1.6418)	(2.9599)***	(2.0084)**	(2.6814)***
H-Statistic (Total revenue)	0.1226	0.0882	0.5601	0.3229	14.2025	7.6873
	(5.4752)***	(3.2267)***	(5.8730)***	(4.4870)***	(3.1757)***	(3.3636)***
Concentration		0.0590	-0.3778	-0.2731	-0.9809	6.7250
		(5.4645)***	(4.3772)***	(1.5860)	(1.2194)	(2.9766)***
GDP per capita			0.0000	0.0000	0.0004	0.0001
			(4.3014)***	(2.3130)**	(3.1513)***	(2.4749)**
Market share (log)				0.0151	-0.3366	-0.6549
				(0.7998)	(2.3819)**	(2.9850)***
GDP per capita * H-Statistic					-0.0005	
					(3.1116)***	
H-Statistic * Concentration						-11.0176
						(3.2475)***
Observations	8584	8584	8584	8583	8583	8583
Number of banks	2631	2631	2631	2631	2631	2631
Wald χ^2	1688.10***	1226.98***	290.52***	613.40***	40.23***	50.03***

Constant term included but not reported. Absolute value of z statistics in parentheses. H-Statistic, concentration and market share instrumented using entry restrictions, banking freedom and activity restrictions. Interbank ratio instrumented using pre-tax profit/total assets, cost/income ratio, and total assets (log). * significant at 10%; ** significant at 5%; *** significant at 1%.

The H-Statistic enters all six regressions reported in Table 3.3. positively and significantly, indicating that banks tend to hold higher levels of capital when the degree of competition increases. This finding will persist throughout the remainder of the chapter with only minor changes observed. The positive association between the two variables suggests prudent behaviour on the part of the banks when competition stiffens. When the concentration ratio enters the regressions in Setup (2) - (6) we discover that the relationship between the level of concentration and the level of capital held by financial institutions is not clear-cut. The coefficient enters in Setup (2) with a positive sign at the one percent level. This indicates that banks in more concentrated banking systems tend to hold relatively higher capital ratios than banks in less concentrated banking systems. However, this finding is reversed in Setup (3). Since banks in more concentrated systems tend to be bigger, moral hazard can explain this finding. For instance, Mishkin (1999) puts forward that banking systems with a limited number of large institutions are more likely to be subject to regulators' 'too big to fail' policies. This, in turn, could encourage large banks to hold less capital as a buffer against asset malfunction. Note that controlling for concentration does not adversely impact upon the significance of the H-Statistic. This finding suggests that the positive link between concentration and banking (system) soundness reported in studies by Beck et al. (2006, forthcoming) is not applicable, when competition is directly measured. Thus, this result recommends a re-examination of the nexus between concentration and bank stability put forward in previous work. In Setup (3), we additionally include GDP per capita to control for the level of economic environment. This variable enters significantly with a positive sign, suggesting that banks in more highly developed countries exhibit higher capital ratios. The effect of the H-Statistic on the capital ratio is left unchanged. We incorporate the log of the market share of individual banks in Setup (4) to control for the relative size of the individual institution. The market share variable remains insignificant, not supporting the conjecture that banks that are large relative to the banking system hold lower capital ratios. This specification reiterates that competition retains its positive and significant association with capital ratios.

The results point so far to a generally positive effect of competitive conduct of financial institutions on capital ratios. An important consideration are however interactions of the overall level of economic development with the competitiveness in the banking industry,

and between concentration and competition. These linkages give rise to some testable hypotheses: The effect of competition on capital ratios may be limited when i) the overall level of economic development is high; and ii) when the industry is highly concentrated since larger banks will then have less incentive to maintain high capital ratios.

To this end, we first interact GDP per capita with the H-Statistic.[59] Setup (5) shows that the benchmark effect of the H-Statistic remains positive and significant. The interaction term enters negatively and significantly at the one percent level. Although the slope coefficient of the interaction term is close to zero, this finding indicates that the effect of competition is reduced in countries with a higher level of economic development. Second, to examine the link between competition and concentration explicitly, we employ an interaction term between these two variables in Setup (6). This specification corroborates the finding for the positive benchmark effect of competition on capital and the interaction term enters negatively at the one percent level indicating that the effect of competition is considerably reduced in concentrated banking systems. This appears reasonable and may be explained with moral hazard. For instance, banks in concentrated banking systems may be more likely to be bailed out in case of difficulties as pointed out by Mishkin (1999).

Among the bank-specific control variables, we find that the operating based profit measure and the interbank ratio tend to go hand in hand with larger capital buffers (Nier and Baumann, 2006). Consistent with Flannery and Rangan (2004), we also find evidence that larger banks hold less capital, which may be explained with better opportunities to diversify, such that less capital is required to absorb adverse shocks. However, this finding does not hold across all specifications. The ratio of loan loss provisions to net loans is positively associated with the capital ratio only in three out of six regressions. This result may be due to the fact that loan loss provisions are an ex-post measure for the riskiness of an institution. Moreover, loan losses may only be recognized with a time lag (Laeven and Majoni, 2003).[60]

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[59] Note that the interaction terms between GDP per capita and the H-Statistic and between the H-Statistic and concentration are to be treated as endogenous since individual components of the interaction terms are instrumented.

[60] It is important to bear in mind that any analysis of loan loss provisioning is to some extent influenced by different approaches to recognising non-performing loans depending on accounting principles and supervisory guidelines that vary across countries (Laeven and Majoni, 2003).

As alluded to previously, we also incorporate commonly employed macroeconomic control variables since the level of capital held by banks may be affected by the economic cycle. We find that GDP growth enters the regressions in Table 3.3. positively and significantly, a finding that is aligned with Borio et al. (2001). This is indicative for prudent behaviour on the part of the banks since it suggests that they accumulate capital during episodes of economic prosperity.[61] While inflation is positively associated with capital ratios in all regressions, the real interest rate is not consistently associated with bank capital ratios. We do not report goodness of fit statistics, since there is no unique definition of measures such as R^2 or adjusted R^2 when using instrumental variable techniques.[62]

[61] For a detailed discussion of the effect of the macroeconomic cycle on bank capital taking issues of procyclicality into consideration see, for instance, Ayuso et al. (2004), Danielsson et al. (2001) and Pennacchi (2005).

[62] Note that estimation with instrumental variable techniques aims to consistently estimate the causal effect of competition, measured by the H-Statistic, on bank risk-taking behaviour. Thus, goodness of fit is not a major consideration and therefore plays no role in comparing the alternative regressions reported (Verbeek, 2004).

We illustrate the economic impact of competitive conduct is in Table 3.4., where we quantify the effect of a one percent increase in the H-Statistic on the capital ratio.

Table 3.4 Quantifying the effect of increases in the H-Statistic on the capital ratio

Percentile	(1) 25^{th}	Increase in percent	(2) 50^{th}	Increase in percent	(3) 75^{th}	Increase in percent
Capital ratio (all banks)	0.0445		0.0559		0.0872	
Effect increases capital ratio to	0.0477	7.2 %	0.0591	5.7 %	0.0904	7.8 %
Capital ratio (small banks)	0.0492		0.0635		0.1167	
Effect increases capital ratio to	0.0524	6.1 %	0.0667	5.0 %	0.1199	2.7 %
Capital ratio (large banks)	0.0413		0.0502		0.0647	
Effect increases capital ratio to	0.0445	7.7 %	0.0534	6.4 %	0.0679	4.9 %

Effect of a one percent (0.01) increase in the H-Statistic (0.0032) on the capital ratio, evaluated at the 25^{th}, 50^{th}, and 75^{th} percentile of the distribution of the capital ratio.

The results in Table 3.4. demonstrate that the impact of competition on the banks' capital ratios is considerable. These calculations are based on Setup (4) in Table 3.3. Evaluated at the median bank's capital ratio in the sample, we find that increasing competition by one percent (0.0032=0.01*0.3229) increases the capital ratio from 5.59 percent to 5.91 percent (see Table 3.4., column 2). The breakdown by bank size further illustrates that the median small bank increases the capital ratio from 6.35 percent to 6.67 percent as a result from a one percent increase in the H-Statistic. The effect is however more pronounced for the median large bank, where the capital buffer increases from 5.02 percent to 5.34 percent. In addition, our illustration highlights that banks ranked at the 25^{th} percentile in terms of their capital ratio exhibit a higher sensitivity to increases in competition. Small banks increase their capital buffer from 4.92 percent to 5.24 percent and their larger counterparts at the 25^{th} percentile raise the capital ratio by more than 7.7 percent to 4.45 percent. The effect is less pronounced for small and large banks that are ranked at the 75^{th} percentile as depicted in column (3). Moreover, the table also suggests that larger banks indeed tend to hold lower capital buffers, a finding consistent with the results reported by Demsetz and Strahan (1997).

In sum, our baseline regressions consistently provide evidence for a positive impact of competitive conduct of financial institutions on the level of capital held. However, this positive effect is weakened in circumstances when the country is characterized by a high

level of economic development and when the banking system under consideration is more concentrated. No consistent relationship between the level of concentration in the banking system and capital ratios is found. To this extent, our findings contrast with previous work on the nexus between concentration and banking soundness on the systemic level.

3.4. EXTENSIONS

This section extends the previous analysis to a consideration of the impact of the level of competition in the banking sector on capital ratios while additionally taking key characteristics of the wider financial system and the regulatory and institutional environment into account. Controlling for these characteristics not only provides a robustness check for the contemplated positive relationship between the H-Statistic and the capital ratio, but also offers insights as to whether the H-Statistic proxies for competition arising from other agents in the wider financial system and for the institutional environment. If this is the case, forcing these additional variables to enter the regressions will drive out the significance of the H-Statistic. We enter these additional control variables one at a time. This is due to the high correlation between these country-level variables as illustrated in Appendix 3.D.

3.4.1. THE WIDER FINANCIAL SYSTEM

Table 3.5. presents the results of the examination of the effect of allowing for important characteristics of the wider financial system. The results confirm that banks tend to hold higher capital ratios as the level of competition increases. The H-Statistic remains significant at the one percent level when controlling for the level of non-performing loans in the banking system, competition from the stock markets, competition from the life assurance industry, credit growth, the number of financial institutions, and mean bank size.

Table 3.5 Competition, capital ratio, and the wider financial system

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Pre-tax profit/Total assets	1.1181	1.9348	0.4878	0.6314	0.5450	0.8708	0.8103
	(3.5276)***	(4.3509)***	(2.1526)**	(4.3818)***	(3.6573)***	(3.9039)***	(5.9938)***
Interbank ratio	-0.0017	-0.0260	0.0977	0.0843	0.0924	0.0454	0.0685
	(0.0590)	(0.7016)	(5.0484)***	(6.5925)***	(5.3146)***	(2.3036)**	(6.5322)***
Loan loss provisions/Net loans	0.0606	-0.0767	0.3743	0.4033	0.3355	0.1713	0.3000
	(0.2547)	(0.2671)	(1.9739)**	(3.2505)***	(2.2998)**	(0.8503)	(2.4246)**
Total assets, deflated	0.3899	0.1735	-0.4216	-0.1796	-0.0488	-0.3405	-0.1746
	(3.0204)***	(2.3120)**	(4.7745)***	(5.6523)***	(1.7096)*	(4.1188)***	(4.3389)***
GDP growth	6.5287	16.9497	-0.5836	0.3039	1.4422	3.5998	2.2241
	(5.2454)***	(3.5043)***	(1.3651)	(0.8111)	(3.9478)***	(5.2851)***	(5.0058)***
Inflation	6.8096	7.0039	5.7209	1.5647	2.4267	8.0913	3.1378
	(4.7884)***	(3.5712)***	(5.0343)***	(2.3395)**	(3.5179)***	(5.1336)***	(4.0934)***
Real interest rate	-8.7724	-9.9901	11.0690	3.7725	2.0681	6.8166	2.5255
	(3.2204)***	(2.7858)***	(5.1455)***	(5.6512)***	(2.8993)***	(4.5013)***	(4.7953)***
GDP per capita	-0.0001	0.0001	0.0001	0.0000	0.0000	0.0001	0.0000
	(2.5246)**	(3.1552)***	(4.5478)***	(1.3707)	(2.9571)***	(4.4106)***	(4.0086)***
Market share (log)	-0.4043	-0.2111	0.4222	0.1834	0.0507	0.3253	0.1681
	(3.0434)***	(2.4847)**	(4.7483)***	(5.6277)***	(1.7120)*	(4.0547)***	(4.2367)***
Concentration	0.7991	-0.1386	-3.8455	-0.8408	-0.7413	-2.6320	-0.6654
	(1.4274)	(0.3267)	(4.7899)***	(3.7898)***	(2.6096)***	(4.1948)***	(3.2649)***
H-Statistic (Total revenue)	1.9403	1.9110	0.9734	0.2883	0.4171	1.4446	0.6391
	(4.6793)***	(3.5800)***	(5.3423)***	(3.7965)***	(4.1950)***	(5.0153)***	(5.8509)***
Non-performing loans/Banking system loans	-10.5008						
	(4.6449)***						
Stockmarket capitalisation/GDP		-0.5453					
		(3.2619)***					
Size of banking sector relative to stock market			-0.1687				
			(5.2094)***				
Life insurance penetration				5.7209			
				(5.8493)***			
Credit growth					-0.0230		
					(2.1549)**		
Number of banks/population (log)						-0.4156	
						(4.3627)***	
Mean bank size							0.1750
							(5.1841)***
Observations	6278	8583	8583	8583	8398	8583	8583
Number of banks	2380	2631	2631	2631	2612	2631	2631
Wald χ^2	107.25***	111.73***	210.35***	457.44***	257.57***	189.99***	452.42***

Absolute value of z statistics in parentheses. Setup (1) controls for the ratio of non-performing loans to total loans in the system and Setup (2) controls for the size of the stock market. We introduce controls for the size of the banking sector relative to the stock market in Setup (3) and consider the effect of life insurers in Setup (4). Setup (5) controls for credit growth and Setup (6) for the number of banks in the system. Setup (7) additionally includes the mean bank size as regressor. Constant term included but not reported. H-Statistic, concentration and market share instrumented using banking freedom, entry restrictions, and activity restrictions. Interbank ratio instrumented using pre-tax profit/total assets, cost/income ratio, and total assets (log). * significant at 10%; ** significant at 5%; *** significant at 1%.

First, we investigate if controlling for the level of non-performing loans in the banking system affects the inferences drawn thus far. Our finding in Setup (1) in Table 3.5. is aligned with the conjecture that banks hold lower capital ratios in periods of stress in banking systems as the coefficient of the additionally included variable enters with a negative sign at the one percent level. Also, the magnitude of the coefficient for the H-Statistic is considerably larger than in the baseline regressions reported in Table 3.3. and remains significant at the one percent level. This is consistent with the idea that charter values will be eroded in episodes of high levels of non-performing loans. The ratio of non-performing loans in the system exhibits a negative sign at the one percent significance level. This suggests an inverse relationship between the level of non-performing loans in banking systems and capital ratios. This is not surprising: Laeven and Majoni (2003) present empirical evidence in a cross-country setting that banks provision too much and too late for non-performing loans when economic downturn has already set in.

Second, considering the effect of stock market development on the capital ratios in Setup (2), we detect a negative and significant sign. This suggests that the trend towards disintermediation adversely affects capital ratios. Bikker (2004) reports that traditional banking activities have declined in Europe and Schmidt et al. (1999) also find some empirical evidence for a trend towards disintermediation in Europe, particularly in France. Thus, banks seem to be more prone to engage in risk-taking behaviour in countries with more developed stock markets. Controlling for this effect has no marked impact on the significance of the H-Statistic. This finding is aligned with the result by Claessens and Laeven (2004), who report no evidence for any link between the H-Statistic and the degree of stock market development.

Third, our assertion that a declining role of the banking sector relative to the stock market adversely affects capital ratios is corroborated by the result in Setup (3). Nevertheless, controlling for this variable does not interfere with the relationship between the H-Statistic and the capital ratio, once again aligned with Claessens and Laeven (2004).

Fourth, Setup (4) indicates that interindustry competition from life insurers is positively and significantly related to banks' capital ratios, suggesting that bank managers behave in a prudent way when interindustry competition increases. However, this does not affect the significance of the H-Statistic.

Fifth, we control for credit growth in Setup (5), since this variable is well suited to capture competition in banks' lending activities. Consistent with our assertion, increased credit growth tends to decrease the capital ratio. This result is aligned with the conjecture that capital buffers can suffer as a result of lending booms. Indeed, Keeton (1999) finds evidence that supply-driven loan growth can give rise to higher loan losses. Controlling for this variable has no effect on the significance of the H-Statistic.

Sixth, the log of the ratio of the number of banks to population enters significantly and negatively in Setup (6), consistent with this hypothesis that banks in systems with more banks tend to have lower capital ratios. However, there is no impact upon the significance of the H-Statistic. We therefore conclude that competitive conduct of banks and the number of banks describe different characteristics of banking systems, a finding well-known in the industrial organization literature (Baumol et al., 1982; Tirole, 1988).

Finally, our result in Setup (7) does not verify the conjecture that banking systems with - on average - larger banks tend to have banks with lower capital ratios. Rather, the variable that captures average bank size in the system enters with a positive sign. There is again no evident effect on the H-Statistic.

3.4.2. The Institutional and Regulatory Environment

We now turn to the discussion of the impact of competition on capital ratios whilst additionally controlling for the regulatory and institutional environment. Table 3.6. further substantiates that banks tend to hold more capital when competition increases. Indeed, the H-Statistic remains positively and robustly associated with capital ratios when controlling for origin of a country's judicial system, rule of law, the effect of capital regulation, shareholder rights and ownership structure of banks. The H-Statistic is only rendered insignificant upon controlling for deposit insurance design features.

Table 3.6 Competition, capital ratio, and the regulatory and institutional environment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Pre-tax profit/Total assets	0.9718	0.8343	1.0328	0.9753	0.9632	0.8775	1.3465
	(10.4981)***	(6.5430)***	(14.2165)***	(8.2132)***	(7.5533)***	(12.1585)***	(5.2328)***
Interbank ratio	0.0402	0.0693	0.0261	0.0589	0.0444	0.0322	-0.0437
	(4.5236)***	(6.2495)***	(3.7873)***	(6.4015)***	(3.8621)***	(3.9832)***	(1.6889)*
Loan loss provisions/Net loans	0.2860	0.3417	0.2927	0.2870	0.2480	0.3039	-0.0518
	(3.5987)***	(3.0252)***	(4.8765)***	(2.6468)***	(2.1609)**	(4.8907)***	(0.2272)
Total assets, deflated	-0.0741	0.0444	0.0267	-0.0128	-0.1225	-0.0801	-0.3960
	(5.8197)***	(2.3673)**	(1.7297)*	(0.6812)	(5.1111)***	(4.5212)***	(4.8868)***
GDP growth	0.1093	2.3098	0.5211	2.3830	2.0219	0.2642	0.0628
	(0.6318)	(4.9555)***	(4.3985)***	(5.8253)***	(5.3936)***	(1.5116)	(0.1350)
Inflation	1.4733	3.0425	-0.0045	3.3346	4.7506	0.1629	6.1758
	(5.2536)***	(4.6021)***	(0.0175)	(5.0566)***	(6.0570)***	(0.5683)	(4.5295)***
Real interest rate	2.6328	-0.5026	-0.8263	0.4802	3.4145	1.2705	7.4816
	(6.7113)***	(1.3129)	(1.7019)*	(1.3769)	(6.4768)***	(5.3133)***	(4.8960)***
GDP per capita	0.0000	-0.0000	-0.0000	0.0000	0.0000	0.0000	0.0000
	(7.5086)***	(3.0735)***	(1.8542)*	(3.2850)***	(4.6799)***	(0.7741)	(1.0134)
Market share (log)	0.0676	-0.0465	-0.0325	0.0049	0.1133	0.0754	0.3581
	(5.0898)***	(2.4200)**	(1.9346)*	(0.2552)	(4.9572)***	(4.6273)***	(4.7453)***
Concentration	-0.4875	0.1445	0.2454	-0.3894	-0.9296	-0.1977	-2.2415
	(6.5130)***	(1.1351)	(2.4767)**	(2.1615)**	(4.6184)***	(1.9075)*	(4.1809)***
H-Statistic (Total revenue)	0.3075	0.4209	0.0465	0.5191	0.6941	0.1213	1.6806
	(6.5248)***	(4.5206)***	(1.2622)	(5.6535)***	(6.6125)***	(3.4282)***	(5.2521)***
French legal origin	0.2403						
	(8.3122)***						
Scandinavian legal origin	0.0519						
	(1.9790)**						
British legal origin	0.1120						
	(6.6894)***						
Rule of law		0.2591					
		(3.7365)***					
Moral hazard index			0.2964				
			(1.9700)**				
Capital regulatory index				0.0624			
				(6.4898)***			
Shareholder rights index					0.0606		
					(5.6221)***		
Foreign ownership						0.3554	
						(4.9906)***	
Government ownership							-2.7917
							(5.3774)***
Observations	8583	8583	8501	8583	8583	7830	8583
Number of banks	2631	2631	2590	2631	2631	2403	2631
Wald χ^2	1152.62***	524.81***	1839.40***	578.78***	560.08***	1578.79***	170.08***

Absolute value of z statistics in parentheses. Constant term included but not reported. Setup (1) controls for legal origin and Setup (2) controls for rule of law. A control variable for deposit insurance design features is included in Setup (3) and Setup (4) includes a capital regulatory index. We control for shareholder rights in Setup (5) and test ownership in Setup (6) and Setup (7). H-Statistic, concentration and market share instrumented using banking freedom, entry restrictions, and activity restrictions. Interbank ratio instrumented using pre-tax profit/total assets, cost/income ratio, and total assets (log).* significant at 10%; ** significant at 5%; *** significant at 1%.

First, we additionally include the three dummies for legal origin to account for the differences in the general institutional framework regarding financial contracting. The three dummy variables enter the regression significantly and positively, corroborating that origin of a country's legal system has a bearing for the level of capital held by banks. The H-Statistic retains its positive sign at the one percent level.

Second, we include rule of law to control for the strength of institutions in Setup (2). As anticipated, the coefficient of the index exhibits a positive and significant sign, indicating indeed that a stronger institutional environment makes banks hold higher capital ratios. Controlling for this variable has no considerable effect on the competitiveness measure.

Third, Setup (3) shows that the moral hazard index enters positively and significantly, suggesting that deposit insurance can encourage bank managers to hold higher levels of capital which may reflect a commitment that deposit insurance will only be limited to insured depositors (Gropp and Vesala, 2004).[63] While this result stands up against a considerable body of literature highlighting the negative effects arising from deposit insurance, it is nevertheless not unreasonable. For instance, Hutchinson and McDill (2002) find no consistent effect arising from deposit insurance on the probability of observing systemic banking crises and Eichengreen and Arteta (2000) also fail to find support for moral hazard attributable to deposit insurance. Controlling for deposit insurance design features renders the H-Statistic insignificant.

Fourth, we enter the capital regulatory index obtained from Barth et al. (2004) in Setup (4) and we find clear evidence for our assertion that higher levels of capital stringency are associated with higher capital ratios. Fifth, Setup (5) shows that stronger shareholder rights are also positively related to a bank's capital ratio. Taking the effect of these two variables into consideration has no effect on the H-Statistic.

Finally, we take ownership structure into consideration in Setup (6) and (7). Consistent with our assertion that foreign-owned banks are better governed, the coefficient shows a positive and significant sign. By contrast, government-owned institutions operate at lower levels of capital, this variable enters the regression with a negative sign in Setup (7). This is

[63] Note that a simple dummy variable that captures presence of explicit deposit insurance cannot be employed for our sample as all countries have explicit deposit insurance schemes in place.

aligned with our hypothesis that moral hazard is prevalent in government-owned institutions. Accounting for ownership structure of banks does not change our inferences with respect to the relationship between competition and capital ratios.

The results of a broad set of regressions with additional control variables suggest that competition tends to increase banks' capital ratios. Moreover, our core finding is complemented by evidence that extensive capital regulation, a strong institutional environment and foreign ownership tend to increase capital ratios. As regards to the link between concentration and capital ratios, we again find no consistent relationship between these two variables.

3.5. Robustness Tests

We perform a vast array of sensitivity checks and report them in Table 3.7. It is pertinent to verify that our results are not driven by the way the H-Statistic is calculated. We therefore use two alternative ways of computing our measure of competition and also obtain H-Statistics from Claessens and Laeven (2004). Moreover, we examine the robustness of our results to using an alternative concentration measure, employing an alternative dependent variable, omitting the observations when the H-Statistic is found to be in disequilibrium, and we also test if bank-specific endogeneity drives our results by dropping the bank-level controls. Furthermore, an additional set of sensitivity tests investigates sample selectivity. Our final check uses bootstrapping to correct the standard errors of the H-Statistic.

Table 3.7 Robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Pre-tax profit/Total assets	-0.3324	0.8734	-0.6195	0.5748	1.5251		0.6580	0.9038	0.7469	1.2537	0.8905
	(0.8656)	(8.3015)***	(1.5491)	(2.7085)***	(4.9010)***		(1.6415)	(2.8353)***	(5.6189)***	(17.6799)***	(6.4647)***
Interbank ratio	0.0850	0.0603	0.1237	0.1010	0.1588		-0.0079	-0.0264	0.0777	0.0226	0.0547
	(3.8972)***	(6.4377)***	(3.7910)***	(4.5937)***	(5.8882)***		(0.2684)	(1.0015)	(6.5634)***	(3.7156)***	(5.1930)***
Loan loss provisions/Net loans	0.0788	0.3469	0.4401	0.4422	0.5612		-0.0629	-0.0946	0.3666	0.2774	0.2677
	(0.3198)	(3.7228)***	(1.2412)	(2.7882)***	(2.0382)**		(0.1948)	(0.3784)	(3.1545)***	(5.4202)***	(2.6278)***
Total assets, deflated	0.1867	-0.0084	-1.7912	-0.1494	-0.0875		-0.1585	-0.7316	-0.0742	0.0290	-0.0657
	(3.4449)***	(0.5063)	(4.1070)***	(2.2427)**	(1.7882)*		(2.2300)**	(3.7985)***	(2.7764)***	(3.6349)***	(0.7747)
GDP growth	-0.0194	1.1432	-7.7387	1.6270	4.6514	0.3164	7.2408	13.2002	1.3689	0.5663	2.9044
	(0.0396)	(4.3209)***	(3.8735)***	(3.4036)***	(4.7906)***	(3.6471)***	(3.2874)***	(4.2380)***	(4.2135)***	(3.3238)***	(4.2646)***
Inflation	4.4619	2.0377	10.9719	-2.8597	8.0795	-0.0557	-0.2744	-17.1064	2.6756	0.4882	4.6400
	(3.8678)***	(3.7159)***	(4.0339)***	(1.2423)	(4.6449)***	(0.3883)	(0.1648)	(4.6153)***	(4.3508)***	(1.5846)	(3.7587)***
Real interest rate	-2.5844	0.8333	43.2282	-0.4031	4.3853	-0.8255	-8.8471	-22.0767	2.2307	-0.7255	1.6413
	(2.7698)***	(2.2847)**	(4.1073)***	(0.7360)	(3.9420)***	(11.1004)***	(3.4759)***	(4.8145)***	(3.9760)***	(3.2076)***	(2.2980)**
GDP per capita	-0.0000	0.0000	0.0001	0.0001	0.0001	-0.0000	0.0001	0.0003	0.0000	-0.0000	0.0000
	(2.5704)**	(1.4845)	(3.7172)***	(2.6060)***	(3.7255)***	(4.7200)***	(3.2514)***	(4.1945)***	(3.5796)***	(3.4563)***	(1.799679)*
Market share (log)	-0.2768	0.0088	1.7993	0.1579	0.0898		0.1211	0.6834	0.0737	-0.0353	0.0585
	(3.9964)***	(0.5105)	(4.0964)***	(2.2234)**	(1.7897)*		(1.8211)*	(3.6581)***	(2.7190)***	(4.2222)***	(0.6568)
Concentration	1.4676	-0.1262	-6.3357		-1.3619	0.1367	-2.0629	-1.1661	-0.8468	0.3041	-0.7791
	(3.5063)***	(0.8266)	(3.9682)***		(2.9798)***	(3.5461)***	(2.5676)**	(2.3866)**	(3.1746)***	(4.2079)***	(1.2052)
H-Statistic (Interest revenue)	1.3858										
	(4.6219)***										
H-Statistic (without capital ratio)		0.1882									
		(3.5283)***									
H-Statistic (Claessens and Laeven)			13.9257								
			(4.1348)***								
H-Statistic (Total revenue)				0.3932	1.0372	0.1483	2.4793	2.1038	0.3427	0.0587	0.5559
				(3.8781)***	(5.3949)***	(4.4124)***	(3.4990)***	(4.6795)***	(4.8351)***	(1.6478)*	(4.0000)***
Herfindahl-Hirschman index				-2.5643							
				(2.4294)**							
Observations	8583	8583	8513	8583	8579	10248	7851	7545	8500	7893	8583
Number of banks	2631	2631	2590	2631	2629	2962	2342	2220	2604	2526	2631
Wald χ^2	132.69***	754.51***	49.26***	291.86***	257.44***	169.30***	63.22***	86.25***	491.00***	1812.48***	545.1515***

Absolute value of z statistics in parentheses. Constant term included but not reported. H-Statistic, concentration and market share instrumented using banking freedom, entry restrictions, and activity restrictions. Interbank ratio instrumented using pre-tax profit/total assets, cost/income ratio, and total assets (log). Setup (1) uses an alternative H-Statistic obtained with interest revenue as dependent variable whereas Setup (2) uses a H-Statistic that does not contain the capital ratio in the H-Statistic equation. Setup (3) uses the H-Statistics calculated by Claessens and Laeven (2004). In Setup (4) we employ the Herfindahl-Hirschman index as an alternative concentration measure. We replace our dependent variable with the inverse of the leverage ratio in Setup (5). Setup (6) drops all bank level controls. The sample is constrained to EU banks only in Setup (7) and we drop non-Euro currency area countries in Setup (8). We remove countries for which we have less than 20 bank-year observations in Setup (9) from the dataset and Setup (10) drops all observations for which the H-Statistic is not in equilibrium. Setup (11) uses a bootstrapping procedure with 1,000 replications to account for the fact that the H-Statistic is estimated with standard error. * significant at 10%; ** significant at 5%; *** significant at 1%.

First, we utilize two alternative H-Statistics which again distinguish between small and large banks. We calculate one H-Statistic using the ratio of interest revenue to total assets instead of the ratio of total revenue to total assets as dependent variable. Subsequently, we compute H-Statistics that are calculated without the equity ratio as a control variable (see Section 3.2.1.) to investigate if any possibly remaining correlation between the equity ratio and the H-Statistic drives our findings. The results for the H-Statistic with the ratio of interest revenue to total assets are presented in Setup (1) where we corroborate the findings obtained in our previous regressions. We report this result mainly because some other studies used the ratio of interest revenue to total assets as a dependent variable (e.g. Molyneux et al., 1994). In Setup (2), we employ the H-Statistics that is calculated without the equity ratio in the regressions for the H-Statistic. This specification reiterates the finding that higher capital ratios are significantly and positively associated with higher degrees of competition. The sensitivity test in Setup (3) utilizes the H-Statistics computed by Claessens and Laeven (2004). This is a particularly tough test for our hypothesis, since Claessens and Laeven (2004) do not discriminate between bank size, and calculate their competitiveness measure for the sampling period 1994 - 2001. However, since the regulatory environment has not undergone much change over time, we expect that the different sampling horizon will not markedly impact the inferences.[64] The coefficient for the H-Statistic in Setup (3) confirms this conjecture.

Second, we employ an alternative measure of concentration. Setup (4) presents the results obtained with the Herfindahl-Hirschman index[65] as a measure for concentration in the banking system instead of the 3-bank concentration ratio. Contrary to the 3-bank concentration ratio, this index takes all banks in the system into consideration and stresses the importance of larger institutions by assigning them greater weight than smaller banks (Bikker, 2004). The H-Statistic remains positively and significantly associated with the

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[64] Claessens and Laeven (2004) find that the regulatory and institutional environment is the major determinant for the H-Statistic and Barth et al. (2004) and Podpiera (2004) underscore that the regulatory environment remains very stable over longer periods. Extending this argument, Schaeck et al. (2006) contemplate that the H-Statistics may be assumed to remain constant as well; see also Chapter II, Section 2.3.

[65] The Herfindahl-Hirschman index is the sum of the squared market shares. Formally,

$$HHI = \sum_{i=1}^{n} s_i^2$$

where s is the market share for bank $i,\ldots, n$. The HHI index ranges between 1/n and 1 (Bikker, 2004).

capital ratio. The Herfindahl-Hirschman index enters the equation with a negative sign, thus reiterating that there is an ambiguous relationship between concentration in banking systems and the level of capital held by individual banks.

Third, Setup (5) replaces the capital ratio with the inverse of the leverage ratio as dependent variable.[66] This dependent variable is similar to the dependent variable employed by Nier and Baumann (2006). Using this alternative dependent variable again corroborates that banks tend to hold more capital when competition increases.

Fifth, we eliminate the bank-specific control variables to examine if bank-specific endogeneity drives our finding for the positive link between competition and the capital ratio. Setup (6) confirms that this is not the case.

Sixth, we perform tests for sample selectivity. Switzerland is omitted to constrain the sample to EU banks in Setup (7), whereas Switzerland, Denmark, Sweden and the United Kingdom are dropped from the sample in Setup (8) to only focus on banks operating in the Euro-currency area. In all specifications, the H-Statistic enters positively and significantly at the one percent level. Setup (9) omits H-Statistics computed with less than 20 observations, since Claessens and Laeven (2004) argue that 20 banks are necessary to obtain reasonable estimates for the measure of competition.[67] Using these alternative samples has no marked effect on our inferences and we conclude that our results are not subject to sample selectivity.

It is well known in the literature that the Panzar-Rosse (1987) H-Statistic assumes long-run equilibrium (Shaffer, 2004a). Molyneux et al. (1994, 1996) therefore suggest that it is pertinent to ascertain that factor input prices are not correlated with industry returns. This can be examined by estimating the equation for the H-Statistic with the return on assets as dependent variable. The equilibrium test assumes $E = 0$ and the equilibrium statistic is the sum of the slope coefficients for the three factor input prices (see Section 3.2.1.). If rejected, the market is assumed not to be in equilibrium. We perform this equilibrium test and remove those bank-year observations for which the market fails to pass this test in

[66] The correlation between the capital ratio and leverage is 0.81.

[67] We therefore drop the observations for Belgium, the observations for large banks in Denmark and the observations for large banks in Luxembourg in 2003 and 2004, and for small and large banks in the UK in 1999.

Setup (10).[68] Our main result is however not affected after dropping these observations. Only the magnitude of the coefficient decreases in this specification and the significance level declines from the one to the ten percent level.

Finally, in order to account for the fact that our H-Statistics are estimated with a standard error, we run a robustness check where we correct the standard errors using a bootstrapping procedure with 1,000 replications. This approach helps take the sampling variation of the H-Statistic into consideration. The results in Setup (11) indicate that our inferences regarding the positive and significant impact of the H-Statistic on capital ratios are once again reiterated.[69]

3.6. Concluding Remarks and Policy Implications

This chapter presents an empirical analysis of the nexus between competition, concentration, and banking stability by testing the hypothesis if increased competitive conduct among financial institutions incentivizes them to hold capital buffers against adverse shocks arising to their asset portfolio.

In analysing the link between competition, concentration and individual bank stability, we complement and extend the literature on competition and stability in five distinct aspects. Foremost, this study is to the best of our knowledge the first to relate a direct measure of financial institutions' competitive conduct, the Panzar and Rosse (1987) H-Statistic, to bank capital ratios. Second, we shed new light on the nexus between concentration in banking systems and the level of capital held by individual banks. Third, we improve upon previous studies by exploiting both cross-sectional and time-series variation of our

[68] We therefore drop observations for small Italian banks in 2002 and 2003, for large Italian banks in 2003, for small Swiss banks between 2000 - 2002, and 2004, for small banks in Luxembourg in 2004, for large banks in Luxembourg in 2000, and for small banks in Sweden between 2001 and 2004. As highlighted in Section 3.1, rejection of equilibrium does not constitute invalidation of the H-Statistic but signals a dynamically developing industry. This is particularly true for many European banking systems that have undergone major changes during our sampling period following deregulation and harmonisation as a result of several EU banking directives.

[69] We also tested the effect of using additional country dummies and year dummies. This is a rigorous test since part of the explanatory power of the H-Statistic might be attributable to cross-country differences. Equally, entering year dummies will soak up any variation arising from changes in capital ratios that are trending upwards over time according to Nier and Baumann (2006). In a final check, we examine the effect of macroeconomic volatility, and include the standard deviation of GDP growth in the country as an additional control variable to capture risk in the financial system. Our inferences regarding the impact of competition on capital ratios are qualitatively not affected in these sensitivity tests. The results are reported in Appendix 3.E.

measure of competition to draw more precise inferences. Fourth, we take account of the endogeneity of competitive conduct, concentration, bank market share, and our proxy for bank stability. Fifth, our analyses also consider important characteristics of the wider financial system, such as the overall fragility of the banking system, interindustry competition, the number of banks in the market, strength of institutions, deposit insurance design features and bank ownership structure.

Using cross-country data for ten European countries with more than 8,500 bank-year observations for more than 2,600 banks for the period 1999 - 2004, we distinguish between competitive conduct of small and large banks to account for differences in the way these institutions compete. Our empirical analysis robustly indicates that banks tend to hold higher capital buffers against default when operating in a more competitive environment. While the effect of competition is slightly reduced when banks operate in a country with high level of overall economic environment and when the banking industry is more highly concentrated, our results hold up to a broad set of sensitivity analyses. Precisely, a vast number of robustness checks involving i) alternative H-Statistics, ii) alternative concentration measures, iii) an alternative dependent variable, iv) the omission of bank level controls, v) a correction of the standard errors of the H-Statistic, and, finally vi) alternative samples excluding non-EU banks and non Euro-area banks confirms our key finding. However, we find no consistent relationship between concentration in banking systems and capital ratios. In line with the results presented in Chapter II on the link between competition and systemic crises[70], these results recommend a re-examination of the positive link between concentration and banking stability reported in previous research on banking stability on the systemic level. We also find that the effect of increasing competition upon capital ratios is considerable in magnitude. A one percent increase in the H-Statistic increases the capital ratio for the median bank in our sample from 5.6 percent to 5.9 percent.

In sum, our results offer empirical support for theoretical studies that propose a positive effect of competition on bank stability. The findings therefore bolster the view that competition and soundness tend to go hand in hand (even though, this result does not necessarily mean that competitive banking systems will be free of failures). This outcome

[70] See also Schaeck et al. (2006).

may be explained with the argument that more competition encourages prudent behaviour, and with the conjecture that more efficient banks tend to operate at lower costs, thereby increasing market share. Moreover, this result may be amplified by the presence of economies of scale.

Our results stand in contrast to the established literature in that we do not find any evidence for a (negative) trade-off between competition and stability. However, our findings are in fact closely aligned with a growing body of recent empirical research presenting substantial evidence for a positive link between concentration, contestability, competition and banking system soundness. Indeed, we show that the consensus results regarding the trade-off between competition and stability can be easily reversed when two important considerations are accounted for: First, possible endogeneity between the measures of market structure, competition and the proxy for bank stability has to be taken into consideration. Second, competition has to be formally derived from profit-maximising equilibrium conditions rather than proxied with the level of concentration in the banking industry as implied by the SCP-paradigm.

The findings bear important policy considerations. While the extant literature substantially influenced policymaking regarding restrictions imposed on competitive bank conduct to curtail risk-taking behaviour, we find no compelling empirical evidence that would justify such regulations. Conversely, our results imply that competition tends to encourage prudent behaviour by bank managers by increasing capital ratios as a consequence of increased competition. In addition, many of the normative analyses of bank regulation based on the previous literature ought to be subject to a critical review in light of the context of our study. Finally, regulatory policy geared towards encouraging (domestic) bank mergers may also have to be re-evaluated.

The exact transmission mechanism by which increased competition translates into enhanced bank stability is of utmost importance. Our ongoing research therefore continues to examine the linkages between bank efficiency, competition, and stability to shed some light into this 'dark side' of banking stability.

Data Appendix

Variable	Description	Source
H-Statistic (H1)	The H-Statistic (H1) is estimated using cross-sectional regressions with total revenue for each country during the period 1999 - 2004.	BankScope; authors' calculations
H-Statistic (H2)	The H-Statistic (H2) is calculated using cross-sectional regressions with interest revenue for each country during the period 1999 - 2004.	BankScope; authors' calculations
H-Statistic (H3)	The H-Statistic (H3) is estimated using cross-sectional regressions with total revenue for each country during the period 1999 - 2004, but it excludes the capital ratio as control variable.	BankScope; authors' calculations
H-Statistic (Claessens and Laeven)	The H-Statistics are calculated for 50 countries for the period 1994 - 2001 using four alternative modelling setups.	Claessens and Laeven (2004)
Loan loss provisions/Net loans	Ratio of loan loss provisions to net loans	BankScope
Leverage (inverse)	Ratio of equity capital to liabilities	BankScope
Capital ratio	Ratio of equity capital to total assets	BankScope
Interbank ratio	Ratio of deposits due from banks to deposits due to banks	BankScope
Pre-tax profit/Total assets	Ratio of profit before tax to total assets	BankScope
Total assets, deflated	Logarithm of total bank assets, deflated using the GDP deflator.	BankScope, World Bank Development Indicators
3-bank concentration ratio	Total assets held by the three largest banks in a country in relation to total banking system assets.	BankScope; authors' calculations
Herfindahl-Hirschman index	Index computed as the sum of the squared market shares for each bank in a country.	BankScope; authors' calculations
Market share (log)	Market share held by the individual financial institution.	BankScope; authors' calculations
Activity restrictions	The indicator is constructed as an index and takes on values between (1) and (4), whereby the activities are classified as unrestricted (1), permitted (2), restricted (3), or prohibited (4), with possible index variation between four and sixteen. Higher values indicate greater restrictions on bank activities and non-financial ownership and control.	Barth et al. (2004)
Entry restrictions	The indicator is constructed as an index and takes on values between (1) and (8), whereby a higher index value indicates greater entry restrictions arising from legal requirements.	Barth et al. (2004)
Banking freedom	The index informs whether foreign banks are allowed to operate freely, the difficulties when setting up domestic banks, and on government influence over the allocation of credit. It is constructed as index ranging from (1) to (5), whereby higher values indicate fewer restrictions.	Heritage Foundation
Real GDP growth	Rate of growth of the Gross Domestic Product.	World Bank Development Indicators
Real interest rate	Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator.	World Bank Development Indicators
Inflation	Rate of change of the GDP deflator.	World Bank Development Indicators
GDP per capita	Ratio of GDP to population	World Bank Development Indicators
Non-performing loans/Total loans	Proportion of non-performing loans to total loans in a banking system.	World Bank Development Indicators
Market capitalisation/GDP	Stock market capitalisation to Gross Domestic Product.	World Bank Development Indicators
Credit growth	Growth of the ratio of domestic credit provided by the banking sector to GDP.	World Bank Development Indicator; anthors' calculations
Size of banking sector relative to stock market	Proportion of the banking sector assets to stock market capitalisation.	Beck et al. (2000)
Life insurance penetration	Measure for the competition from the life insurance industry calculated as the ratio of the volume of life insurance premiums to GDP.	Beck et al. (2000)
Number of banks/population	The logarithm of the ratio of the number of banks in the country to the total population in the country, measured as at 2001.	Barth et al. (2001) and World Bank Development Indicators; authors' calculatious
British legal origin	Dummy variable that takes on the value one if the country's legal system is of British origin or zero otherwise	La Porta et al. (1998)
Freneh legal origin	Dummy variable that takes on the value one if the country's legal system is of French origin or zero otherwise	La Porta et al. (1998)
German legal origin	Dummy variable that takes on the value one if the country's legal system is of German origin or zero otherwise	La Porta et al. (1998)
Scandinavian legal origin	Dummy variable that takes on the value one if the country's legal system is of Scandinavian origin or zero otherwise	La Porta et al. (1998)
Rule of law	Measure for the strength of the institutional environment. The index is increasing in the quality of the institutional environment and ranges between zero and six.	Beck et al. (2000)
Government bank ownership	Bank ownership measured as the proportion of bank assets held by government.	La Porta et al. (2002)
Foreign bank ownership	Bank ownership measured as the proportion of bank assets held by foreigners.	Barth et al. (2001)
Moral hazard index	Indicator for generosity of deposit insurance schemes calculated as the first principal component of the design features: co-insurance, coverage of FX and interbank deposits, membership, management, type and source of funding and level of explicit coverage.	Demirgüç-Kunt and Detragiache (2002)
Capital regulatory index	Index of capital stringency calculated as initial capital stringency and overall capital stringency.	Barth et al. (2004)
Shareholder rights index	Summary index for the emphasis on shareholder rights, with higher values indicating more shareholder rights.	La Porta et al. (1998)

Appendix 3.A. Correlation Matrix (Instruments)

Panel A: Instruments for Interbank ratio

	Interbank ratio	Cost-income ratio	Pre-tax profit/Total assets	Total assets (log)
Interbank ratio	1.00			
Cost-income ratio	0.05***	1.00		
Pre-tax profit/Total assets	0.10***	-0.20***	1.00	
Total assets (log)	-0.11***	-0.14***	-0.07***	1.00

Panel B: Instruments for H-Statistic, concentration and market share

	H-Statistic	Concentration	Market share (log)	Entry fit test	Activity restrictions	Banking freedom
H-Statistic	1.00					
Concentration	0.01	1.00				
Market share (log)	-0.01*	0.02**	1.00			
Entry fit test	0.04***	0.45***	0.28***	1.00		
Activity restrictions	-0.10***	0.01	0.04***	0.52***	1.00	
Banking freedom	0.03***	-0.59***	-0.29***	-0.84***	-0.22***	1.00

Appendix 3.B. First-Stage Regressions

	(1)	(2)	(3)	(4)
	H-Statistic	Concentration	Market share (log)	Interbank ratio
Pre-tax profit/Total assets	0.113	0.030	0.341	3.779
	(1.1554)	(2.0524)**	(2.9315)***	(3.3812)***
Loan loss provisions/Net loans	0.161	-0.029	-0.211	-1.507
	(1.1854)	(0.6767)	(0.6663)	(0.8418)
Cost to income ratio	0.022	-0.006	-0.063	0.251
	(3.1732)***	(5.4317)***	(7.2330)***	(3.6192)***
Total assets, deflated	0.012	-0.006	0.935	-0.148
	(9.3415)***	(10.6026)***	(246.0027)***	(6.7269)***
Entry fit test	0.079	0.070	0.574	-0.933
	(7.1341)***	(22.3878)***	(26.2809)***	(6.8145)***
Activity restrictions	-0.009	0.008	0.069	0.404
	(2.6506)***	(6.0972)***	(7.5473)***	(7.1339)***
Banking freedom	-0.001	-0.041	0.056	-0.728
	(0.0489)	(25.6495)***	(4.4167)***	(6.6572)***
GDP growth	-4.966	0.129	1.730	-3.836
	(23.3762)***	(4.9919)***	(8.4225)***	(2.4950)**
Inflation	-7.579	2.547	4.681	0.068
	(20.8269)***	(53.0407)***	(12.4050)***	(0.0239)
Real interest rate	-0.073	2.260	-8.713	-10.365
	(0.2953)	(63.2123)***	(31.7802)***	(5.1928)***
GDP per capita	-0.000	0.000	0.000	-0.000
	(3.6517)***	(113.3912)***	(18.3807)***	(2.0810)**
Observations	9724	9764	9757	8617
Number of banks	2837	2843	2843	2636
Wald χ^2	1373.73***	51390.69***	75066.17***	683.49***
First stage *F*-Statistic for instruments	330.73***	5269.18***	61613.25***	181.02***

Constant term included but not reported. Absolute value of z statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix 3.C. Correlation Matrix (Bank level variables)

	Capital ratio	Leverage	Interbank ratio	Market share (log)	Pre-tax profit/Total assets	Loan loss provisions/Net loans	Total assets (log)
Capital ratio	1.00						
Leverage	0.81***	1.00					
Interbank ratio	0.20***	0.15***	1.00				
Market share (log)	-0.17***	-0.12***	0.01	1.00			
Pre-tax profit/Total assets	0.36***	0.43***	0.10***	-0.01***	1.00		
Loan loss provisions/Net loans	0.04***	0.02**	-0.02**	-0.01***	-0.04***	1.00	
Total assets (log)	-0.30***	-0.18***	-0.11***	0.37***	-0.07***	-0.05	1.00***

Appendix 3.D. Correlation Matrix (Country level variables)

	H-Statistic	Concentration	Entry fit test	Activity restrictions	Banking freedom	GDP growth	Inflation	Real interest rate	GDP per capita	Non-performing loans/Total loans	Stock market cap/GDP	Credit growth	Relative size of the banking system	Life insurance penetration	Banks/Population (log)	Mean bank size	British legal origin	Scandinavian legal origin	French legal origin	Rule of law	Moral hazard index	Capital regulatory index	Shareholder rights index	Foreign ownership	Government ownership
H-Statistic	1.00																								
Concentration	0.01	1.00																							
Entry fit test	0.04***	0.45***	1.00																						
Activity restrictions	-0.10***	0.01	0.59***	1.00																					
Banking freedom	0.03***	-0.59***	-0.84***	-0.22***	1.00																				
GDP growth	-0.09***	-0.07***	0.07***	-0.14***	-0.10***	1.00																			
Inflation	-0.16***	-0.07***	0.42***	0.44***	-0.36***	-0.20***	1.00																		
Real interest rate	0.13***	-0.33***	-0.65***	-0.36***	0.83***	0.14***	-0.66***	1.00																	
GDP per capita	0.16***	0.51***	0.36***	-0.36***	-0.60***	0.21***	-0.01*	-0.33***	1.00																
Non-performing loans/Total loans	-0.18***	-0.49***	-0.27***	0.56***	0.47***	-0.18***	0.08***	0.04***	-0.78***	1.00															
Stock market cap/GDP	0.07***	0.65***	0.41***	-0.22***	-0.72***	0.29***	-0.08***	-0.52***	0.71***	-0.42***	1.00														
Credit growth	-0.07***	0.10***	0.15***	0.23***	-0.09***	0.04***	0.18***	-0.12***	0.02**	-0.05***	-0.03***	1.00													
Relative size of the banking system	0.07***	-0.34***	-0.21***	0.08***	0.46***	-0.20***	-0.13***	0.51***	-0.56***	0.27***	-0.64***	-0.10***	1.00												
Life insurance penetration	-0.05***	0.60***	-0.02***	-0.59***	-0.40***	0.03***	-0.24***	-0.28***	0.46***	-0.42***	0.75***	-0.06***	-0.46***	1.00											
Banks/Population (log)	0.31***	0.07***	0.20***	-0.25***	-0.13***	0.07***	-0.17***	0.27***	0.61***	-0.40***	0.10***	-0.09***	0.12***	-0.08***	1.00										
Mean size	-0.03***	-0.83***	-0.57***	-0.35***	0.51***	0.13***	0.03***	0.37***	-0.19***	0.23***	-0.36***	-0.19***	0.12***	-0.27***	0.13***	1.00									
British legal origin	-0.27***	-0.05***	0.17***	-0.29***	-0.28***	0.11***	0.21***	-0.23***	-0.01***	-0.18***	0.18***	0.02**	-0.24***	0.44***	-0.25***	0.10***	1.00								
Scandinavian legal origin	-0.23***	0.46***	0.27***	0.30***	-0.24***	0.10***	0.14***	-0.18***	0.15***	-0.37***	0.02***	0.36***	-0.30***	0.01	-0.32***	-0.64***	-0.03***	1.00							
French legal origin	-0.16***	-0.45***	0.14***	0.44***	-0.19***	0.20***	0.57***	-0.51***	-0.12***	0.26***	-0.06***	0.05***	-0.13***	-0.38***	-0.24***	0.40***	-0.08***	-0.12***	1.00						
Rule of law	0.11***	0.73***	0.19***	-0.40***	-0.34***	0.12***	-0.31***	0.03***	0.77***	-0.83***	0.49***	0.03***	-0.09***	0.44***	0.51***	-0.45***	-0.09***	0.34***	-0.50***	1.00					
Moral hazard index	-0.34**	-0.46***	-0.12***	0.22***	0.34***	0.04***	0.14***	0.35***	-0.34***	0.08***	-0.69***	0.29***	0.44***	-0.52***	-0.06***	0.13***	0.01	0.61***	0.03***	-0.06***	1.00				
Capital regulatory index	-0.22***	-0.49***	-0.13***	-0.01	0.25***	-0.07***	0.08***	0.27***	-0.37***	0.25***	-0.44***	0.01	0.60***	-0.30***	0.40***	0.55***	0.18***	-0.44***	0.11***	-0.23***	0.86***	1.00			
Shareholder rights index	-0.32***	0.17***	0.31***	-0.01	-0.69***	0.26***	0.45***	-0.73***	0.17***	-0.27***	0.41***	0.13***	-0.34***	0.46***	-0.58***	-0.17***	0.62***	0.28***	0.42***	-0.09***	-0.07***	-0.15***	1.00		
Foreign ownership	0.06	-0.17***	0.39***	-0.33***	-0.43***	0.46***	0.30***	-0.41***	0.68***	-0.71***	0.34***	-0.03***	-0.70***	0.07***	0.62***	0.49***	0.33***	-0.09***	0.37***	0.25***	-0.11***	0.09***	0.86***	1.00	
Government ownership	0.27	-0.37***	-0.21***	0.17***	0.64***	-0.17***	-0.14***	0.61***	-0.65***	0.37***	-0.75***	-0.15***	0.80***	-0.80***	0.30***	0.31***	-0.44***	-0.32***	-0.07***	-0.29***	0.31***	0.31***	-0.69***	-0.66***	1

Appendix 3.E. Further Robustness Checks

	(1)	(2)	(3)
Pre-tax profit/Total assets	0.6100	0.9198	0.8360
	(1.3053)	(9.8823)***	(7.1053)***
Interbank ratio	-0.0073	0.0436	0.0670
	(0.2077)	(4.7093)***	(6.5965)***
Loan loss provisions/Net loans	-0.0655	0.3257	0.3482
	(0.2225)	(4.2333)***	(3.3324)***
Total assets, deflated	-2.8823	0.0245	-0.0289
	(2.5928)***	(0.8622)	(1.7402)*
GDP growth	0.5440	2.0402	1.5549
	(0.5093)	(1.7203)*	(4.3203)***
Inflation	-33.2188	3.4486	2.5125
	(2.0641)**	(5.0689)***	(3.8630)***
Real interest rate	11.3406	0.6744	1.4163
	(1.8780)*	(2.0218)**	(3.4962)***
Market share (log)	2.8418	-0.0273	0.0280
	(2.5500)**	(1.0007)	(1.6462)*
Concentration	-9.5573	0.2242	-0.4601
	(3.2209)***	(1.0958)	(3.0449)***
H-Statistic (Total revenue)	1.3942	0.1429	0.2911
	(2.1816)**	(2.3709)**	(4.0927)***
GDP per capita	0.0009	-0.0000	0.0000
	(2.4866)**	(0.2992)	(4.2567)***
Standard deviation of GDP growth			-9.1493
			(3.5580)***
Country dummies	Yes	No	No
Year dummies	No	Yes	No
Observations	8583	8583	8583
Number of banks	2631	2631	2631
Wald χ^2	116.12***	1147.84***	615.150***

Constant term included but not reported. Absolute value of z statistics in parentheses. H-Statistic, concentration and market share instrumented using entry restrictions, banking freedom and activity restrictions. Interbank ratio instrumented using pre-tax profit/total assets, cost/income ratio, and total assets (log). Setup (1) includes country dummies and Setup (2) includes year dummies. Setup (3) includes the standard deviation of GDP growth to control for macroeconomic volatility. * significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix 3.F. Calculation of H-Statistics

This appendix contains the tables for the calculation of the H-Statistics, using the ratios of interest revenue and total revenue to total assets as dependent variable. The tables also report t-statistics for H = 0 (rejection of monopoly), H = 1 (rejection of perfect competition) and additionally report whether the market is found to be in equilibrium. Disequilibrium is assumed if the equilibrium statistic is rejected at the one percent significance level. We report t-tests for H = 0 and H = 1 for completeness; note that rejection of certain types of market structure is not the main purpose of this study. As highlighted in Section 3.2.4., we can reject in most instances that revenues are earned under conditions of monopoly and under conditions of perfect competition. Rather, the tests imply monopolistic competition (see also Staikouras and Koutsomanoli-Filipaki, 2006).

The different variations of the H-Statistic as well as the tests for the determination of market equilibrium are calculated as presented in Section 3.2.1.

The standard errors are obtained easily as Shaffer (2004b) has shown that the equation for the H-Statistic

$$\ln(R) = \alpha + \beta_1 \ln(W_1) + \beta_2 \ln(W_2) + \beta_3 \ln(W_3) + \gamma_1 \ln(Y_1) + \gamma_2 \ln(Y_2) + \gamma_3 \ln(Y_3) + \gamma_4 \ln(Y_4) + \varepsilon \qquad \text{(A.1)}$$

can be re-written as

$$\ln(R) = \alpha + \beta_1 \ln(W_1) + \beta_2(\ln W_2 - \ln W_1) + \beta_3(\ln W_3 - \ln W_2) + \gamma_1 \ln(Y_1) + \gamma_2 \ln(Y_2) + \gamma_3 \ln(Y_3) + \gamma_4 \ln(Y_4) + \varepsilon \qquad \text{(A.2)}$$

whereby the point estimate and standard error on β_1 now correspond exactly to those on the H-Statisic; the definition of the variables is presented in Section 3.2.1.

The t-statistic for the hypothesis H = 0 is calculated as the coefficient of the H-Statistic divided by its standard error, whereby the complementary test for H = 1 is calculated as (1 - H) divided by the respective standard error of the H-Statistic (Shaffer, 2004b). All standard errors are corrected for heteroskedasticity.

Austria	1999		2000		2001		2002		2003		2004	
Small banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.2772	0.4378	n/a	n/a	n/a	n/a	0.3012	0.3097	0.5061	0.2707	0.4977	0.1777
	(1.8249)*	(2.8778)***	n/a	n/a	n/a	n/a	(2.9962)***	(3.7929)***	(5.9965)***	(2.4736)**	(3.5980)***	(1.1366)
Labour cost/Total assets	-0.0486	0.3217	n/a	n/a	n/a	n/a	0.1318	0.2720	0.1349	0.1829	0.1987	0.2054
	(0.4047)	(4.3483)***	n/a	n/a	n/a	n/a	(0.9995)	(3.6612)***	(1.3940)	(1.9211)*	(0.9977)	(1.0322)
Operating expenses/Total assets	-0.2138	0.0556	n/a	n/a	n/a	n/a	-0.2601	0.2494	-0.4090	0.1091	-0.5815	0.0778
	(1.4344)	(0.5769)	n/a	n/a	n/a	n/a	(1.4332)	(7.8521)***	(1.3681)	(0.6794)	(1.6635)	(0.9082)
Equity/Total assets	0.1527	0.1623	n/a	n/a	n/a	n/a	0.0231	0.1097	-0.0339	0.1739	-0.0193	0.2739
	(1.6548)	(3.5178)***	n/a	n/a	n/a	n/a	(0.3223)	(2.2553)**	(0.4356)	(1.2688)	(0.1729)	(1.9528)*
Net loans/Total assets	0.1450	0.0465	n/a	n/a	n/a	n/a	0.1421	-0.0350	0.1531	0.0379	0.1482	0.1107
	(3.4368)***	(1.1288)	n/a	n/a	n/a	n/a	(2.2314)**	(0.4912)	(1.5097)	(0.3041)	(2.0499)**	(1.2056)
Total assets	-0.1571	-0.0384	n/a	n/a	n/a	n/a	-0.1255	-0.0128	-0.1271	0.0497	-0.2097	0.0767
	(2.5896)**	(1.3075)	n/a	n/a	n/a	n/a	(2.3291)**	(0.4610)	(1.2161)	(0.5870)	(1.6573)	(1.2056)
Deposits/Deposits and other funding	0.0050	0.0075	n/a	n/a	n/a	n/a	0.0079	0.0871	0.0661	0.0581	0.0901	0.09661
	(0.5781)	(0.3561)	n/a	n/a	n/a	n/a	(0.3060)	(0.5600)	(0.8600)	(0.8689)	(0.5961)	(0.8800)
Observations	75	75	n/a	n/a	n/a	n/a	73	73	72	72	64	64
Adjusted R-squared	0.3973	0.7711	n/a	n/a	n/a	n/a	0.4607	0.8166	0.4659	0.2551	0.4682	0.4641
H-Statistic	0.0148	0.8150	n/a	n/a	n/a	n/a	0.1729	0.8311	0.2320	0.5627	0.1149	0.4609
H-Statistic Standard Error	0.2757	0.1946	n/a	n/a	n/a	n/a	0.1584	0.1341	0.2367	0.1443	0.2460	0.2456
H = 0 (t-test)	0.0500	4.19	n/a	n/a	n/a	n/a	1.09	6.20	0.9800	3.9000	0.4700	1.8800
H = 1 (t-test)	3.5734	0.9507	n/a	n/a	n/a	n/a	5.22	1.26	3.2445	3.0326	3.5980	2.1950
Equilibrium/Disequilibrium	Equilibrium		n/a		n/a		Equilibrium		Equilibrium		Equilibrium	

Austria	1999		2000		2001		2002		2003		2004	
Large banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.5446	0.2075	0.3944	0.4210	0.3992	0.4819	0.3009	0.3102	0.1839	0.2472	0.2722	0.3571
	(2.9585)***	(1.5464)	(5.5372)***	(6.9003)***	(9.1167)***	(8.1107)***	(2.3342)**	(3.3998)***	(1.9438)*	(3.2088)***	(2.5685)**	(3.8902)***
Labour cost/Total assets	0.1794	0.1034	0.0764	0.1710	0.1248	0.1679	0.0214	0.1519	-0.0240	0.0954	-0.0420	0.1584
	(2.0426)*	(1.8608)*	(1.1218)	(2.2419)**	(2.6545)**	(2.6245)**	(0.2295)	(2.2057)**	(0.3611)	(1.6822)	(0.4899)	(1.9471)*
Operating expenses/Total assets	-0.1370	0.2408	0.0508	0.2030	-0.0013	0.1444	0.0152	0.0714	-0.0085	0.0644	0.0262	0.0877
	(0.9606)	(3.1730)***	(0.8374)	(3.2923)***	(0.0284)	(3.1778)***	(0.1800)	(1.2729)	(0.1316)	(1.2926)	(0.5433)	(2.5086)**
Equity/Total assets	0.0890	-0.0109	0.1284	0.0643	0.1666	0.1565	0.1742	0.1312	0.1421	0.1430	0.2770	0.2201
	(0.7702)	(0.1258)	(2.8330)***	(1.2764)	(6.8823)***	(6.7494)***	(2.1169)**	(3.2856)***	(1.9424)*	(3.0506)***	(2.6676)**	(3.1944)***
Net loans/Total assets	0.2241	-0.0449	0.2113	-0.0007	0.1804	-0.0624	0.1532	0.0029	0.1586	0.0588	0.3232	0.1515
	(1.9991)*	(0.5578)	(3.2078)***	(0.0082)	(3.9678)***	(1.2084)	(1.9459)*	(0.0640)	(1.8873)*	(0.7434)	(2.8530)***	(1.3006)
Total assets	-0.0182	-0.0721	-0.0193	-0.0561	-0.0203	-0.0419	-0.0423	-0.0279	-0.0556	-0.0145	-0.0270	0.0168
	(0.4239)	(2.4362)**	(0.7033)	(2.7791)**	(1.3258)	(2.4636)**	(1.3970)	(1.6339)	(1.9485)*	(0.6503)	(1.0893)	(0.8023)
Deposit/Deposits and other funding	0.10661	0.09661	0.29661	0.2967	0.9901	0.0501	0.0981	0.0651	0.0559	0.08521	0.0891	0.0778
	(0.5000)	(0.8800)	(0.9980)	(0.8950)	(0.9560)	(0.2001)	(0.1501)	(0.1008)	(0.1901)	(0.2981)	(0.2501)	(0.5509)
Observations	28	28	32	32	35	35	40	40	43	43	43	43
Adjusted R-sqnared	0.3582	0.6777	0.8489	0.8939	0.8658	0.8904	0.3640	0.6914	0.1802	0.3933	0.4449	0.5757
H-Statistic	0.5870	0.5518	0.5216	0.7950	0.5527	0.7941	0.3376	0.5344	0.1513	0.4070	0.2564	0.6032
H-Statistic Standard Error	0.1571	0.1341	0.0763	0.0885	0.0577	0.0661	0.1494	0.0855	0.1272	0.1031	0.1392	0.1307
H = 0 (t-test)	3.74	4.1200	6.8400	8.9800	9.0600	12.0200	2.2600	6.24000	1.1900	3.9500	1.8400	4.6100
H = 1 (t-test)	2.6289	3.3423	6.2699	2.3164	8.2721	3.1149	4.4367	5.4637	6.6721	5.7517	5.3427	3.0357
Equilibrium/Disequilibrium	Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium	

Belgium	1999		2000		2001		2002		2003		2004	
Small banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.4811	-0.3540	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	(1.4685)	(1.2099)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Labour cost/Total assets	-0.2334	-0.3822	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	(3.2122)***	(2.5859)***	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Other expenses/Total assets	0.3831	0.8074	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	(1.3747)	(1.7373)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Equity/Total assets	0.3077	0.1540	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	(1.9508)	(0.4337)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Net loans/Total assets	0.0803	0.0701	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	(1.0383)	(0.5966)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total assets	0.0852	-0.3191	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	(0.7112)	(1.5664)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Deposits/Deposits and other funding	-0.1053	0.0402	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	(0.5848)	(0.1347)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Observations	10	10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Adjusted R-squared	0.9221	0.6631	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
H-Statistic	0.6308	0.0712	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
H-Statistic Standard Error	0.3127	0.5023	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
H = 0 (t-test)	2.0200	0.1400	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
H = 1 (t-test)	1.1800	1.8491	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Equilibrium/Disequilibrium	Equilibrium		n/a		n/a		n/a		n/a		n/a	

Belgium	1999		2000		2001		2002		2003		2004	
Large banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.7193	-0.1699	0.2929	0.0071	0.1977	0.1616	0.3849	0.0610	0.2434	0.1977	0.4394	0.1061
	(1.5610)	(2.2837)**	(1.3599)	(0.0416)	(1.1473)	(0.7701)	(3.0410)**	(2.3590)***	(1.9529)**	(1.9584)**	(1.8939)*	(1.9153)**
Labour cost/Total assets	-0.0631	0.2265	-0.0207	0.3778	0.0870	0.1420	0.0322	0.0953	-0.0619	0.0147	-0.0295	0.1986
	(2.3923)***	(3.9461)***	(0.1488)	(3.9075)***	(1.9025)**	(1.8435)*	(0.2863)	(0.8080)	(1.8336)*	(1.8567)*	(0.1488)	(0.9561)
Other expenses/Total assets	0.0927	0.0236	0.0460	0.0006	0.0483	0.0740	0.1148	0.1495	0.1701	0.1783	0.1207	0.0694
	(1.3031)	(0.6448)	(0.9329)	(0.0131)	(1.1449)	(1.4231)	(1.4286)	(1.2722)	(1.3107)	(1.6178)	(0.6495)	(0.4031)
Equity/Total assets	0.0909	0.1260	0.1315	0.0101	0.1043	0.0332	0.2572	0.1612	0.1219	0.0796	0.2438	0.1557
	(0.9368)	(2.3123)**	(1.8439)*	(0.1113)	(1.4944)	(0.3777)	(1.7758)	(1.2632)	(1.5955)	(1.4137)	(2.1756)*	(1.7911)*
Net loans/Total assets	0.0709	-0.0313	0.0838	-0.1377	0.0481	0.0412	0.1095	0.1199	0.1089	0.0784	0.1105	0.0066
	(0.8547)	(1.0671)	(0.7599)	(2.0180)*	(0.7515)	(0.7165)	(0.7304)	(0.7923)	(1.0187)	(0.8853)	(0.7561)	(0.0649)
Total assets	0.0741	0.0319	0.0746	-0.0344	0.0433	0.0426	0.0513	0.0068	0.0188	0.0173	0.1502	0.1080
	(0.6958)	(0.5565)	(0.9011)	(0.4746)	(0.8485)	(0.8362)	(0.5983)	(0.0737)	(0.2515)	(0.3214)	(1.0672)	(0.7561)
Deposits/Deposits and other funding	-0.4872	0.0458	-0.4006	0.4884	-0.2342	-0.1392	-0.7405	-0.7080	-0.7038	-0.4646	-0.4116	-0.0770
	(1.3782)	(0.1879)	(1.1445)	(1.4408)	(1.0288)	(0.5663)	(1.8658)*	(1.4539)	(1.5813)	(1.2476)	(0.4554)	(0.0919)
Observations	18	18	18	18	19	19	19	19	17	17	18	18
Adjusted R-squared	0.1736	0.6165	0.0047	0.6205	0.4092	0.4946	0.4603	0.4086	0.0562	0.3813	0.4283	0.3599
H-Statistic	0.7489	0.0819	0.3182	0.3855	0.3330	0.3776	0.5320	0.3057	0.3516	0.3907	0.5306	0.3741
H-Statistic Standard Error	0.3879	0.07479	0.1597	0.0710	0.1273	0.1637	0.1615	0.1800	0.2015	0.1282	0.3439	0.2689
H = 0 (t-test)	1.9300	1.0700	1.9900	5.4200	2.6200	2.3100	3.2900	1.7000	1.7400	3.0500	1.5400	1.3900
H = 1 (t-test)	0.5184	12.2999	4.2693	11.3376	5.2437	3.8043	2.8945	3.8572	3.1955	4.7535	1.3652	2.3236
Equilibrium/Disequilibrium	Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium	

Denmark	1999		2000		2001		2002		2003		2004	
Small banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.0659	-0.0024	0.6446	0.6387	0.2158	0.0481	0.0322	-0.0288	0.1174	0.0180	0.1997	0.1703
	(1.0799)	(0.0544)	(3.8487)***	(3.0133)***	(1.7674)*	(0.5131)	(0.3212)	(0.4543)	(1.2666)	(0.2692)	(1.7380)*	(1.3850)
Labour cost/Total assets	0.1852	0.2514	-0.0040	0.0940	-0.0338	0.1152	0.1319	0.1900	0.1191	0.2150	0.2933	0.4358
	(3.4245)***	(5.6283)***	(0.0498)	(0.9873)	(0.2780)	(0.9545)	(2.0554)**	(2.5761)**	(1.9404)*	(3.1855)***	(2.6562)**	(3.5038)***
Other expenses/Total assets	-0.0554	0.0505	-0.1064	-0.0895	-0.0556	-0.0687	-0.1049	-0.0634	0.0183	0.0275	0.0143	0.1033
	(0.8396)	(0.9490)	(1.6620)	(1.1235)	(0.6531)	(0.7753)	(1.2927)	(0.8406)	(0.5260)	(0.9595)	(0.2012)	(1.2339)
Equity/Total assets	0.1049	0.0578	0.1382	0.0902	0.1991	0.1689	0.2375	0.1864	0.2516	0.2015	0.0246	-0.0463
	(2.7779)***	(2.1136)**	(1.9145)*	(1.0422)	(3.2837)***	(3.2039)***	(3.0851)***	(3.2044)***	(3.5428)***	(3.0943)***	(0.3152)	(0.5613)
Net loans/Total assets	0.2787	0.1918	0.5810	0.5172	0.4216	0.3330	0.3158	0.2074	0.0418	0.0294	-0.0803	-0.1545
	(4.6783)***	(5.7859)***	(6.4154)***	(4.6440)***	(5.3284)***	(4.6158)***	(5.3570)***	(5.8996)***	(0.3563)	(0.3085)	(0.8523)	(1.3561)
Total assets	-0.0203	0.0059	-0.0153	0.0063	-0.0195	0.0146	-0.0206	0.0147	0.0084	0.0269	0.0093	0.0424
	(1.8074)*	(0.7369)	(0.8594)	(0.2962)	(1.2568)	(1.0871)	(1.0263)	(1.0434)	(0.3497)	(1.6766)	(0.3528)	(1.9594)*
Deposits/Deposits and other funding	0.1598	0.2691	0.1991	0.2098	0.9511	1.9856	1.0856	1.5856	1.9156	1.8587	1.9006	0.8556
	(0.5681)	(0.7685)	(0.2651)	(0.8581)	(0.95898)	(1.5511)	(1.0012)	(1.6511)	(1.0324)	(1.0041)	(0.9542)	(1.0088)
Observations	49	49	48	48	49	49	46	46	42	42	43	43
Adjusted R-squared	0.7277	0.8784	0.7108	0.6097	0.6651	0.6810	0.6640	0.6336	0.3683	0.4209	0.2855	0.5269
H-Statistic	0.1956	0.2996	0.5342	0.6431	0.1264	0.0947	0.0592	0.0978	0.2548	0.2605	0.5073	0.7095
H-Statistic Standard Error	0.0868	0.0615	0.1653	0.19578	0.2062	0.1965	0.1548	0.1135	0.1356	0.1315	0.2194	0.2572
H = 0 (t-test)	2.2500	4.8700	3.2300	3.2900	0.6100	0.4800	0.3800	0.8600	1.8800	1.9800	2.3100	2.7600
H = 1 (t-test)	9.2661	11.3889	2.8179	1.8228	4.2364	4.6071	6.0775	8.1074	5.4956	5.6236	2.2457	1.1297
Equilibrium/Disequilibrium	Equilibrium		Equilibrium		Equilibrium		Disequilibrium		Equilibrium		Equilibrium	

Denmark	1999		2000		2001		2002		2003		2004	
Large banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	n/a	n/a	n/a	n/a	n/a	n/a	0.1959	0.2867	0.3882	0.4040	0.1565	0.1131
	n/a	n/a	n/a	n/a	n/a	n/a	(0.7720)	(2.6988)	(0.9255)	(2.3016)	(1.9706)	(0.8436)
Labour cost/Total assets	n/a	n/a	n/a	n/a	n/a	n/a	0.2649	0.3157	0.3771	0.3708	0.1446	0.1520
	n/a	n/a	n/a	n/a	n/a	n/a	(1.2136)	(3.1320)*	(1.5908)	(3.4894)**	(1.0181)	(0.3943)
Other expenses/Total assets	n/a	n/a	n/a	n/a	n/a	n/a	0.1351	0.1190	0.0320	0.0437	0.1507	0.0942
	n/a	n/a	n/a	n/a	n/a	n/a	(2.9359)*	(5.4105)**	(1.8348)	(3.8578)**	(1.0421)	(0.2748)
Equity/Total assets	n/a	n/a	n/a	n/a	n/a	n/a	0.4016	0.1933	0.2212	0.1190	0.2110	0.1076
	n/a	n/a	n/a	n/a	n/a	n/a	(2.4730)	(2.2205)	(2.1337)	(2.0340)	(4.1217)***	(0.6243)
Net loans/Total assets	n/a	n/a	n/a	n/a	n/a	n/a	-0.2469	-0.1188	0.2724	0.1716	0.2681	0.1556
	n/a	n/a	n/a	n/a	n/a	n/a	(0.9239)	(0.8208)	(15.0788)***	(15.5524)***	(8.1096)***	(2.2620)*
Total assets	n/a	n/a	n/a	n/a	n/a	n/a	0.2955	0.0897	0.0820	-0.0139	0.0627	0.0034
	n/a	n/a	n/a	n/a	n/a	n/a	(3.1466)*	(1.2209)	(0.5083)	(0.1936)	(1.0171)	(0.0315)
Deposits/Deposits and other funding	n/a	n/a	n/a	n/a	n/a	n/a	1.8906	1.9975	1.5565	1.9861	1.9875	0.1555
	n/a	n/a	n/a	n/a	n/a	n/a	(1.0522)	(1.0324)	(0.9804)	(0.8514)	(1.5104)	(0.8164)
Observations	n/a	n/a	n/a	n/a	n/a	n/a	10	10	10	10	12	12
Adjusted R-squared	n/a	n/a	n/a	n/a	n/a	n/a	0.7328	0.9798	0.9209	0.9780	0.9332	0.6561
H-Statistic	n/a	n/a	n/a	n/a	n/a	n/a	0.5959	0.7214	0.7974	0.8185	0.4519	0.3593
H-Statistic Standard Error	n/a	n/a	n/a	n/a	n/a	n/a	0.4965	0.2134	0.6462	0.2762	0.1945	0.3182
H = 0 (t-test)	n/a	n/a	n/a	n/a	n/a	n/a	1.2000	3.3800	1.2300	3.0000	2.3200	1.1300
H = 1 (t-test)	n/a	n/a	n/a	n/a	n/a	n/a	0.8138	1.3055	0.3137	0.6779	2.8180	2.0135
Equilibrium/Disequilibrium	n/a		n/a		n/a		Equilibrium		Equilibrium		Equilibrium	

France	1999		2000		2001		2002		2003		2004	
Small banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.4249	0.1850	0.4514	0.4994	0.5032	0.4410	0.4145	0.3649	0.2991	0.3367	0.2371	0.3289
	(5.9828)***	(1.6724)	(3.1283)***	(7.1383)***	(6.8256)***	(5.8482)***	(6.1151)***	(3.5874)***	(4.1513)***	(3.9698)***	(2.6519)**	(5.7555)***
Labour cost/Total assets	-0.0163	-0.0108	0.0917	0.1434	0.0552	0.1931	0.1555	0.1406	0.0039	0.0725	-0.0511	0.0140
	(0.1937)	(0.1335)	(1.2714)	(1.7078)*	(0.4435)	(2.6925)**	(1.3588)	(0.8609)	(0.0668)	(0.7468)	(0.9674)	(0.2123)
Other expenses/Total assets	0.0945	0.2657	0.0907	0.2030	-0.0278	0.1054	0.1017	0.1300	0.0723	0.1780	0.0216	0.2459
	(0.9281)	(3.1986)***	(1.4140)	(6.9249)***	(0.2622)	(1.9607)*	(1.2962)	(1.0963)	(1.3575)	(2.7842)**	(0.2719)	(3.5408)***
Equity/Total assets	-0.1389	0.0138	-0.1318	-0.0122	-0.0417	0.1006	0.0805	-0.0573	-0.1564	0.1144	-0.7055	-0.1219
	(2.1067)**	(0.1872)	(1.2442)	(0.0957)	(0.3225)	(0.7827)	(0.5193)	(0.3512)	(2.0461)*	(1.0922)	(4.6740)***	(0.9456)
Net loans/Total assets	0.2250	-0.0014	0.2087	0.0662	0.1726	0.1353	0.3691	0.1507	0.3984	0.1817	0.2386	0.0813
	(2.8401)***	(0.0193)	(2.9536)***	(1.5175)	(1.7255)*	(2.3992)**	(2.5181)**	(1.5210)	(5.7801)***	(1.4411)	(3.5571)***	(1.4160)
Total assets	0.0283	-0.0938	-0.0819	-0.0755	0.0295	0.0184	0.1032	-0.1565	0.0082	-0.0208	-0.1193	-0.1231
	(0.2867)	(0.9939)	(0.7783)	(0.8041)	(0.2825)	(0.1948)	(0.8351)	(1.1361)	(0.1117)	(0.3010)	(0.7745)	(1.0245)
Deposits/Deposits and other funding	-0.0073	0.0179	0.1251	-0.0095	0.1067	-0.1782	-0.1044	-0.2646	-0.5274	-0.1386	-0.5208	-0.1319
	(0.0651)	(0.1891)	(2.2173)**	(0.1616)	(0.3518)	(0.5951)	(0.3435)	(0.6946)	(3.4558)***	(0.7798)	(3.9448)***	(1.1209)
Observations	46	46	46	46	49	49	33	33	32	32	20	20
Adjusted R-squared	0.6438	0.3336	0.7083	0.7498	0.5366	0.6328	0.6522	0.5523	0.6899	0.4799	0.7103	0.7243
H-Statistic	0.5031	0.4398	0.8374	0.8459	0.5307	0.7395	0.6717	0.6355	0.3754	0.5872	0.2045	0.5883
H-Statistic Standard Error	0.1231	0.1662	0.1500	0.1245	0.2073	0.1067	0.1184	0.1686	0.0973	0.1243	0.1298	0.0850
H = 0 (t-test)	4.0900	2.6500	5.5800	6.8000	2.5600	6.9500	5.6700	3.7700	3.8600	4.7200	1.6000	6.9200
H = 1 (t-test)	4.0395	3.3706	1.0840	1.2387	2.2644	2.4483	27728	2.1619	6.4193	3.3209	6.1055	4.8376
Equilibrium/Disequilibrium	Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium	

France	1999		2000		2001		2002		2003		2004	
Large banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.4885	0.3967	0.3100	0.2093	0.1670	0.1200	0.1353	0.0826	0.0737	0.1117	0.1128	0.0557
	(4.0775)***	(2.8555)***	(2.7851)***	(2.2022)**	(2.0002)**	(1.7921)*	(1.5361)	(0.9895)	(0.8714)	(1.4736)	(1.3693)	(0.9062)
Labour cost/Total assets	0.0369	0.0929	0.0433	0.1330	0.0068	0.1124	0.0205	0.1215	-0.0643	0.1436	0.0648	0.2223
	(1.0622)	(1.8199)*	(0.8533)	(2.6956)***	(0.1345)	(2.2475)**	(0.4884)	(3.0233)***	(0.7053)	(1.7361)*	(1.0220)	(3.5941)***
Other expenses/Total assets	0.1864	0.2545	0.0895	0.1297	0.0163	0.0440	0.0109	0.0483	0.0652	0.0950	0.0903	0.1220
	(2.8696)***	(2.9056)***	(1.4913)	(1.6838)*	(0.5887)	(1.3485)	(0.4212)	(1.9886)**	(1.2086)	(1.9977)**	(2.0236)**	(2.7092)***
Equity/Total assets	-0.0018	0.0026	0.0618	0.0879	0.0057	0.0469	0.0395	0.0283	0.0261	0.0198	0.0546	0.0214
	(0.0307)	(0.0495)	(1.4643)	(2.3321)**	(0.1384)	(1.3959)	(0.8917)	(0.6822)	(0.4707)	(0.4181)	(1.3375)	(0.5633)
Net loans/Total assets	0.0455	0.0053	0.0382	-0.0268	0.0613	0.0133	0.1084	0.0678	0.1564	0.0667	0.2820	0.1471
	(0.8142)	(0.0723)	(0.8507)	(0.5169)	(1.2120)	(0.2447)	(2.6560)***	(2.1304)**	(2.5929)**	(1.3257)	(3.2670)***	(1.7748)*
Total assets	-0.0436	-0.0409	-0.0500	-0.0582	-0.0589	-0.0555	-0.0356	-0.0365	-0.0240	-0.0377	0.0015	0.0060
	(1.6747)*	(1.4289)	(1.7708)*	(2.3820)**	(2.7255)***	(3.1666)***	(1.3888)	(1.6692)*	(0.6289)	(1.0551)	(0.0540)	(0.2403)
Deposit/Deposits and funding	-0.0534	-0.0564	-0.0826	-0.1244	-0.3875	-0.3030	-0.3489	-0.3667	-0.3675	-0.3410	-0.1255	-0.2806
	(0.7516)	(0.5813)	(0.2664)	(0.4497)	(1.6662)*	(1.4095)	(1.0066)	(1.2899)	(1.2999)	(1.3716)	(0.3278)	(0.9587)
Observations	111	111	114	114	104	104	94	94	86	86	79	79
Adjusted R-squared	0.5520	0.5153	0.4576	0.5319	0.2113	0.3646	0.3404	0.4343	0.1314	0.4130	0.4059	0.5220
H-Statistic	0.7118	0.7441	0.4427	0.4720	0.1901	0.2765	0.1668	0.2523	0.7465	0.3504	0.2679	0.4000
H-Statistic Standard Error	0.1367	0.1498	0.1508	0.1374	0.1351	0.1125	0.1231	0.1162	0.1663	0.1283	0.1248	0.1109
H = 0 (t-test)	5.2100	4.9700	2.9400	3.4300	1.4100	2.4600	1.3500	2.1700	0.4500	2.7300	2.1500	3.6100
H = 1 (t-test)	2.1080	1.7083	3.6956	3.8443	5.9948	6.4311	6.7684	6.4346	5.5536	5.0679	5.8662	5.4152
Equilibrium/Disequilibrium	Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium	

Germany	1999		2000		2001		2002		2003		2004	
Small banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.2158	0.1275	0.0001	0.1691	0.0024	0.3974	0.0051	0.2615	0.4936	0.3104	0.5345	0.3160
	(4.1206)***	(2.0046)**	(0.1244)	(2.9341)***	(0.0589)	(5.5452)***	(0.0050)	(2.4632)**	(4.3509)***	(3.7550)***	(5.0834)***	(4.3902)***
Labour cost/Total assets	0.1291	0.1936	0.0551	0.2692	0.0943	0.2474	0.1640	0.3551	0.0997	0.3487	0.0979	0.3359
	(4.6233)***	(3.0589)***	(1.0151)	(5.9747)***	(1.8441)*	(5.0535)***	(2.4721)**	(7.4839)***	(1.6031)	(7.5490)***	(1.4468)	(5.7172)***
Other expenses/Total assets	-0.0854	0.1807	-0.0414	0.1335	-0.0247	0.1781	-0.0415	0.1247	-0.0075	0.1587	0.0331	0.2256
	(3.1564)***	(2.9607)***	(0.9353)	(3.0421)***	(0.6997)	(3.9848)***	(1.1596)	(3.2040)***	(0.1721)	(5.4683)***	(0.6926)	(6.4095)***
Equity/Total assets	-0.0712	0.1286	0.0199	0.1474	-0.0446	0.0283	-0.1329	0.0780	-0.0921	0.0840	-0.0563	0.0985
	(1.8928)*	(3.4943)***	(0.5110)	(5.2916)***	(0.9692)	(0.6819)	(2.3715)**	(1.8077)*	(1.8789)*	(1.7970)*	(1.1519)	(2.2370)**
Net loans/Total assets	0.0892	0.0222	0.1553	-0.0192	0.0691	-0.0426	0.0655	-0.0094	0.0523	-0.0307	0.0894	-0.0055
	(4.0919)***	(0.8604)	(3.6057)***	(0.8832)	(2.0949)**	(2.0703)**	(1.8226)*	(0.3639)	(1.6860)*	(1.3986)	(3.8910)***	(0.3059)
Total assets	-0.0123	-0.0039	-0.0030	-0.0027	-0.0079	-0.0161	-0.0252	-0.0131	-0.0313	-0.0132	-0.0245	-0.0105
	(2.0600)**	(0.5883)	(0.3200)	(0.5017)	(1.0440)	(2.6434)***	(1.8259)*	(1.2970)	(2.5514)**	(1.5548)	(1.9195)*	(0.9674)
Deposits/Deposits and other funding	2.8506	1.1970	4.1524	2.8837	3.5859	3.2988	5.6105	-1.0764	7.1041	1.5832	7.8125	5.6636
	(2.4815)**	(0.8464)	(2.8616)***	(2.2613)**	(2.4824)**	(2.0173)**	(4.0005)***	(0.5070)	(3.9109)***	(0.6274)	(4.0883)***	(3.1404)***
Observations	896	896	903	902	775	775	676	676	609	609	527	527
Adjusted R-sqnared	0.3455	0.5205	0.3776	0.6433	0.3430	0.7069	0.4784	0.7253	0.5481	0.7762	0.6276	0.7632
H-Statistic	0.2595	0.5018	0.2765	0.5718	0.3945	0.8229	0.5441	0.7412	0.5878	0.8178	0.6654	0.8776
H-Statistic Standard Error	0.0754	0.0821	0.1558	0.0532	0.0764	0.0834	0.2043	0.1198	0.1534	0.0728	0.1267	0.0823
H = 0 (t-test)	3.4400	6.1100	1.7800	10.7400	5.1700	9.8600	2.6600	6.1800	3.8200	11.2400	5.2500	10.6600
H = 1 (t-test)	9.8733	6.0682	4.6395	8.0489	7.9684	2.1231	2.2320	2.1611	2.6990	2.5319	2.6441	1.4872
Equilibrium/Disequilibrium	Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium	

Germany	1999		2000		2001		2002		2003		2004	
Large banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.5280	0.4102	0.5131	0.4949	0.3378	0.3727	0.3099	0.3591	0.3588	0.3401	0.2715	0.3146
	(12.0160)***	(11.1193)***	(9.6218)***	(13.3308)***	(7.9020)***	(9.0559)***	(4.9777)***	(5.4053)***	(4.1212)***	(6.1455)***	(6.6533)***	(8.0496)***
Labour cost/Total assets	0.0517	0.1241	0.0781	0.1454	-0.0428	0.0509	0.0219	0.0699	0.0218	0.0647	0.0072	0.0055
	(1.4415)	(3.3163)***	(2.7940)***	(3.6302)***	(1.3444)	(1.2961)	(0.7616)	(2.2055)**	(0.8910)	(2.5731)**	(0.2899)	(0.1571)
Other expenses/Total assets	0.1276	0.1936	0.0543	0.1815	0.1218	0.2147	0.1010	0.2113	0.1012	0.2310	0.0673	0.2914
	(4.0206)***	(6.1463)***	(1.8400)*	(5.1026)***	(3.4555)***	(6.0920)***	(3.0614)***	(6.1057)***	(2.7932)***	(7.3005)***	(2.7752)***	(6.8391)***
Equity/Total assets	-0.0842	0.0061	0.0111	0.0796	0.0532	0.0732	0.0101	0.0737	-0.0192	0.0925	0.0310	0.1226
	(2.7068)***	(0.1752)	(0.3696)	(2.6487)***	(2.0383)**	(2.9104)***	(0.3986)	(2.4794)**	(0.5981)	(2.6184)***	(1.0923)	(6.1183)***
Net loans/Total assets	0.0415	-0.0138	0.0420	-0.0821	0.1608	0.0341	0.1478	0.0322	0.1729	0.0440	0.1757	0.0443
	(1.5579)	(0.7285)	(1.2791)	(3.1792)***	(5.6486)***	(1.3466)	(4.8721)***	(1.0414)	(3.7943)***	(1.2310)	(4.3510)***	(1.5613)
Total assets	-0.0141	-0.0031	-0.0218	-0.0028	-0.0129	-0.0031	-0.0046	0.0027	-0.0164	-0.0030	-0.0135	-0.0085
	(2.1331)**	(0.4665)	(2.7869)***	(0.3537)	(2.4152)**	(0.5146)	(0.6466)	(0.3554)	(2.3030)**	(0.4202)	(1.9256)*	(1.2311)
Deposits/Deposits and other funding	1.6008	-0.2206	5.3170	4.9152	3.4766	1.2447	3.8782	1.4542	1.5786	0.2534	0.2334	-0.0378
	(1.4043)	(0.2620)	(6.1634)***	(5.4042)***	(1.7898)*	(0.5873)	(1.4375)	(0.8063)	(1.9926)**	(0.3478)	(0.3289)	(0.0645)
Observations	761	761	785	785	783	783	770	770	739	739	737	737
Adjusted R-squared	0.6458	0.7209	0.6510	0.7070	0.6237	0.6709	0.5856	0.6318	0.6038	0.6725	0.5099	0.7016
H-Statistic	0.7073	0.7278	0.6455	0.8216	0.4168	0.6383	0.4328	0.6402	0.4817	0.6357	0.3461	0.6115
H-Statistic Standard Error	0.0619	0.0505	0.0699	0.0597	0.0501	0.0584	0.0696	0.0798	0.1117	0.0697	0.0544	0.0504
H = 0 (t-test)	11.4100	14.4100	9.2300	13.7600	8.3200	10.9200	6.2200	8.0200	4.3100	9.1300	6.3600	12.1300
H = 1 (t-test)	14.9516	5.3900	5.072	2.9865	11.6666	6.1934	8.1612	4.5088	4.6401	5.2797	12.2111	7.19444
Equilibrium/Disequilibrium	Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium	

Italy	1999		2000		2001		2002		2003		2004	
Small banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.0561	0.3047	0.1110	0.0103	0.1262	0.0752	0.0616	0.0900	0.1669	0.1240	0.1449	0.0166
	(1.1871)	(5.6558)***	(1.1249)	(0.1018)	(1.8430)*	(1.4085)	(0.8556)	(1.8549)*	(4.0837)***	(2.3318)**	(2.7612)***	(0.3831)
Labour cost/Total assets	0.1719	0.7072	0.2414	0.3537	0.0468	0.2349	0.0355	0.2762	0.3334	0.4394	0.2410	0.2649
	(2.6522)***	(5.6021)***	(2.2945)**	(4.0365)***	(0.9762)	(2.4624)**	(0.5877)	(3.8124)***	(4.1365)***	(4.6713)***	(1.8505)*	(2.6554)***
Other expenses/Total assets	-0.2068	-0.0581	-0.2302	-0.0027	-0.0412	0.0439	-0.0268	0.2475	-0.1824	0.1398	-0.1308	0.3183
	(5.1166)***	(0.6682)	(2.7587)***	(0.0464)	(0.9844)	(1.6174)	(0.4611)	(4.5261)***	(2.8410)***	(1.8607)*	(1.6330)	(4.6499)***
Equity/Total assets	0.0046	-0.0286	-0.0560	-0.0690	0.0302	0.0098	-0.0864	-0.0815	0.0055	-0.0517	-0.0436	-0.1150
	(0.1246)	(0.6808)	(0.9151)	(1.8765)*	(0.8528)	(0.2336)	(1.7807)*	(1.7711)*	(0.1067)	(1.0342)	(0.8835)	(3.4651)***
Net loan/Total assets	0.2465	-0.0838	0.1046	-0.0101	0.1852	-0.0446	0.0792	-0.0191	0.1404	-0.0125	0.1112	-0.0050
	(5.1955)***	(1.8729)*	(2.8108)***	(0.1711)	(4.6751)***	(1.5764)	(1.9706)*	(0.3621)	(4.6470)***	(0.3413)	(5.3014)***	(0.2131)
Total assets	-0.0901	-0.0476	-0.0755	-0.0041	-0.0184	0.0302	-0.0172	0.0289	-0.0726	0.0083	-0.0567	0.0412
	(5.6054)***	(2.1106)**	(3.5301)***	(0.1912)	(1.2448)	(2.3438)**	(1.2387)	(1.6626)*	(3.9433)***	(0.4207)	(2.6209)***	(2.0633)**
Deposits/Deposits and other funding	-0.2673	0.0277	-0.2114	0.1209	-0.2229	0.2460	-0.3850	-0.1326	-0.2296	0.0569	-0.3963	-0.0640
	(2.7278)***	(0.2812)	(1.8795)*	(0.8465)	(1.5571)	(1.5918)	(4.3090)***	(1.4251)	(1.7559)*	(0.4606)	(3.2260)***	(0.5301)
Observations	213	213	205	205	208	208	186	186	182	182	165	165
Adjusted R-squared	0.5365	0.6787	0.4009	0.3181	0.5802	0.3557	0.1927	0.5699	0.5721	0.6571	0.3694	0.6565
H-Statistic	0.0212	0.9538	0.1222	0.3613	0.1312	0.3541	0.0703	0.6137	0.3179	0.7032	0.2616	0.5998
H-Statistic Standard Error	0.0953	0.1162	0.2089	0.1341	0.0962	0.1352	0.1029	0.1152	0.0798	0.1104	0.9412	0.1839
H = 0 (t-test)	0.2200	8.2000	0.5900	2.6900	1.3700	2.6200	0.6800	5.3200	3.9800	6.3700	2.7800	7.1400
H = 1 (t-test)	10.2700	0.3976	4.2020	4.7672	9.0231	4.8047	9.0447	3.3542	8.5476	2.6884	7.8459	4.7699
Equilibrium/Disequilibrium	Equilibrium		Equilibrium		Equilibrium		Disequilibrium		Disequilibrium		Equilibrium	

Italy	1999		2000		2001		2002		2003		2004	
Large banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.4908	0.3399	0.5725	0.4624	0.4768	0.3923	0.3573	0.3427	0.3530	0.3113	0.3406	0.2611
	(7.5038)***	(6.6341)***	(10.6791)***	(9.4068)***	(9.3012)***	(10.1275)***	(7.1123)***	(7.5598)***	(5.6016)***	(5.7054)***	(7.2398)***	(6.4148)***
Labour cost/Total assets	-0.0287	-0.0173	0.1840	0.1381	0.0967	0.0588	0.0624	0.1134	0.2573	0.2987	0.0897	0.1595
	(0.4139)	(0.3760)	(2.3238)**	(2.4054)**	(1.5928)	(1.1930)	(0.8645)	(1.6266)	(2.6847)***	(3.4941)***	(1.6922)*	(3.7632)***
Other expenses/Total assets	0.3746	0.3185	0.0921	0.2533	0.1313	0.2451	0.1836	0.2247	-0.0043	0.0445	0.1415	0.2023
	(6.2954)***	(6.4677)***	(1.0918)	(5.3130)***	(2.0685)**	(5.5412)***	(2.4285)**	(3.4508)***	(0.0472)	(0.5576)	(2.7617)***	(5.7719)***
Equity/Total assets	0.1324	-0.0016	-0.0362	-0.0566	-0.0679	-0.0532	0.0522	0.0263	-0.0988	-0.1213	0.0104	-0.0840
	(1.7288)*	(0.0226)	(0.8716)	(1.2910)	(1.8404)*	(1.2450)	(0.3999)	(0.2335)	(1.8977)*	(2.5499)**	(0.2209)	(2.0751)**
Net loans/Total assets	0.1707	-0.0038	0.0780	-0.0381	0.1143	0.0215	0.1792	0.0747	0.1275	-0.0329	0.1603	0.0273
	(2.0968)**	(0.0826)	(1.9090)*	(0.9154)	(2.6555)***	(0.4885)	(4.9722)***	(2.0621)**	(4.0929)***	(1.0459)	(4.0148)***	(1.3695)
Total assets	0.0211	-0.0058	-0.0331	0.0074	-0.0304	0.0148	0.0261	0.0522	0.0017	0.0284	0.0084	0.0403
	(0.9698)	(0.2664)	(1.9301)*	(0.4549)	(1.6801)*	(0.9497)	(0.6559)	(1.5095)	(0.1152)	(2.0427)**	(0.8284)	(4.2536)***
Deposits/Deposits and other funding	-0.1236	0.2742	0.2817	0.3215	0.2425	0.3441	0.0520	0.1597	0.0283	0.1663	-0.2518	0.1989
	(0.9543)	(1.7242)*	(2.4311)**	(3.5950)***	(1.1225)	(2.1413)**	(0.1455)	(0.5279)	(0.0750)	(0.5519)	(0.9149)	(0.9030)
Observations	124	124	135	135	139	139	146	146	158	158	169	169
Adjusted R-squared	0.7276	0.6546	0.7575	0.8039	0.7284	0.7234	0.6647	0.6452	0.5677	0.4744	0.6510	0.6328
H-Statistic	0.8367	0.6411	0.8485	0.8537	0.7049	0.6963	0.6033	0.6808	0.6060	0.6546	0.5719	0.6229
H-Statistic Standard Error	0.1117	0.0941	0.0844	0.0881	0.0878	0.0712	0.0771	0.0808	0.0994	0.0858	0.0876	0.0722
H = 0 (t-test)	7.4900	6.8100	1.0500	9.6900	8.0300	9.7800	7.8200	8.4200	6.1000	7.6300	6.5300	8.6300
H = 1 (t-test)	1.4619	3.8150	1.7942	1.6606	3.3649	4.2654	5.1520	3.9504	3.9797	4.0291	4.9953	5.2229
Equilibrium/Disequilibrium	Equilibrium		Equilibrium		Equilibrium		Equilibrium		Disequilibrium		Equilibrium	

Luxembourg	1999		2000		2001		2002		2003		2004	
Small banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.8261	0.6130	n/a	n/a	n/a	n/a	0.4227	0.3251	0.5774	0.3646	0.5319	0.3144
	(23.4905)***	(3.7617)***	n/a	n/a	n/a	n/a	(3.5287)***	(5.0129)***	(3.6874)***	(3.3253)***	(7.5154)***	(2.4132)**
Labour cost/Total assets	0.1181	0.3038	n/a	n/a	n/a	n/a	0.2095	0.1748	0.2208	0.2974	0.1524	0.1372
	(2.8159)**	(3.4772)***	n/a	n/a	n/a	n/a	(2.0013)*	(2.1532)**	(2.4923)**	(2.7441)**	(3.0376)**	(1.1564)
Other expenses/Total assets	-0.1090	0.0697	n/a	n/a	n/a	n/a	-0.0823	0.1893	-0.0918	0.2920	-0.0879	0.3676
	(2.7737)**	(0.7896)	n/a	n/a	n/a	n/a	(0.7600)	(2.4134)**	(0.7908)	(2.3273)**	(1.9839)*	(2.5043)**
Equity/Total assets	0.0367	0.0445	n/a	n/a	n/a	n/a	0.2873	0.1834	0.2579	0.0555	0.2622	0.0328
	(0.6789)	(0.3578)	n/a	n/a	n/a	n/a	(2.4268)**	(1.8529)*	(1.2720)	(0.4887)	(5.2897)***	(0.2938)
Net loans/Total assets	0.0306	0.0208	n/a	n/a	n/a	n/a	0.0465	0.0150	0.0990	0.0248	0.1186	0.0764
	(1.4038)	(0.6899)	n/a	n/a	n/a	n/a	(1.5162)	(0.3393)	(2.8569)**	(0.5903)	(7.9173)***	(3.2044)**
Total assets	0.0109	0.1720	n/a	n/a	n/a	n/a	0.1386	0.0946	0.0372	0.0814	0.0770	-0.0066
	(0.3074)	(1.0103)	n/a	n/a	n/a	n/a	(1.5381)	(1.0898)	(0.2018)	(0.6075)	(1.4996)	(0.0600)
Deposits/Deposits and other funding	0.1319	0.1627	n/a	n/a	n/a	n/a	1.5795	-2.1948	1.4143	-5.0303	2.3091	-7.5577
	(0.4817)	(0.4202)	n/a	n/a	n/a	n/a	(2.1332)**	(2.4322)**	(1.2165)	(4.6848)***	(6.6476)***	(11.5210)***
Observations	30	30	n/a	n/a	n/a	n/a	25	25	19	19	16	16
Adjusted R-squared	0.9567	0.7136	n/a	n/a	n/a	n/a	0.6203	0.7224	0.8112	0.8385	0.9574	0.8867
H-Statistic	0.8352	0.9865	n/a	n/a	n/a	n/a	0.5499	0.6892	0.7064	0.9540	0.5964	0.8191
H-Statistic Standard Error	0.0489	0.1242	n/a	n/a	n/a	n/a	0.1093	0.0939	0.1538	0.1399	0.0664	0.1215
H = 0 (t-test)	17.0800	7.9500	n/a	n/a	n/a	n/a	5.0300	7.3400	4.5900	6.8200	8.9900	6.7400
H = 1 (t-test)	3.3701	0.1089	n/a	n/a	n/a	n/a	4.1180	3.3099	1.9089	0.3288	6.0935	1.4888
Equilibrium/Disequilibrium	Equilibrium		n/a		n/a		Equilibrium		Equilibrium		Disequilibrium	

Luxembourg	1999		2000		2001		2002		2003		2004	
Large banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.8553	0.6059	0.8211	0.5416	0.8183	0.6540	0.8838	0.6461	0.7331	0.4844	0.6521	0.4570
	(26.9006)***	(8.3593)***	(15.7548)***	(4.4681)***	(11.0496)***	(9.4500)***	(15.4591)***	(9.4526)***	(10.6334)***	(9.5788)***	(7.6456)***	(7.8736)***
Labour cost/Total assets	0.0032	0.1140	0.0905	0.2103	0.0641	0.1201	0.0162	0.0137	0.0773	0.1071	0.0536	0.0926
	(0.1257)	(1.9825)*	(1.3271)	(2.2366)**	(0.9952)	(1.5967)	(0.3073)	(0.2935)	(1.4044)	(1.5375)	(0.7874)	(1.1009)
Other expenses/Total assets	0.0088	0.0365	-0.0448	0.0154	-0.0008	0.0449	0.0117	0.1569	-0.0911	0.0604	-0.0457	0.1473
	(0.4966)	(0.6646)	(0.9352)	(0.2209)	(0.0190)	(0.7914)	(0.2367)	(2.1407)**	(1.6490)	(0.7483)	(0.6089)	(1.5855)
Equity/Total assets	-0.0331	0.0408	0.0218	0.0482	0.0436	0.0693	-0.0886	0.0731	0.0873	0.1093	0.0967	0.0686
	(1.4494)	(0.8267)	(0.5567)	(0.9708)	(1.0909)	(1.7391)*	(1.5100)	(2.1220)**	(1.8686)*	(3.0190)***	(1.9617)*	(1.2756)
Net loans/Total assets	0.0046	-0.0473	0.0087	0.0104	0.0207	-0.0421	0.0199	-0.0510	0.0232	-0.0298	0.0101	-0.0450
	(0.5299)	(2.0460)**	(1.1668)	(0.5150)	(1.3778)	(1.1876)	(1.5320)	(1.5140)	(1.1864)	(1.1507)	(0.4012)	(1.4272)
Total assets	-0.0147	0.0081	0.0130	0.0479	0.0135	0.0394	-0.0116	0.0106	-0.0095	0.0177	0.0151	0.0366
	(1.6646)	(0.4368)	(0.4634)	(1.4824)	(0.5994)	(1.5778)	(0.7094)	(0.4079)	(0.3685)	(0.9500)	(0.6275)	(1.2755)
Deposits/Deposits and other funding	-0.0076	-0.0107	-0.0494	-0.1256	-0.1233	-0.0407	0.0681	-0.0017	0.0305	0.0142	-0.0076	-0.0366
	(0.0844)	(0.0939)	(0.5966)	(1.0387)	(1.4441)	(0.3292)	(1.5299)	(0.0169)	(0.4814)	(0.2018)	(0.1034)	(0.4007)
Observations	67	67	71	71	60	60	53	53	56	56	51	51
Adjusted R-squared	0.9627	0.7664	0.9184	0.6890	0.8695	0.7214	0.8931	0.7754	0.9020	0.7055	0.8614	0.6524
H-Statistic	0.8674	0.7564	0.8668	0.7672	0.8816	0.8190	0.9117	0.8167	0.7193	0.6518	0.6601	0.6967
H-Statistic Standard Error	0.0416	0.0750	0.0347	0.0990	0.0933	0.0982	0.0658	0.0669	0.0683	0.0590	0.0946	0.0933
H = 0 (t-test)	20.8500	10.0900	24.9900	7.7500	9.4500	8.3400	13.8400	12.2100	10.5200	11.0400	6.9800	7.4600
H = 1 (t-test)	3.1875	5.4133	3.8408	2.3515	1.2690	1.8442	1.5345	2.7418	4.1113	5.9017	3.5930	3.2484
Equilibrium/Disequilibrium	Equilibrium		Disequilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium	

Sweden	1999		2000		2001		2002		2003		2004	
Small banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	n/a	n/a	n/a	n/a	0.1483	0.1100	0.4849	0.4176	0.5210	0.4091	0.1407	0.0006
	n/a	n/a	n/a	n/a	(3.5222)***	(2.1943)**	(2.0216)**	(1.8066)*	(1.8821)*	(1.5251)	(2.1927)**	(0.0090)
Labour cost/Total assets	n/a	n/a	n/a	n/a	0.1005	0.1550	0.0512	0.1065	0.1249	0.1900	0.1072	0.1365
	n/a	n/a	n/a	n/a	(3.1345)***	(4.6534)***	(0.9920)	(2.0515)**	(2.9430)***	(3.6321)***	(2.3553)**	(2.4770)**
Other expenses/Total assets	n/a	n/a	n/a	n/a	0.0434	0.1057	0.2163	0.2611	0.1771	0.2204	0.0516	0.1486
	n/a	n/a	n/a	n/a	(1.5558)	(3.4923)***	(1.5710)	(1.9620)*	(1.7261)*	(2.1853)**	(1.0965)	(2.4591)**
Equity/Total assets	n/a	n/a	n/a	n/a	0.0773	0.0612	0.0989	0.0645	0.0967	0.0439	0.0871	0.0440
	n/a	n/a	n/a	n/a	(3.4447)***	(2.7057)***	(2.2960)**	(1.5187)	(1.9614)*	(0.9125)	(2.9688)***	(1.3849)
Net loans/Total assets	n/a	n/a	n/a	n/a	0.1161	0.0860	0.1136	0.0958	0.0785	0.0430	0.1495	0.1180
	n/a	n/a	n/a	n/a	(4.6539)***	(3.4947)***	(2.3386)**	(1.9052)*	(1.1843)	(0.6571)	(3.0713)***	(2.6159)**
Total assets	n/a	n/a	n/a	n/a	0.0032	0.0506	0.0041	0.0484	0.0125	0.0581	0.0082	0.0615
	n/a	n/a	n/a	n/a	(0.6939)	(8.8086)***	(0.7138)	(8.2996)***	(1.4249)	(5.5242)***	(0.8315)	(5.0577)***
Deposits/Deposits and other funding	n/a	n/a	n/a	n/a	-1.3197	-2.0324	8.1413	-5.3888	-8.1142	-2.8689	-0.1659	-1.0689
	n/a	n/a	n/a	n/a	(1.2983)	(1.6519)	(0.4196)	(0.2874)	(0.0210)	(0.7737)	(0.8037)	(0.7547)
Observations	n/a	n/a	n/a	n/a	80	80	80	80	80	80	71	71
Adjusted R-squared	n/a	n/a	n/a	n/a	0.4837	0.8141	0.5012	0.7027	0.4687	0.6430	0.3763	0.7036
H-Statistic	n/a	n/a	n/a	n/a	0.2922	0.3707	0.7523	0.7852	0.8230	0.8195	0.2995	0.2856
H-Statistic Standard Error	n/a	n/a	n/a	n/a	0.0638	0.0754	0.3363	0.3226	0.3950	0.3831	0.0903	0.0886
H = 0 (t-test)	n/a	n/a	n/a	n/a	4.5800	4.9200	2.2400	2.4300	2.0800	2.1400	3.3200	3.2200
H = 1 (t-test)	n/a	n/a	n/a	n/a	11.1115	8.3475	0.7365	0.6658	0.4485	0.4712	7.7661	8.0632
Equilibrium/Disequilibrium	n/a		n/a		Disequilibrium		Disequilibrium		Disequilibrium		Disequilibrium	

Sweden	1999		2000		2001		2002		2003		2004	
Large banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Labour cost/Total assets	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Other expenses/Total assets	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Equity/Total assets	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Net loans/Total assets	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total assets	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Deposits/Deposits and other funding	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Observations	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Adjusted R-squared	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
H-Statistic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
H-Statistic Standard Error	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
H = 0 (t-test)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
H = 1 (t-test)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Equilibrium/Disequilibrium	n/a		n/a		n/a		n/a		n/a		n/a	

Switzerland	1999		2000		2001		2002		2003		2004	
Small banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.2873	0.1132	0.3024	0.0319	0.3944	0.1727	0.2293	0.1720	0.2636	0.0765	0.2340	0.0324
	(3.2738)***	(2.3750)***	(3.7501)***	(0.4216)	(4.8456)***	(2.7987)***	(4.5416)***	(3.4311)***	(3.3024)***	(1.5780)	(4.5915)***	(0.9331)
Labour cost/Total assets	0.0296	0.2913	0.1185	0.4174	0.1258	0.5038	-0.0775	0.5149	-0.1230	0.4553	-0.1040	0.4630
	(0.2933)	(1.5386)	(1.5711)	(6.0615)***	(2.0036)**	(5.8460)***	(1.4932)	(7.7619)***	(1.5006)	(7.9690)***	(1.6583)*	(10.1099)***
Other expenses/Total assets	-0.0017	0.3400	-0.0742	0.2292	-0.0498	0.1190	-0.0045	0.0886	0.0180	0.2108	0.0350	0.1689
	(0.0155)	(1.5748)	(0.9269)	(2.8633)***	(0.7953)	(1.4039)	(0.0856)	(1.2521)	(0.2350)	(3.5881)***	(0.5655)	(3.2823)***
Equity/Total assets	0.0101	0.0022	0.0343	0.0855	-0.0188	0.0322	0.0228	0.0148	0.0253	0.0537	0.0210	0.0517
	(0.2754)	(0.0404)	(1.1841)	(2.7477)***	(0.6083)	(1.1892)	(1.3535)	(0.6098)	(0.8860)	(2.9345)***	(1.1456)	(3.4896)***
Net loans/Total assets	0.2412	-0.0756	0.0655	0.1014	0.0594	0.0667	0.0791	0.0295	0.1442	0.0588	0.1231	0.0477
	(2.6915)***	(1.0194)	(1.6864)*	(1.9415)*	(1.4560)	(1.6981)*	(1.6797)*	(0.7697)	(3.2168)***	(0.6234)	(3.0556)***	(1.0283)
Total assets	0.0494	0.0176	-0.0273	0.0418	-0.0476	-0.0073	-0.0009	-0.0506	-0.0405	-0.0062	-0.0179	-0.0059
	(1.2146)	(0.4782)	(0.8437)	(1.3097)	(1.3155)	(0.2197)	(0.0400)	(1.7837)*	(1.7283)*	(0.3108)	(0.8374)	(0.3375)
Deposits/Deposits and other funding	0.1373	-0.0138	-0.2424	-0.1051	-0.2538	-0.3303	-0.1901	-0.3116	-0.2484	-0.5390	-0.6952	-0.6986
	(1.2135)	(0.1320)	(1.5492)	(0.9504)	(3.5717)***	(3.5617)***	(2.2544)**	(4.2237)***	(1.0369)	(4.1114)***	(1.4985)	(2.2273)**
Observations	123	123	128	128	166	166	231	230	254	254	233	233
Adjusted R-squared	0.5979	0.7720	0.4464	0.8824	0.5702	0.8278	0.6611	0.8572	0.7081	0.8924	0.7043	0.9142
H-Statistic	0.3153	0.7444	0.3467	0.6785	0.4704	0.7955	0.1473	0.7753	0.1586	0.7426	0.1650	0.6643
H-Statistic Standard Error	0.1151	0.1228	0.1167	0.1077	0.1155	0.0882	0.0785	0.0815	0.1142	0.0609	0.0801	0.0564
H = 0 (t-test)	2.7400	6.0600	2.9700	6.300	4.0700	9.0200	1.8800	9.5200	1.3900	12.1900	2.0600	11.7700
H = 1 (t-test)	5.9487	2.0814	5.5933	2.9851	4.5853	2.3186	10.8624	2.7577	7.3677	4.2266	10.4245	5.9521
Equilibrium/Disequilibrium	Equilibrium		Disequilibrium		Disequilibrium		Disequilibrium		Equilibrium		Disequilibrium	

Switzerland	1999		2000		2001		2002		2003		2004	
Large banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.7021	-0.0487	0.6241	0.2672	0.5523	0.3860	0.5747	0.2536	0.6408	0.2487	n/a	n/a
	(8.4122)***	(3.1903)***	(5.2644)***	(1.4454)	(7.6354)***	(2.3965)**	(6.6027)***	(2.3336)**	(6.8491)***	(2.8171)***	n/a	n/a
Labour cost/Total assets	-0.4012	0.0623	-0.1537	-0.1349	0.0198	-0.0363	0.0071	0.2464	0.0383	0.2714	n/a	n/a
	(2.0390)*	(0.3184)	(0.8123)	(0.6108)	(0.3017)	(0.3699)	(0.0744)	(2.9093)***	(0.3290)	(3.0035)***	n/a	n/a
Other expenses/Total assets	0.5264	0.3038	0.2673	0.7237	0.1040	0.5775	0.1445	0.3577	0.0473	0.2846	n/a	n/a
	(2.7965)***	(1.4743)	(1.4745)	(3.5676)***	(1.1292)	(4.8432)***	(1.1601)	(2.9423)***	(0.3586)	(2.7802)***	n/a	n/a
Equity/Total assets	0.0245	0.2398	-0.0466	0.0328	-0.0433	0.0050	-0.1733	-0.0392	-0.0924	0.0693	n/a	n/a
	(0.2105)	(1.0659)	(0.5442)	(0.2151)	(0.7294)	(0.0541)	(2.2278)**	(0.3584)	(1.2721)	(0.9615)	n/a	n/a
Net loans/Total assets	0.2268	0.0484	0.1311	0.0636	0.0620	0.0217	0.0811	-0.0914	0.0607	-0.1026	n/a	n/a
	(2.7348)**	(0.6720)	(1.5274)	(0.8490)	(2.0441)**	(0.4075)	(1.2478)	(1.0768)	(0.8455)	(1.6493)	n/a	n/a
Total assets	-0.0277	0.0077	-0.0261	0.0127	-0.0039	-0.0093	-0.0240	-0.0319	-0.0272	-0.0252	n/a	n/a
	(0.7068)	(0.1342)	(0.6233)	(0.1952)	(0.1744)	(0.3226)	(0.8568)	(1.2851)	(0.9525)	(0.7929)	n/a	n/a
Deposits/Deposits and other funding	2.4914	2.5849	0.2102	1.8609	-0.5265	0.4333	-0.0564	0.2614	-0.5081	0.6189	n/a	n/a
	(1.9028)*	(1.6953)	(0.2423)	(1.6256)	(2.4194)**	(1.0586)	(0.1252)	(0.4439)	(1.2054)	(1.0817)	n/a	n/a
Observations	39	39	41	41	46	46	46	46	43	43	n/a	n/a
Adjusted R-squared	0.7374	0.4345	0.4716	0.6848	0.6456	0.7881	0.7950	0.8274	0.8574	0.8376	n/a	n/a
H-Statistic	0.8274	0.3174	0.73756	0.8560	0.6761	0.9272	0.7263	0.8577	0.7264	0.8047	n/a	n/a
H-Statistic Standard Error	0.1159	0.4137	0.1444	0.2274	0.1145	0.2052	0.1292	0.1525	0.1295	0.1166	n/a	n/a
H = 0 (t-test)	7.1400	0.7700	5.1100	3.7700	5.9000	4.5200	5.6200	5.6300	5.6100	6.9000	n/a	n/a
H = 1 (t-test)	1.4892	1.6499	1.8172	0.6325	2.8288	0.3548	2.1184	0.9337	2.1127	1.6749	n/a	n/a
Equilibrium/Disequilibrium	Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium		n/a	

United Kingdom	1999		2000		2001		2002		2003		2004	
Small banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.0445	-0.1516	0.0505	-0.1450	n/a	n/a	n/a	n/a	n/a	n/a	0.3121	0.2328
	(0.2035)	(0.5113)	(0.3861)	(1.9574)**	n/a	n/a	n/a	n/a	n/a	n/a	(1.9551)**	(0.9887)
Labour cost/Total assets	0.1232	0.2511	-0.2213	-0.0900	n/a	n/a	n/a	n/a	n/a	n/a	0.5375	0.5615
	(2.7981)**	(1.9902)***	(0.9801)	(2.2411)***	n/a	n/a	n/a	n/a	n/a	n/a	(1.9389)**	(2.6880)**
Other expenses/Total assets	-0.0602	0.0303	0.2823	0.3285	n/a	n/a	n/a	n/a	n/a	n/a	-0.2253	0.0253
	(0.2346)	(0.0790)	(2.6280)**	(1.4800)	n/a	n/a	n/a	n/a	n/a	n/a	(0.5484)	(0.1240)
Equity/Total assets	-0.0725	-0.0099	-0.0047	0.0214	n/a	n/a	n/a	n/a	n/a	n/a	-0.0211	-0.2234
	(0.2808)	(0.0354)	(0.0529)	(0.1341)	n/a	n/a	n/a	n/a	n/a	n/a	(0.0764)	(1.0423)
Net loans/Total assets	0.0910	0.0886	0.1069	0.1211	n/a	n/a	n/a	n/a	n/a	n/a	0.0410	0.0451
	(1.3275)	(1.1636)	(2.5275)**	(1.5284)	n/a	n/a	n/a	n/a	n/a	n/a	(0.4197)	(0.5877)
Total assets	-0.1516	-0.1065	-0.1044	-0.0936	n/a	n/a	n/a	n/a	n/a	n/a	0.1268	-0.0645
	(1.2861)	(0.7195)	(0.7761)	(0.3918)	n/a	n/a	n/a	n/a	n/a	n/a	(0.4289)	(0.3942)
Deposit /Deposits and other funding	-3.2089	-1.0080	-6.0080	-5.9188	n/a	n/a	n/a	n/a	n/a	n/a	4.3912	0.8856
	(2.25065)***	(0.0950)	(2.1065)*	(1.2746)	n/a	n/a	n/a	n/a	n/a	n/a	(1.0694)	(0.3572)
Observations	17	17	17	17	n/a	n/a	n/a	n/a	n/a	n/a	25	25
Adjusted R-squared	0.1725	0.4929	0.6371	0.5537	n/a	n/a	n/a	n/a	n/a	n/a	-0.0877	0.6878
H-Statistic	0.1074	0.1298	0.1115	0.0934	n/a	n/a	n/a	n/a	n/a	n/a	0.6243	0.8196
H-Statistic Standard Error	0.3664	0.2814	0.2720	0.4378	n/a	n/a	n/a	n/a	n/a	n/a	0.3691	0.2739
H = 0 (t-test)	0.2900	0.2600	0.4100	0.2100	n/a	n/a	n/a	n/a	n/a	n/a	1.6900	2.9900
H = 1 (t-test)	2.4359	1.7177	3.2665	2.0700	n/a	n/a	n/a	n/a	n/a	n/a	1.0182	0.6589
Equilibrium/Disequilibrium	Equilibrium		Equilibrium		n/a		n/a		n/a		Equilibrium	

UK	1999		2000		2001		2002		2003		2004	
Large banks	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue	Interest Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.3228	-0.2133	0.5100	0.0844	0.5001	0.1306	0.5052	0.1234	0.1548	0.2587	n/a	n/a
	(3.4834)**	(3.9428)***	(1.3807)	(1.8532)**	(1.8598)**	(1.3471)	(1.8399)*	(0.6255)	(2.4749)***	(1.2152)	n/a	n/a
Labour cost/Total assets	0.0737	0.5142	-0.5988	0.2784	-0.3000	0.2666	-0.5360	0.2374	-0.0105	0.1572	n/a	n/a
	(0.6472)	(4.4763)***	(1.8939)**	(1.1516)	(2.0504)***	(1.9308)**	(1.9094)**	(1.9596)**	(1.9712)**	(1.8958)**	n/a	n/a
Other expenses/Total assets	0.0354	-0.1523	0.2589	0.0429	0.2657	0.0312	0.1226	0.0862	0.1040	0.2051	n/a	n/a
	(0.4218)	(1.7384)	(0.6376)	(0.2738)	(1.0543)	(0.2573)	(0.5498)	(0.6436)	(1.2020)	(1.5661)	n/a	n/a
Equity/Total assets	-0.0747	-0.0925	1.1785	0.2675	0.9763	0.2377	0.4559	-0.0088	-0.0704	0.0518	n/a	n/a
	(0.4969)	(0.7708)	(1.4050)	(1.2648)	(1.5743)	(1.8763)*	(1.0431)	(0.0628)	(0.4326)	(0.3952)	n/a	n/a
Net loans/Total assets	0.0765	0.0727	-0.2617	0.0099	-0.0065	0.0377	-0.0184	0.0779	0.0645	0.0355	n/a	n/a
	(0.9674)	(1.5388)	(0.9257)	(0.1183)	(0.0486)	(0.6848)	(0.1401)	(1.2613)	(0.8939)	(0.6302)	n/a	n/a
Total assets	-0.0932	-0.1034	-0.3176	-0.0456	-0.3628	-0.0593	-0.5976	-0.0760	0.0515	-0.0663	n/a	n/a
	(1.2927)	(2.2672)*	(0.6728)	(0.5023)	(0.7727)	(0.7757)	(1.1218)	(0.8797)	(0.7285)	(1.1325)	n/a	n/a
Deposits/Deposits and other funding	-1.0018	-2.6412	-5.5697	-3.5575	-3.9958	-2.5483	-4.1362	-1.3046	0.3908	-0.9924	n/a	n/a
	(1.5942)	(5.9876)***	(1.3764)	(2.8172)**	(1.3775)	(2.3829)**	(1.4116)	(1.1350)	(0.4200)	(0.9890)	n/a	n/a
Observations	14	14	22	22	22	22	25	25	24	25	n/a	n/a
Adjusted R-squared	0.6276	0.8817	0.2691	0.5770	0.2468	0.6174	0.1312	0.5501	-0.0551	0.6608	n/a	n/a
H-Statistic	0.4319	0.1487	0.1700	0.4057	0.4658	0.4284	0.0918	0.4469	0.2483	0.6210	n/a	n/a
H-Statistic Standard Error	0.1000	0.0694	0.3580	0.1255	0.3795	0.1558	0.3654	0.2027	0.1664	0.1774	n/a	n/a
H = 0 (t-test)	4.3200	2.1400	0.4700	3.2300	1.2300	2.7500	0.2500	2.2000	1.4900	3.5000	n/a	n/a
H = 1 (t-test)	5.6810	12.3391	2.3184	4.7362	1.4076	3.6688	2.4855	2.7286	4.5201	2.1376	n/a	n/a
Equilibrium/Disequilibrium	Equilibrium		Equilibrium		Equilibrium		Equilibrium		Equilibrium		n/a	

We report t statistics in parentheses, * denotes 10% significance, ** denotes 5 % significance, and *** denotes 1 % significance. The missing values are due to the fact that the number of institutions was insufficient to obtain reasonable estimates for the coefficients. This may be due to accelerating consolidation in the banking systems under consideration.

H-Statistics (calculated without equity/total assets)

Austria	Small banks						Large banks					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.5063	n/a	n/a	0.3500	0.3101	0.2717	0.2063	0.4380	0.4440	0.2348	0.1728	0.3458
	(4.2122)***	n/a	n/a	(4.2589)***	(3.0093)***	(1.7384)*	(1.5324)	(6.9151)***	(4.8207)***	(2.1422)**	(1.8711)*	(3.6219)***
Labour cost/Total assets	0.3679	n/a	n/a	0.3124	0.1826	0.3094	0.1040	0.1995	0.2527	0.2228	0.1343	0.2091
	(3.9446)***	n/a	n/a	(4.5438)***	(1.5585)	(1.2807)	(1.9278)*	(2.8393)***	(2.6002)**	(2.6194)**	(1.9304)*	(2.5626)**
Other expenses/Total assets	0.1014	n/a	n/a	0.2545	0.1411	0.0798	0.2405	0.1799	0.0840	0.0344	0.0623	0.1152
	(1.0467)	n/a	n/a	(7.6106)***	(0.9287)	(0.8457)	(3.2498)***	(3.0839)***	(0.8860)	(0.4171)	(0.9545)	(2.7990)***
Net loans/Total assets	0.0200	n/a	n/a	-0.0419	0.0184	0.0864	-0.0387	-0.0004	-0.0593	-0.0443	0.0143	0.0716
	(0.5279)	n/a	n/a	(0.5950)	(0.1591)	(0.9044)	(0.6147)	(0.0050)	(0.8642)	(0.9012)	(0.1828)	(0.6490)
Total assets, deflated	-0.0531	n/a	n/a	-0.0386	-0.0067	0.0060	-0.0686	-0.0673	-0.0445	-0.0329	-0.0298	-0.0079
	(1.5847)	n/a	n/a	(1.6456)	(0.0991)	(0.1204)	(3.2184)***	(3.5700)***	(1.7835)*	(1.6766)	(1.3335)	(0.3370)
Deposits/Deposits and other funding	-1.5008	n/a	n/a	-0.5818	-0.9818	0.6918	0.9888	0.7591	0.9818	-1.0855	-0.9869	-1.5551
	(1.0942)	n/a	n/a	(1.0002)	(1.2508)	(0.9987)	(0.9587)	(0.1087)	(0.1087)	(0.0087)	(1.0087)	(1.6558)
Observations	75	n/a	n/a	73	72	64	28	32	35	40	43	43
Adjusted R-squared	0.7261	n/a	n/a	0.8021	0.2278	0.3802	0.6920	0.8901	0.8407	0.6446	0.3398	0.4851
H-Statistic	0.9756	n/a	n/a	0.9170	0.6338	0.6609	0.5508	0.8175	0.7807	0.4920	0.3693	0.6700
H-Statistic Standard Error	0.1769	n/a	n/a	0.1228	0.1478	0.2590	0.1330	0.0893	0.1012	0.1067	0.1188	0.1176
H = 0 (t-test)	5.5100	n/a	n/a	7.4600	4.2900	2.5500	4.1400	9.1600	7.7200	4.6100	3.1100	5.7000
H = 1 (t-test)	0.1379	n/a	n/a	0.6767	2.4794	1.3093	3.3800	2.0465	2.1670	4.7620	5.3089	2.8061
Equilibrium/Disequilibrium	Equilibrium	n/a	n/a	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium

Belgium	Small banks						Large banks					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.8100	n/a	n/a	n/a	n/a	n/a	-0.0669	0.0059	0.1565	0.0141	0.1507	0.1633
	(2.7149)*	n/a	n/a	n/a	n/a	n/a	(0.5740)	(0.0366)	(0.7794)	(0.0885)	(1.2307)	(0.5562)
Labour cost/Total assets	0.2663	n/a	n/a	n/a	n/a	n/a	0.1971	0.3780	0.1442	0.0810	0.0066	0.1943
	(0.6768)	n/a	n/a	n/a	n/a	n/a	(3.4044)***	(4.1324)***	(2.0112)*	(2.7392)***	(1.9741)**	(1.9429)**
Other expenses/Total assets	-0.2274	n/a	n/a	n/a	n/a	n/a	0.0472	0.0018	0.0769	0.1869	0.1960	0.0950
	(0.5127)	n/a	n/a	n/a	n/a	n/a	(1.4080)	(0.0436)	(1.6278)	(1.6346)	(1.8496)*	(0.5443)
Net loans/Total assets	-0.0782	n/a	n/a	n/a	n/a	n/a	-0.0100	-0.1366	0.0450	0.1604	0.0956	0.0126
	(0.6621)	n/a	n/a	n/a	n/a	n/a	(0.2912)	(2.0658)*	(0.8276)	(1.0881)	(1.1838)	(0.1163)
Total assets, deflated	0.2740	n/a	n/a	n/a	n/a	n/a	-0.0128	-0.0370	0.0343	-0.0806	-0.0101	0.0479
	(1.1911)	n/a	n/a	n/a	n/a	n/a	(0.2834)	(0.6150)	(0.7648)	(1.0896)	(0.2036)	(0.4211)
Deposits/Deposits and other funding	-0.4938	n/a	n/a	n/a	n/a	n/a	0.0213	0.4886	-0.1310	-0.8179	-0.4945	-0.0309
	(1.5218)	n/a	n/a	n/a	n/a	n/a	(0.1147)	(1.5223)	(0.5504)	(1.7337)	(1.3787)	(0.0383)
Observations	10	n/a	n/a	n/a	n/a	n/a	18	18	19	19	17	18
Adjusted R-squared	0.8765	n/a	n/a	n/a	n/a	n/a	0.5656	0.6548	0.5323	0.3821	0.3981	0.3150
H-Statistic	0.8489	n/a	n/a	n/a	n/a	n/a	0.1774	0.3857	0.3775	0.2821	0.3533	0.4525
H-Statistic Standard Error	0.5316	n/a	n/a	n/a	n/a	n/a	0.1147	0.1390	0.1535	0.1633	0.1181	0.3134
H = 0 (t-test)	1.5900	n/a	n/a	n/a	n/a	n/a	1.5500	2.7700	2.4600	1.7300	2.9900	1.4400
H = 1 (t-test)	0.2842	n/a	n/a	n/a	n/a	n/a	7.1718	4.4194	4.0580	4.3956	5.4805	1.7475
Equilibrium/Disequilibrium	Equibbrium	n/a	n/a	n/a	n/a	n/a	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium

Denmark	Small banks						Large banks					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue
Funding costs/Total deposits and other funding	-0.0226	0.6359	0.0524	-0.0497	0.0614	0.1748	n/a	n/a	n/a	0.2449	0.5147	0.1186
	(0.5421)	(3.0693)***	(0.4980)	(0.5768)	(0.7974)	(1.3466)	n/a	n/a	n/a	(2.9222)*	(3.4739)**	(3.0089)***
Labour cost/Total assets	0.2587	0.1191	0.1741	0.2198	0.2658	0.4421	n/a	n/a	n/a	0.2561	0.4274	0.0315
	(5.7353)***	(1.1705)	(1.2819)	(2.0141)*	(2.5936)**	(3.4566)***	n/a	n/a	n/a	(3.7185)**	(3.5840)**	(0.1078)
Other expenses/Total assets	0.0433	-0.0970	-0.1322	-0.1505	0.0853	0.1026	n/a	n/a	n/a	0.0680	0.0230	0.1790
	(0.8038)	(1.2325)	(1.1710)	(1.3081)	(3.1930)***	(1.2062)	n/a	n/a	n/a	(13.0098)***	(4.1388)**	(0.6216)
Net loans/Total assets	0.1837	0.5080	0.3497	0.2486	-0.0053	-0.1600	n/a	n/a	n/a	0.0447	0.1843	0.1802
	(5.8522)***	(4.6806)***	(4.3318)***	(5.0489)***	(0.0602)	(1.3092)	n/a	n/a	n/a	(0.5409)	(4.3662)**	(1.8313)
Total assets, deflated	0.0031	0.0002	-0.0007	-0.0064	0.0073	0.0471	n/a	n/a	n/a	-0.0623	-0.1149	-0.0907
	(0.3720)	(0.0112)	(0.0489)	(0.3928)	(0.2398)	(1.9874)*	n/a	n/a	n/a	(1.9708)	(3.0244)**	(1.5875)
Deposits/Deposits and other funding	0.0213	0.4886	0.0586	0.2013	0.4996	0.9806	n/a	n/a	n/a	1.5896	1.6806	0.9891
	(0.1147)	(1.5223)	(1.3123)	(0.5447)	(1.0223)	(1.0253)	n/a	n/a	n/a	(1.5803)	(1.6203)	(1.1225)
Observations	49	48	49	46	42	43	n/a	n/a	n/a	9	10	12
Adjusted R-squared	0.8725	0.6131	0.6144	0.4993	0.1818	0.5345	n/a	n/a	n/a	0.9626	0.9696	0.6792
H-Statistic	0.2795	0.6580	0.0944	0.0197	0.4125	0.7195	n/a	n/a	n/a	0.5690	0.9651	0.3291
H-Statistic Standard Error	0.0611	0.1981	0.2148	0.1616	0.1366	0.2740	n/a	n/a	n/a	0.1507	0.0261	0.3086
H = 0 (t-test)	4.5700	3.3200	0.4400	0.1200	3.0200	2.6300	n/a	n/a	n/a	3.7800	3.7000	1.0700
H = 1 (t-test)	11.7921	1.7264	4.2184	6.0775	4.3040	1.0241	n/a	n/a	n/a	2.8600	0.1338	2.1740
Equilibrium/Disequilibrium	Equilibrium	Equilibrium	Equilibrium	Disequilibrium	Equilibrium	Equilibrium	n/a	n/a	n/a	Disequilibrium	Disequilibrium	Equilibrium

France	Small banks						Large banks					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.1877	0.4939	0.4413	0.3611	0.3226	0.3525	0.3955	0.2302	0.1367	0.0910	0.1158	0.0603
	(1.7239)*	(7.4963)***	(5.5497)***	(3.8087)***	(4.0696)***	(7.4660)***	(2.8783)***	(2.5011)**	(2.0540)**	(1.1499)	(1.5873)	(0.9992)
Labour cost/Total assets	-0.0138	0.1424	0.1744	0.1428	0.0822	0.0026	0.0938	0.1447	0.1215	0.1275	0.1478	0.2259
	(0.1820)	(2.2211)**	(2.3727)**	(0.9014)	(0.8588)	(0.0373)	(1.8731)*	(2.8254)***	(2.3616)**	(3.2263)***	(1.8001)*	(3.8528)***
Other expenses/Total assets	0.2663	0.2020	0.1126	0.1285	0.1799	0.2281	0.2530	0.1406	0.0470	0.0479	0.0966	0.1230
	(3.2515)***	(6.3892)***	(1.9451)*	(1.0735)	(2.8208)***	(3.6568)***	(2.9726)***	(1.7580)*	(1.3848)	(1.9535)*	(2.0469)**	(2.7426)***
Net loans/Total assets	-0.0024	0.0638	0.1011	0.1797	0.1560	0.0997	0.0055	-0.0211	0.0264	0.0720	0.0679	0.1437
	(0.0330)	(1.6365)	(1.3831)	(1.7840)*	(1.2958)	(2.1834)**	(0.0770)	(0.3944)	(0.5475)	(2.5101)**	(1.3628)	(1.7552)*
Total assets, deflated	-0.1026	-0.0707	-0.0045	-0.1337	-0.0804	-0.0608	-0.0409	-0.0628	-0.0545	-0.0390	-0.0388	0.0051
	(1.1313)	(1.1633)	(0.0610)	(1.3670)	(1.3199)	(0.8243)	(1.3886)	(2.5388)**	(3.1801)***	(1.7985)*	(1.0888)	(0.2071)
Deposits/Deposits and other funding	0.0185	-0.0124	-0.2200	-0.2074	-0.2360	-0.0563	-0.0581	-0.2836	-0.2786	-0.3819	-0.3472	-0.2818
	(0.1974)	(0.2256)	(0.7125)	(0.4865)	(1.9606)*	(0.6870)	(0.6251)	(0.9961)	(1.3305)	(1.3436)	(1.4105)	(0.9773)
Observations	46	47	49	33	32	20	112	114	104	94	86	79
Adjusted R-squared	0.3502	0.7610	0.6314	0.5667	0.4781	0.7324	0.5250	0.5112	0.3583	0.4358	0.4190	0.5264
H-Statistic	0.4402	0.8384	0.7284	0.6324	0.5847	0.5831	0.7424	0.5154	0.3052	0.2664	0.3602	0.4092
H-Statistic Standard Error	0.1638	0.1173	0.1133	0.1717	0.1245	0.0788	0.1421	0.1318	0.1145	0.1086	0.1214	0.1042
H = 0 (t-test)	2.6900	7.1500	6.3400	3.6800	4.7000	7.4000	5.2300	3.9100	2.6700	2.4500	2.9700	3.9300
H = 1 (t-test)	3.3461	1.3788	2.3972	2.1409	3.3357	5.3449	1.8148	3.6796	6.0681	6.7622	5.2702	5.6699
Equilibrium/Disequilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium

Germany	Small banks						Large banks					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.1593	0.2596	0.4073	0.2877	0.3265	0.3299	0.4133	0.5353	0.4134	0.3749	0.3644	0.3324
	(2.6274)***	(4.1999)***	(5.9911)***	(2.9457)***	(4.0395)***	(4.7849)***	(12.2941)***	(15.8847)***	(11.6431)***	(6.0392)***	(6.1067)***	(8.1273)***
Labour cost/Total assets	0.1866	0.2926	0.2509	0.3617	0.3772	0.3622	0.1239	0.1444	0.0646	0.0852	0.0833	0.0174
	(2.6735)***	(5.9671)***	(5.1223)***	(7.1084)***	(6.9254)***	(5.5026)***	(3.2934)***	(3.6291)***	(1.6974)*	(2.6418)***	(3.1176)***	(0.4700)
Other expenses/Total assets	0.2157	0.1551	0.1811	0.1394	0.1669	0.2370	0.1942	0.1902	0.2135	0.2069	0.2294	0.3042
	(3.0571)***	(3.1715)***	(3.9508)***	(3.3483)***	(5.1631)***	(6.0548)***	(6.0223)***	(4.9516)***	(5.8863)***	(5.4708)***	(6.4286)***	(6.5270)***
Net loans/Total assets	-0.0222	-0.0678	-0.0489	-0.0284	-0.0470	-0.0280	-0.0144	-0.0788	0.0312	0.0326	0.0359	0.0453
	(0.9896)	(2.9641)***	(2.5091)**	(1.2876)	(2.6228)***	(1.8234)*	(0.8031)	(2.9497)***	(1.1800)	(0.9833)	(0.8823)	(1.3524)
Total assets, deflated	-0.0192	-0.0220	-0.0191	-0.0229	-0.0229	-0.0242	-0.0036	-0.0095	-0.0089	-0.0018	-0.0077	-0.0143
	(3.3816)***	(4.7183)***	(3.5576)***	(2.6882)***	(3.3230)***	(2.4078)**	(0.5430)	(1.1929)	(1.4266)	(0.2423)	(1.1186)	(2.0384)**
Deposits/Deposits and other funding	3.3120	6.2712	3.9305	-0.2996	3.5754	8.1320	-0.2228	4.6427	1.5254	1.5669	0.2943	-0.3099
	(1.9460)*	(4.5550)***	(2.4866)**	(0.1233)	(1.3989)	(4.3020)***	(0.2640)	(4.0371)***	(0.6664)	(0.8477)	(0.3897)	(0.5228)
Observations	896	902	775	676	609	527	761	785	783	770	740	737
Adjusted R-squared	0.4714	0.5983	0.7058	0.7166	0.7660	0.7486	0.7211	0.6956	0.6554	0.6155	0.6451	0.6653
H-Statistic	0.5616	0.7073	0.8393	0.7887	0.8706	0.9291	0.7315	0.8699	0.6915	0.6671	0.6771	0.6539
H-Statistic Standard Error	0.0802	0.0620	0.0792	0.1090	0.0627	0.0814	0.0457	0.0545	0.0501	0.0743	0.0778	0.0532
H = 0 (t-test)	7.0000	11.4100	10.5900	7.2400	13.8800	11.4200	15.9900	15.9500	13.8100	8.9800	8.7000	12.3000
H = 1 (t-test)	5.4663	4.7209	2.0290	1.940.3	2.0638	0.8710	5.8752	2.3889	6.1700	4.4865	4.1506	6.5179
Equilibrium/Disequilibrium	Equilibrium	Disequilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium

Italy	Small banks						Large banks					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.3030	0.0090	0.0737	0.1041	0.1361	0.0348	0.3397	0.4646	0.3917	0.3417	0.3187	0.2709
	(5.7052)***	(0.0870)	(1.4448)	(1.9388)*	(2.7780)***	(0.7240)	(6.5482)***	(9.3553)***	(9.6728)***	(7.4643)***	(5.6590)***	(6.3499)***
Labour cost/Total assets	0.7103	0.3570	0.2346	0.2769	0.4477	0.2896	-0.0181	0.1143	0.0373	0.1210	0.2745	0.1524
	(5.5623)***	(4.2051)***	(2.4575)**	(3.8313)***	(4.8188)***	(2.7933)***	(0.4200)	(2.0038)**	(0.8740)	(2.3618)**	(3.1292)***	(3.5418)***
Other expenses/Total assets	-0.0686	-0.0210	0.0447	0.2467	0.1305	0.2926	0.3190	0.2725	0.2600	0.2202	0.0459	0.1921
	(0.7223)	(0.3220)	(1.5784)	(4.2801)***	(1.7137)*	(4.1192)***	(6.8213)***	(5.5898)***	(6.5856)***	(4.2181)***	(0.5463)	(5.0402)***
Net loans/Total assets	-0.0798	0.0027	-0.0459	-0.0113	-0.0202	-0.0062	-0.0036	-0.0367	0.0219	0.0778	-0.0479	0.0114
	(1.7965)*	(0.0464)	(1.6295)	(0.2148)	(0.5846)	(0.2597)	(0.0792)	(0.8507)	(0.4631)	(2.2857)**	(1.6299)	(0.5754)
Total assets, deflated	-0.0465	-0.0004	0.0298	0.0361	0.0138	0.0464	-0.0054	0.0195	0.0275	0.0467	0.0445	0.0515
	(2.0423)**	(0.0189)	(2.2695)**	(1.9309)*	(0.6749)	(2.1070)**	(0.3514)	(1.1832)	(2.3967)**	(2.7620)***	(3.1720)***	(5.4447)***
Deposits/Deposits and other funding	0.0214	0.0690	0.2519	-0.1810	0.0528	-0.0494	0.2740	0.3296	0.3565	0.1520	0.2038	0.2440
	(0.2116)	(0.5062)	(1.7738)*	(1.8029)*	(0.4219)	(0.3841)	(1.7391)*	(3.8792)***	(2.0754)**	(0.5328)	(0.6183)	(1.0780)
Observations	213	205	208	186	182	165	124	135	139	146	158	169
Adjusted R-squared	0.6789	0.3029	0.3586	0.5562	0.6546	0.6370	0.6576	0.8009	0.7187	0.6465	0.4476	0.6169
H-Statistic	0.9447	0.3450	0.3531	0.6279	0.7143	0.6170	0.6406	0.8514	0.6890	0.6829	0.6391	0.6154
H-Statistic Standard Error	0.1152	0.1403	0.1341	0.1156	0.1086	0.0902	0.0953	0.0899	0.0737	0.0780	0.0884	0.0752
H = 0 (t-test)	8.2000	2.4600	2.6300	5.4300	6.5800	6.8400	6.7200	9.4700	9.3500	8.7600	7.2300	8.1900
H = 1 (t-test)	0.4800	4.6719	4.8284	3.2197	2.6308	4.2508	3.7842	1.6549	4.2269	4.0706	4.0826	5.1212
Equilibrium/Disequilibrium	Equilibrium	Equilibrium	Equilibrium	Disequilibrium	Disequilibrium	Equilibrium	Equilibrium	Equilibrium	Disequilibrium	Equilibrium	Disequilibrium	Equilibrium

Luxembourg	Small banks						Large banks					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.6182	n/a	n/a	0.3151	0.3907	0.3587	0.6175	0.5495	0.6731	0.6511	0.4943	0.4778
	(4.1997)***	n/a	n/a	(4.5133)***	(2.9987)**	(4.0671)***	(8.3929)***	(4.6869)***	(10.0649)***	(9.1067)***	(8.0746)***	(9.0034)***
Labour cost/Total assets	0.3042	n/a	n/a	0.1476	0.3072	0.1426	0.1177	0.2274	0.1309	0.0065	0.1009	0.0891
	(3.4913)***	n/a	n/a	(1.3142)	(2.9903)**	(1.2731)	(2.0634)**	(2.3214)**	(1.8941)*	(0.1466)	(1.4253)	(1.0786)
Other expenses/Total assets	0.0699	n/a	n/a	0.1979	0.2818	0.3554	0.0388	0.0081	0.0474	0.1828	0.0858	0.1766
	(0.7711)	n/a	n/a	(2.0911)*	(2.2360)**	(2.6311)**	(0.7094)	(0.1147)	(0.8743)	(2.4838)**	(1.0469)	(2.0745)**
Net loans/Total assets	0.0135	n/a	n/a	0.0041	0.0289	0.0742	-0.0410	0.0131	-0.0311	-0.0498	-0.0263	-0.0427
	(0.6915)	n/a	n/a	(0.0659)	(0.7217)	(3.8374)***	(1.8986)*	(0.6419)	(0.8694)	(1.4295)	(0.9857)	(1.3389)
Total assets, deflated	0.1429	n/a	n/a	-0.0243	0.0425	-0.0310	0.0060	0.0465	0.0355	0.0114	0.0159	0.0346
	(1.1953)	n/a	n/a	(0.2620)	(0.4228)	(0.4545)	(0.3403)	(1.4525)	(1.3843)	(0.4308)	(0.7231)	(1.1911)
Deposits/Deposits and other funding	0.0786	n/a	n/a	-3.3068	-5.2824	-7.6741	-0.0179	-0.1192	-0.0334	0.0188	0.0548	-0.0432
	(0.1886)	n/a	n/a	(4.1513)***	(7.8086)***	(17.5605)***	(0.1625)	(1.0130)	(0.2810)	(0.1834)	(0.7763)	(0.4956)
Observations	30	n/a	n/a	25	19	16	67	71	60	53	56	51
Adjusted R-squared	0.7244	n/a	n/a	0.6609	0.8485	0.8982	0.7663	0.6901	0.7137	0.7622	0.6723	0.6484
H-Statistic	0.9924	n/a	n/a	0.6606	0.9797	0.8567	0.7740	0.7850	0.8514	0.8404	0.6810	0.7435
H-Statistic Standard Error	0.1075	n/a	n/a	0.1002	0.1329	0.0833	0.0751	0.0886	0.0889	0.0705	0.0673	0.0694
H = 0 (t-test)	9.2300	n/a	n/a	6.5900	7.3700	10.2900	10.3100	8.8600	9.5700	11.9200	10.1200	10.7200
H = 1 (t-test)	0.0716	n/a	n/a	3.3872	0.1527	1.7236	3.0147	2.4278	1.6715	2.2638	4.7485	3.6974
Equilibrium/Disequilibrium	Equilibrium	n/a	n/a	Equilibrium	Equilibrium	Disequilibrium	Disequilibrium	Disequilibrium	Equilibrium	Equilibrium	Equilibrium	Disequilibrium

Sweden	Small banks						Large banks					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue
Funding costs/Total deposits and other funding	n/a	n/a	0.0867	0.3743	0.3884	-0.0114	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	(1.6938)*	(1.7140)*	(1.5180)	(0.1861)	n/a	n/a	n/a	n/a	n/a	n/a
Labour cost/Total assets	n/a	n/a	0.1567	0.1101	0.1953	0.1482	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	(4.2559)***	(2.0807)**	(3.6707)***	(2.7577)***	n/a	n/a	n/a	n/a	n/a	n/a
Other expenses/Total assets	n/a	n/a	0.0916	0.2441	0.2098	0.1291	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	(2.8948)***	(1.8907)*	(2.2447)**	(2.1751)**	n/a	n/a	n/a	n/a	n/a	n/a
Net loans/Total assets	n/a	n/a	0.0748	0.0882	0.0336	0.1092	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	(2.8526)***	(1.6566)	(0.4693)	(2.3892)**	n/a	n/a	n/a	n/a	n/a	n/a
Total assets, deflated	n/a	n/a	0.0546	0.0531	0.0610	0.0620	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	(9.5438)***	(7.8468)***	(5.3681)***	(5.1223)***	n/a	n/a	n/a	n/a	n/a	n/a
Deposits/Deposits and other funding	n/a	n/a	-2.4359	-8.1539	-2.0759	-1.0759	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	(1.9694)*	(0.4508)	(0.7885)	(1.2085)	n/a	n/a	n/a	n/a	n/a	n/a
Observations	n/a	n/a	80	80	80	71	n/a	n/a	n/a	n/a	n/a	n/a
Adjusted R-squared	n/a	n/a	0.7999	0.6952	0.6434	0.7005	n/a	n/a	n/a	n/a	n/a	n/a
H-Statistic	n/a	n/a	0.3350	0.7285	0.7935	0.2659	n/a	n/a	n/a	n/a	n/a	n/a
H-Statistic Standard Error	n/a	n/a	0.0771	0.3080	0.3686	0.0830	n/a	n/a	n/a	n/a	n/a	n/a
H = 0 (t-test)	n/a	n/a	4.8500	2.3700	2.1500	3.2000	n/a	n/a	n/a	n/a	n/a	n/a
H = 1 (t-test)	n/a	n/a	8.4416	8.8177	5.6022	8.8447	n/a	n/a	n/a	n/a	n/a	n/a
Equilibrium/Disequilibrium	n/a	n/a	Disequilibrium	Equilibrium	Disequilibrium	Disequilibrium	n/a	n/a	n/a	n/a	n/a	n/a

Switzerland	Small banks						Large banks					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue
Funding costs/Total deposits and other funding	0.1132	0.0639	0.1869	0.1763	0.0949	0.0544	-0.0171	0.2663	0.3867	0.2612	0.2403	n/a
	(1.9809)**	(0.9310)	(3.1769)***	(3.7882)***	(2.0514)**	(1.6372)	(1.9913)**	(1.4381)	(2.4499)**	(2.3947)**	(2.7009)**	n/a
Labour cost/Total assets	0.2922	0.4724	0.5528	0.5350	0.5365	0.5233	0.1143	-0.1292	-0.0352	0.2308	0.3057	n/a
	(1.6962)*	(7.3627)***	(8.4544)***	(11.0635)***	(10.4857)***	(12.9917)***	(0.6551)	(0.6225)	(0.3774)	(2.5977)**	(3.2746)***	n/a
Other expenses/Total assets	0.3400	0.2246	0.0888	0.0805	0.1678	0.1542	0.2773	0.7232	0.5775	0.3663	0.2681	n/a
	(1.5748)	(2.8469)***	(1.2039)	(1.2624)	(3.0664)***	(3.0834)***	(1.9466)**	(3.6191)***	(4.9065)***	(2.8197)***	(2.6025)**	n/a
Net loans/Total assets	-0.0765	0.0748	0.0608	0.0266	0.0389	0.0263	0.0371	0.0608	0.0206	-0.1001	-0.0949	n/a
	(1.0507)	(1.4458)	(1.5795)	(0.7061)	(0.4181)	(0.5662)	(0.5302)	(0.8716)	(0.3845)	(1.2919)	(1.5625)	n/a
Total assets, deflated	0.0176	0.0296	-0.0127	-0.0514	-0.0102	-0.0117	-0.0702	0.0014	-0.0108	-0.0278	-0.0347	n/a
	(0.4809)	(0.9502)	(0.3929)	(1.8246)*	(0.5256)	(0.6905)	(1.2190)	(0.0281)	(0.4954)	(1.2122)	(1.1599)	n/a
Deposits/Deposits and other funding	-0.0134	-0.0596	-0.2937	-0.3159	-0.5825	-0.7694	3.4869	1.8570	0.4344	0.1553	0.6769	n/a
	(0.1197)	(0.5171)	(3.0165)***	(4.3813)***	(4.3449)***	(2.4430)**	(1.9254)*	(1.6251)	(1.0624)	(0.3658)	(1.2664)	n/a
Observations	123	128	166	230	254	233	39	41	46	46	43	n/a
Adjusted R-squared	0.7740	0.8769	0.8275	0.8573	0.8877	0.9090	0.4058	0.6932	0.7935	0.8309	0.8376	n/a
H-Statistic	0.7454	0.7609	0.8284	0.7918	0.7992	0.7319	0.3745	0.8604	0.9290	0.8584	0.8141	n/a
H-Statistic Standard Error	0.01282	0.0933	0.0822	0.0700	0.0549	0.0536	0.3804	0.2139	0.1947	0.1544	0.1093	n/a
H = 0 (t-test)	5.8200	8.1500	10.0800	11.3200	14.5700	13.6500	0.9800	4.0200	4.7700	5.5600	7.4500	n/a
H = 1 (t-test)	1.9782	2.5627	2.0901	2.9799	3.6642	5.0019	1.6443	0.6500	0.3654	0.9177	1.7024	n/a
Equilibrium/Disequilibrium	Equilibrium	Disequilibrium	Disequilibrium	Disequilibrium	Disequilibrium	Disequilibrium	Equilibrium	Equilibrium	Disequilibrium	Equilibrium	Disequilibrium	n/a

United Kingdom	Small banks						Large banks					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue	Total Revenue
Funding costs/Total deposits and other funding	-0.1580	-0.1307	n/a	n/a	n/a	0.3431	-0.1806	0.0661	0.1414	0.1247	0.2594	n/a
	(1.9613)**	(1.8980)*	n/a	n/a	n/a	(1.9460)*	(4.0676)***	(1.2911)	(1.3625)	(1.9426)**	(1.9559)**	n/a
Labour cost/Total assets	0.2503	-0.0807	n/a	n/a	n/a	0.5584	0.4607	0.4429	0.4310	0.2327	0.1764	n/a
	(1.0900)	(1.9480)*	n/a	n/a	n/a	(2.6311)**	(4.4453)***	(1.9259)*	(2.1809)**	(1.9499)**	(2.1364)**	n/a
Other expenses/Total assets	0.0264	0.3314	n/a	n/a	n/a	0.1242	-0.1043	-0.0672	-0.0389	0.0887	0.2026	n/a
	(0.0881)	(1.5795)	n/a	n/a	n/a	(0.6086)	(1.2038)	(0.4903)	(0.3111)	(0.6464)	(1.6707)	n/a
Net loans/Total assets	0.0868	0.1230	n/a	n/a	n/a	-0.0251	0.0513	0.1091	0.0641	0.0759	0.0407	n/a
	(1.4995)	(1.5345)	n/a	n/a	n/a	(0.4446)	(1.5631)	(2.0022)*	(0.8604)	(1.4900)	(0.7690)	n/a
Total assets, deflated	-0.1037	-0.1005	n/a	n/a	n/a	0.1018	-0.0858	-0.1440	-0.1365	-0.0734	-0.0819	n/a
	(0.8417)	(0.4282)	n/a	n/a	n/a	(0.8531)	(2.5503)**	(2.0184)*	(1.6914)	(0.8422)	(1.2340)	n/a
Deposits/Deposits and other funding	0.0000	-5.7222	n/a	n/a	n/a	1.8562	-2.8647	-3.7060	-2.4422	-1.3003	-1.0155	n/a
	(.)	(1.5302)	n/a	n/a	n/a	(0.9275)	(6.9110)***	(2.7518)**	(2.2925)**	(1.1432)	(1.0652)	n/a
Observations	17	17	n/a	n/a	n/a	25	14	22	22	25	25	n/a
Adjusted R-squared	0.5390	0.5981	n/a	n/a	n/a	0.6744	0.8828	0.5620	0.5989	0.5751	0.6780	n/a
H-Statistic	0.1187	0.1200	n/a	n/a	n/a	1.00	0.1759	0.4419	0.5336	0.4461	0.6384	n/a
H-Statistic Standard Error	0.2323	0.2932	n/a	n/a	n/a	0.2246	0.0579	0.1267	0.1459	0.1997	0.1797	n/a
H = 0 (t-test)	0.4200	0.4100	n/a	n/a	n/a	4.5700	3.0400	3.4900	3.6600	2.2300	3.5500	n/a
H = 1 (t-test)	3.1222	3.0014	n/a	n/a	n/a	0.0010	14.4596	4.4086	3.1989	2.7742	2.0133	n/a
Equilibrium/Disequilibrium	Equilibrium	Equilibrium	n/a	n/a	n/a	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium	n/a

We report t statistics in parentheses, * denotes 10% significance, ** denotes 5 % significance, and *** denotes 1 % significance. The missing values are due to the fact that the number of institutions was insufficient to obtain reasonable estimates for the coefficients. This may be due to accelerating consolidation in the banking systems under consideration.

Chapter IV

BANK LIABILITY STRUCTURE, FDIC LOSS, AND TIME TO FAILURE: A QUANTILE REGRESSION APPROACH.

BANK LIABILITY STRUCTURE, FDIC LOSS, AND TIME TO FAILURE: A QUANTILE REGRESSION APPROACH.

ABSTRACT

Previous studies that aim to determine factors impacting deposit insurers' losses arising from bank failures use standard econometric techniques that assume the losses are homogeneously driven by the same set of explanatory variables: However, deposit insurers are particularly concerned about high-cost failures. If the factors driving high-cost failures differ systematically from the determinants of low and moderate-cost failures, an alternative estimation technique is required. Using a sample of more than 1,000 bank failures in the US between 1984 and 1996, we present a quantile regression approach that illustrates the sensitivity of the dollar value of losses in different quantiles to our explanatory variables. The findings suggest that reliance on standard econometric techniques gives rise to misleading inferences and that losses are not homogeneously driven by the same factors across the quantiles. We also find that liability structure affects time to failure and that both insured and uninsured depositors are a source of market discipline.

4. INTRODUCTION

Deposit insurers need to determine the losses arising to them from bank failures to adequately price deposit insurance and adjust the resources of the insurance fund accordingly. An ongoing discussion about the setting of the designated reserve ratio and the differentiation of pricing schemes by bank size motivates a recent proposal by the Federal Deposit Insurance Corporation (FDIC) to reform deposit insurance legislation. This debate underscores the continued need to investigate the determinants of losses caused by failures of financial institutions.

While a considerable body of literature exists on the factors impacting deposit insurers' losses, these studies are limited in two distinct aspects: First, they largely focus on the failed banks' asset composition and asset quality as key drivers for the loss incurred. However, bank liability structure also has substantial bearing for the pricing of deposit insurance and therefore also impacts eventually deposit insurers' losses (Pennacchi, 2005). In addition, Shibut (2002) underscores that the structure of deposits not only determines which depositors have to be compensated in case of failure, but it is furthermore an influential factor for an institution's risk-taking behaviour.[71] This, in turn, affects potential losses by the insurer. Thus, liability structure affects FDIC losses in two distinct ways: i) directly by determining the FDIC's obligations and its relative position among the failed bank's creditors, and ii) indirectly through market discipline and the impact on asset quality. Second, existing work uses standard econometric techniques such as ordinary least squares that do not sufficiently account for the skewed distribution of the losses and the heterogeneous population of the failed institutions. Since deposit insurers are particularly concerned about high-cost failures (in terms of absolute dollar values) due to their possibly systemic impact on the insurance fund, it is pertinent to understand whether losses are homogeneously driven by the same determinants or if factors impacting resolution costs of expensive failures differ systematically from the factors observed in less expensive failures. Thus, if there are systematic differences between high-cost and low-cost

[71] King et al. (2006) highlight recent changes in the environment banks operate in. Deeper and wider financial markets offer new opportunities for depositories' liability management. They stress, *inter alia*, that banks are relying increasingly on non-core funding such as jumbo CDs, brokered deposits, and Federal Home Loan Bank (FHLBank) advances. To the extent to which these funds are insured or implicitly guaranteed by the government, they give rise to moral hazard and hence alter the risk profile of financial institutions.

failures, there may be opportunities to develop further improvements for the regulatory environment. For instance, amendments in the way troubled banks are treated by means of prompt corrective action may be considered since such provisions are intended to reduce costly failures to the deposit insurer (Shibut et al., 2003). Likewise, implications for the adequacy of the deposit insurer's reserves may be derived.

This chapter contributes to the literature on losses arising to deposit insurers in three distinct ways: First, to differentiate between the factors driving high-cost and low-cost failures, we introduce a methodological advancement using quantile regression, also referred to as least absolute deviation regression, for a sample of more than 1,000 bank failures in the US during the period 1984 - 1996. This technique enables us to focus on the tails of the distribution of the loss variable and permits better inferences about the factors contributing to high-cost failures. Moreover, employing quantile regression mitigates the problems associated with relying on a single measure of central tendency of the distribution of the loss variable and permits inferences about the relative importance of certain regressors at different points of the distribution of the losses. Therefore, quantile regression can be considered superior to the previously used estimation techniques since it provides more precise estimates of the impact of the determinants of losses. Second, we test as to whether bank liability structure plays a role in determining the loss when banks fail. Given the substantial evidence in the literature that ailing institutions tend to substitute uninsured deposits in the run-up to failure with insured deposits, thereby increasing the losses to the insurer, it is critical to focus on the extent to which different types of liabilities impact upon loss. Finally, the new Basel Capital Accord highlights in Pillar 3 the role of market discipline to constrain risk-taking behaviour of financial institutions. Thus, we hypothesize that depositories heavily reliant on uninsured deposits are likely to fail faster than institutions funded by other sources since holders of uninsured claims can respond to impending failure with withdrawal of funds. Alternatively, failing banks will attempt to substitute the cash outflows with insured deposits, thus increasing the deposit insurer's risk exposure. Our hypothesis bears important policy considerations: If such banks tend to fail faster, they would have to be subject to additional measures of prompt corrective action to prevent substitution of uninsured claims with insured deposits. We therefore test the effect of liability structure

on time to failure, and estimate an accelerated failure time model with time-varying covariates for a large sample of failed and non-failed depositories during the period 1982 - 1996. To the best of our knowledge, the nexus between market discipline and liability structure on the one hand and time to failure on the other has not yet been subject to extensive econometric analysis. In addition, the relationship between market discipline and deposit insurance by type of account has been widely ignored in the extant literature on market discipline.

We show that the evolution of FDIC losses, defined as the log of the dollar value of the cost incurred by the FDIC, exhibits considerable variation across different quantiles of the distribution. The focus of this study is on the absolute dollar value of losses instead of loss rates. This is due to the fact that deposit insurers are concerned about costly failures in terms of the absolute dollar value as such failures can pose a systemic threat to the insurance fund (Oshinsky, 1999; Shibut, 2002).[72] Moreover, it is well-established that larger banks tend to have lower loss rates (Shibut, 2002; Oshinsky, 1999). Thus, focusing on loss rates would give rise to misleading inferences for the purpose of this study.

Our quantile regression results illustrate that the loss variable in different quantiles shows significantly different sensitivities to the utilized set of explanatory variables. In particular, the results indicate that bank size, the ratios of real estate owned, C&I loans, agricultural loans, real estate loans, and individual loans to total assets exhibit a varying impact upon FDIC loss as we move up the distribution. Similarly, depositor preference law, bankruptcy growth and unemployment rates on the state level also exhibit non-linear behaviour. While our results also show an important effect of certain liability variables on the loss variable, we do not detect any varying effect of these variables between high-cost and low-cost failures. To this extent, our results extend recent work by Shibut et al. (2003) that provides circumstantial evidence for differences of medians of a set of certain balance sheet and income statement variables between low-cost and high-cost failures.[73] Aligned with theory, we find that the ratio of Fed funds purchased to total assets is negatively

[72] The adverse repercussions of a large bank failure could be amplified by the so-called 'systemic-risk exception', which would further increase exposure of the FDIC as this might even entail compensation of uninsured creditors (Shibut, 2002).

[73] Shibut et al. (2003) divide FDIC loss by total assets and classify failures with resolution cost below 12 percent of assets as low-cost failures.

associated with FDIC loss for low and moderate-cost failures. Our findings for the significant bearing of liability structure variables on losses underscore the importance of considering liability structure when analyzing losses to deposit insurers.

Moreover, the fact that certain variables reveal highly nonlinear relationships with the loss variable substantiate that an alternative to standard estimation procedures is required when analyzing deposit insurers' losses. This suggests that reliance on estimates obtained with standard econometric techniques gives rise to misleading inferences with respect to the impact of certain factors on FDIC losses. Regarding the determinants that drive losses of costly failures, we show that these failures are particularly influenced by bank size, real estate owned, uncollected income, and C&I loans. Moreover, a sluggish macroeconomy is also found to increase the losses arising from expensive failures.

Estimating an accelerated failure time model with time-varying covariates, we furthermore demonstrate that the ratios of Fed funds, brokered deposits, as well as demand and time and savings deposits to total assets tend to shorten failure time, whereas transactions deposits that proxy the charter value of a bank increase survival time of a bank. These results are robust to controlling for the impact of asset quality, capitalization, earnings, liquidity and the macroeconomic setting which banks operate in. Our findings provide a rationale for further strengthening disclosure of the levels of insured and uninsured deposits in financial institutions to enhance depositor discipline.

The plan for the chapter is as follows: Section 4.1. reviews related work and Section 4.2. presents an overview on the methodology employed. The econometric analysis is provided in Section 4.3. and Section 4.4. offers concluding remarks and avenues for future research.

4.1. Related Work

Our survey of related studies draws from two distinct strands in the literature. We first focus on work regarding the losses arising from bank failures and then discuss the link between depositor preference laws, depositor discipline and the cost of bank failures.

A number of studies model the loss on assets as a function of the failed banks' asset composition, its asset quality and a set of additional variables. Bovenzi and Murton (1988) draw upon a sample of bank failures between 1985 and 1986 in the US and report an

average loss rate of 33 percent of assets. Using ordinary least squares regression analysis, they additionally highlight the role of uncollected income, and geographic differences in explaining the loss on assets. Barth et al. (1990) and Blalock et al. (1991) examine resolution costs of thrift failures. Barth et al. (1990) employ a Tobit model for the period 1984 - 1988 and present evidence that tangible net worth, asset quality and core deposits as a proxy for franchise value are significant determinants of the deposit insurer's loss. Similarly, Blalock et al. (1991) confirm that asset mix is a major determinant of resolution costs. James (1991) presents an examination of bank failures during the period 1985 - 1988 and reports an average loss of 30 percent of the failed bank's assets. He moreover underscores the relative importance of unrealized losses, the determinants of charter value and type of resolution procedure for the loss on assets. Brown and Epstein (1992) extend these studies and disaggregate the loss on assets into different asset categories. Using detailed information on receivership recoveries, they illustrate that the loss on assets varies over different asset categories and over time to reiterate that portfolio composition is a key determinant of losses. Osterberg and Thomson (1994) build on previous work and conclude that the dollar value of resolution costs is not only a function of asset quality. Employing data for US bank failures between 1986 and 1992, they find that loss is furthermore influenced by bank size, fraud and off-balance sheet items, and that brokered deposits tend to decrease loss. Recent work by McDill (2004) drawing upon a large sample of failures between 1984 and 2002 analyses the effect of the business cycle on resolution costs. She contemplates that the deposit insurer's loss increases in a sluggish macroeconomic environment. Corroborating the role of asset composition and franchise value highlighted in previous studies, she additionally finds that the pool of potential acquirers of a failed bank is an influential factor for the loss rate. Bennett et al. (2005) study the impact of Federal Home Loan Bank (FHLBank) advances on expected losses to the Bank Insurance Fund (BIF) and point out that subordination of FDIC claims to FHLBank advances increases both probability of default and loss given default.[74]

[74] Note that their loss estimates require knowledge of the existing liability structure of the bank under consideration.

A related body of literature focuses on the role of depositor preference laws, designed to reduce the cost of failures to the deposit insurer.[75] Hirschhorn and Zervos (1990) put forward that nondeposit creditors might respond with collateralizing their claims when depositor preference laws are enacted. The authors' empirical analysis of thrift institutions in the US confirms that large proportions of collateralized claims contribute to higher cost of failures, giving rise to unintended outcomes from a deposit insurer's perspective. On the other hand, Osterberg (1996) substantiates that depositor preference laws decrease resolution costs for failures of commercial banks between 1984 and 1992. However, he also discusses offsetting effects arising from collateralization of claims by nondeposit creditors. Marino and Bennett (1999) analyze failures of six large US commercial banks between 1984 and 1992 to investigate if depositor preference law affects large institutions differently due to their greater dependency on nondeposit and foreign liabilities. Given that depositor preference law provides uninsured and unsecured claimants with an incentive to protect themselves from losing money, an ailing bank's liability structure is likely to change as it approaches failure. While the authors do not offer an econometric analysis of the association between liability structure, depositor preference law and FDIC loss, they illustrate that liability structure experiences considerable changes prior to failure, whereby uninsured and foreign deposits decrease substantially.

Considerable effort has gone into the analysis of how depositors discipline financial institutions.[76] Holders of unsecured claims have an incentive to monitor risk-taking behaviour of banks and discipline them by demanding appropriate risk premiums, collateral or by withdrawing their funds. Goldberg and Hudgins (1996, 2002) investigate the holdings of uninsured deposits at savings and loan associations over different sampling periods and illustrate that failing institutions experience declines in uninsured deposits. This result is aligned with work by Jordan (2000), who analyses liability structure of failing banks in New England in the early 1990s. Billet et al. (1998) study the impact of ratings

[75] The Depositor Preference Act of 1993 was designed to shift the burden of bank failure from taxpayers to uninsured depositors. It gives depositors claims on a failed institution's assets superior to those of general creditors. Several states had depositor preference laws in place prior to 1993. For detailed expositions of depositor preference see Osterberg (1996) and Marino and Bennett (1999).

[76] We constrain our review of related studies to the direct link between depositor discipline and financial institution's response to increases in risk. Some other studies investigate whether investors can discriminate between the risks undertaken by US banks (Flannery and Sorescu, 1996) and how subordinate debt impacts upon risk-taking behaviour of financial institutions (Blum, 2002).

downgrades as a proxy for increased risk in financial institutions and report that downgraded banks increasingly raise insured deposits. This not only increases the deposit insurer's exposure but also suggests that market discipline insufficiently polices banks against risk-taking behaviour since risk-based capital standards and risk-based deposit insurance both fail to consider banks' liability structure. Thus, the evidence that ailing institutions substitute uninsured deposits with insured deposits suggests the undermining of market discipline. Furthermore, this phenomenon is bound to increase the deposit insurer's loss if the troubled bank eventually defaults. Park and Peristiani (1998) focus on the implications of risk for price and quantity of uninsured deposits in a sample of thrifts. Institutions with a higher probability of failure are found to offer higher interest rates on uninsured funds. Due to their increased risk profile, such thrifts however attract smaller amounts of uninsured deposits. These results are consistent with the view that uninsured depositors are a source of market discipline. Recent work by Maechler and McDill (2006) investigates how banks respond to depositor discipline. The study argues that bank behaviour and depositors' response is a jointly determined process and provides evidence that depositors constrain bank risk-taking behaviour. In contrast to Park and Peristiani (1998), their results indicate that weak institutions cannot raise uninsured deposits by increasing the interest rates offered, whereas sound institutions are able to do so. Using bank-level data, Davenport and McDill (2006) focus on the behaviour of fully insured depositors prior to the failure of Hamilton Bank and uncover that insured depositors are also a source of market discipline. They present evidence that the total balance of insured deposits that exited prior to the failure exceeds the amount of uninsured deposits withdrawn. In particular, they find that holders of fully insured personal accounts withdraw large balances in the run-up to failure, whereas certain holders of uninsured accounts virtually exert no discipline. These findings indicate that current regulatory practice insufficiently recognizes the disciplinary effect arising from protected depositors.

4.2. DATA AND METHODOLOGY

Our initial sample consists of 1,515 failed banks that were resolved by the BIF during the period 1984 - 1996.[77] Since failing institutions have been resolved by the FDIC through various different types of transactions, we follow the FDIC's bank failure database[78] and classify failure as either one of the following instances having occurred: assisted merger, purchase and assumption, transfer and assumption of insured deposits, re-privatization, closing and reopening, or depositor payoff. A bank is also classified as having failed if it was subject to the management consignment programme.

Bank specific data are taken from the Quarterly Report of Condition and Income (Call Report) prior to failure. In instances where no final report was available, we use the last available call report.[79] Information on the cost incurred by the FDIC was obtained from the FDIC's database on bank failures. This information is an estimate of the FDIC's resolution cost calculated as the difference between net cash outlays and the estimated discounted net recovery on any assets remaining in the receivership's books. We normalize the explanatory variables by total assets to enable comparison with previous work (e.g. Shibut et al., 2003; McDill, 2004). Also, its is noteworthy to mention that normalising by deposits would yield unusually high loss rates for our descriptive comparison of loss rates as detailed further below since certain types of banks such as trust banks are not heavily reliant on deposits.

We apply several selection criteria that have to be satisfied for inclusion of a failed institution into the econometric analysis. First, our inferences may be misleading if we include failures caused by fraud as the Call Reports may not be informative in such instances (McDill, 2004). We therefore exclude publicly known failures where fraud was the main cause as mentioned by Gup (1995) to adjust the sample accordingly. For the sampling period not covered by Gup (1995), we additionally review FDIC press releases and exclude those failures where fraud is mentioned as a reason for failure. Second, cross-

[77] The sampling period is constrained by the Fed funds variable. This variable is not available on the Quarterly Report of Condition and Income (Call Report) for the period 1997 - 2003 and we therefore sample the failed institutions up to 1996 only.

[78] http://www.fdic.gov/bank/individual/failed/index.html, accessed 05th March 2006

[79] Note that reliance on publicly available Call Report data on a quarterly basis from the Call Report immediately preceding the failure hampers separating out insured and uninsured deposits. The Call Report item containing information on deposit accounts with balances over 100,000 USD was only reported in June Call Reports prior to 1991; see also Maechler and McDill (2006).

guarantee failures (e.g. First Republic and First City) are excluded from the analysis as they cannot be viewed as individual failures (for a detailed discussion see Ashcraft, 2003).[80] Third, multi-bank holding company failures were consolidated into one.[81] Finally, missing values for some explanatory variables further limit the dataset to 1,066 failed bank observations which can be used for our econometric analysis.

In order to test the effect of liability structure on FDIC loss, we include several deposit and non-deposit categories into the regressions. First, we consider the ratio of transactions deposits to total assets and anticipate an inverse relationship between this ratio and FDIC loss. Transactions deposits can be perceived as core deposits that proxy the charter value of a bank, which would be lost in cases of failure (James, 1991; Osterberg and Thomson, 1994). Second, the ratios of demand deposits, time and savings deposits, and brokered deposits to total assets are incorporated as they capture important information about the breakdown of the failed banks' deposit structure by account type. Note that these categories do not discriminate between the status of deposit insurance. Therefore, it is not ex-ante clear whether they increase or decrease FDIC loss. To the extent that they are insured, they will increase losses; to the extent that they are not insured, they will mitigate the deposit insurer's loss. However, as alluded to in the literature review, recent micro-level evidence by Davenport and McDill (2006) provides strong evidence that insured depositors withdraw larger volumes than uninsured depositors. Thus, if the majority of deposits that is left in the bank at the time of failure is uninsured, these recent results point towards a negative relationship between these types of deposits and FDIC loss. We also consider a number of non-deposit variables as large institutions tend to rely more heavily on non-deposit funding (Shibut, 2002). The ratio of subordinated debt to total assets is included as the use of subordinated debt has become increasingly popular for banks to satisfy capital requirements (Evanoff and Wall, 2002). Since subordinated debt is

[80] For instance, First Republic Bank Holding Company had to recognise a large proportion of nonperforming loans at the end of 1987. The bad news affected funding and the bank experienced considerable deposit outflows, forcing the lead banks to borrow from the Federal Reserve Bank of Dallas, this loan was guaranteed by the subsidiaries of the bank holding company. The open-bank assistance was not extended in 1988 and the holding bank could not meet its obligations, forcing the regulatory authority to declare the holding bankrupt. The FDIC charged off the loan against the capital accounts of the subsidiaries, rendering them also insolvent and prompting the failure of otherwise sound institutions. A similar pattern was observed in the failure of First City Bancorporation.

[81] An overview of the banks that were removed from the initial sample is provided in Appendix 4.B.

uninsured, an inverse relationship between subordinated debt and the loss variable is anticipated. Third, we test for the effect of funding through Fed funds. Fed funds are obtained in the interbank market and are not insured. Therefore, we assume that reliance on Fed funds will decrease FDIC losses. The remaining non-deposit liability components of the failed banks' balance sheet are grouped together in the ratio of other liabilities to total assets. These types of liabilities are not insured and we expect this variable to enter the loss equation with a negative sign.

Several control variables are considered. James (1991) and Osterberg and Thomson (1994) show that asset quality is a major determinant for the loss variable. We therefore include the ratios of loans past due (90 + days) and real estate owned to total assets to control for asset quality. The latter variable provides information on the volume of real estate obtained due to foreclosure. Numerous previous studies also report that the level of uncollected income is an important predictor for losses (e.g. James, 1991; Osterberg and Thomson, 1994; McDill, 2004). We therefore include the ratio of uncollected income to total assets as a further control variable. In addition, bank failure is often preceded by strong asset growth in the run-up to failure (McDill, 2004). Hence, a variable that captures asset growth in the 24-month period prior to failure is included. We additionally consider the book value of equity to total assets. Equity serves as a cushion between asset value and the payments to debt holders and we anticipate an inverse relation between the book value of equity to total assets and FDIC loss.

Brown and Epstein (1992) have shown that different types of assets exhibit different recovery rates and Blalock et al. (1991) propose grouping certain asset types into separate categories due to similar credit-risk characteristics. We therefore additionally consider different asset categories that capture information on the loan portfolio and test for the effect of the ratios of C&I loans, agricultural loans, real estate loans, and individual loans to assets on the loss variable. These variables are expected to enter the loss equation negatively.

Furthermore, we incorporate variables that provide information about the macroeconomic environment. Using information on personal income growth, bankruptcy growth and unemployment on the federal state level, McDill (2004) has shown a strong link between such factors and losses arising to the FDIC. These variables are obtained

from the American Bankruptcy Institute, from the Bureau of Labor Statistics and from the Bureau for Economic Analysis.[82] We also include a dummy variable that takes on the value one if the observation is taken from the period following enactment of the Federal Deposit Insurance Corporation Improvement Act (FDICIA) in 1991. This act was ratified by Congress as response to a pervasive fear that the problems experienced in the thrift industry in the 1980s would spread to commercial banks. FDICIA was, *inter alia*, designed to reduce costs arising from bank failures to the deposit insurer and embodies a fundamental overhaul of deposit insurance and prudential regulation (Benston and Kaufman, 1997). Finally, we include a dummy variable that takes on the value one if depositor preference law was in place at the time of the failure or zero otherwise. As highlighted above, depositor preference laws are intended to shift the burden from the taxpayer to uninsured holders of credit to mitigate the losses arising to the deposit insurer (Osterberg, 1996). This dummy variable takes account of the fact that some states already had depositor preference laws in place prior to the enactment of national depositor preference.[83] We also control for asset size using the log of total assets. Larger institutions are assumed to have a higher loss on assets. Table 4.1. presents summary statistics for our dataset.[84]

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[82] The data for personal income growth were obtained from http://bea.gov/bea/regional/statelocal.htm; the data for unemployment rates were obtained from http://www.bls.gov/lau/home.htm, and the data for bankruptcy growth can be retrieved at http://www.abiworld.org, all websites accessed on 05th March 2006.

[83] Additional details for the coding of the depositor preference law dummy are provided in the Data Appendix to this chapter.

[84] A correlation matrix is presented in Appendix 4.A.

Table 4.1 Descriptive statistics

Variable	N	Mean	Max	Min	S.D.	p. 5	p. 10	p. 25	Median	p. 75	p. 90	p. 95
Loss on assets	1074	20778.8	2017459.0	0.00	87937.1	566.0	997.0	2212.0	5107.0	12327.0	32780.0	78778.0
Loss/Total assets	1074	0.34	133.15	0.00	4.06	0.03	0.05	0.13	0.21	0.30	0.40	0.46
Total assets	1092	153239.8	17100000.0	1731.0	924287.0	5915.0	8054.0	13778.5	26595.0	60733.5	171578.0	400540.0
Real estate owned/Total assets	1092	0.05	0.53	0.00	0.05	0.00	0.00	0.01	0.04	0.07	0.11	0.14
Equity/Total assets	1092	-0.01	0.93	-0.58	0.07	-0.12	-0.08	-0.03	0.00	0.03	0.06	0.08
Loans past due/Total assets	1091	0.02	0.28	0.00	0.03	0.00	0.00	0.00	0.01	0.03	0.06	0.09
Uncollected income/Total assets	1092	0.01	0.06	0.00	0.01	0.00	0.00	0.01	0.01	0.02	0.02	0.03
Asset growth	1092	-0.11	4.33	-0.76	0.33	-0.45	-0.40	-0.29	-0.17	-0.01	0.22	0.40
Fed funds/Total assets	1092	0.01	0.34	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.05
Demand deposits/Total assets	1092	0.15	0.65	0.00	0.07	0.05	0.07	0.10	0.14	0.18	0.24	0.28
Brokered deposits/Total assets	1092	0.02	0.85	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.07	0.15
Transactions deposits/Total assets	1088	0.25	0.92	0.00	0.11	0.10	0.13	0.18	0.24	0.31	0.39	0.43
Time and savings deposits/Total assets	1049	0.83	1.35	0.24	0.10	0.66	0.72	0.78	0.84	0.88	0.93	0.97
Subordinated debt/Total assets	1092	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other liabilities/Total assets	1090	0.02	0.39	0.00	0.04	0.00	0.01	0.01	0.01	0.01	0.04	0.09
C&I loans/Total assets	1091	0.17	1.39	0.00	0.12	0.03	0.05	0.09	0.15	0.24	0.33	0.40
Agricultural loans/Total assets	1091	0.07	0.61	0.00	0.12	0.00	0.00	0.00	0.00	0.08	0.23	0.34
Real estate loans/Total assets	1092	0.27	0.86	0.00	0.15	0.06	0.09	0.15	0.25	0.35	0.48	0.55
Individual loans/Total assets	1091	0.12	1.14	0.00	0.10	0.02	0.03	0.05	0.10	0.16	0.24	0.30
Personal income growth (lagged)	1092	0.05	0.18	-0.08	0.03	0.00	0.01	0.02	0.06	0.08	0.10	0.11
Bankruptcy growth rate	1092	0.16	0.94	-0.27	0.19	-0.07	-0.01	0.04	0.11	0.27	0.43	0.56
Unemployment rate	1092	7.03	17.40	2.80	1.61	4.70	5.10	6.00	6.80	7.80	8.90	9.50
Depositor preference law dummy	1092	0.44	1.00	0.00	0.50	0.00	0.00	0.00	0.00	1.00	1.00	1.00
FDICIA dummy	1092	0.12	1.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	1.00	1.00

To enable comparison with previous studies for descriptive purposes, we also compute a loss rate, calculated as FDIC loss divided by total assets. The average loss rate for the full sample is 34 percent of total assets, slightly higher than in James (1991). Our detailed breakdown illustrates a large degree of variation across the quantiles. While the loss rate is 3 percent of total assets for the low-cost failures (5th quantile), failures at the upper tail of the distribution cost the insurer more than 46 percent of total assets. The most expensive failure had a loss rate of more than 133.5 percent of total assets.

It is important to recognize that FDIC losses more than double between the 90th and the 95th quantile, suggesting a considerable increase in losses between the quantiles at the upper tail of the distribution. We therefore consider 'expensive failures' as those failures where losses lie at the 95th quantile and above of the distribution. This reflects that deposit insurers are particularly concerned about those failures that may pose a systemic threat to the insurance fund. Oshinsky (1999) points out that the solvency of the bank insurance fund is very closely tied to the soundness of the largest institutions. His simulations project a 98.5 percent probability that any future insolvency of the bank insurance fund will involve failure of one of the 25 largest banking companies in the US.

Furthermore, our sample also shows that the failed banks have a mean of total assets of 153m USD, with the largest failures exceeding 17bn USD. A few variables stand out: Total assets during the 24 months prior to failure decline on average 11 percent, indicating that troubled depositories shrink in the two years before failure. The ratio of real estate owned to total assets is on average 5 percent. Real estate owned has been found in previous studies to be an appropriate predictor for resolution costs since this category contains properties obtained by foreclosure. Likewise, the ratio of uncollected income to total assets figured prominently in previous work because of its indicative character for loans that have not been written off. This ratio has a mean of 1 percent. In terms of the funding structure, the average ratio of Fed funds purchased to total assets is 1 percent, whereas the ratio of brokered deposits is 2 percent of total assets. Failed banks have on average a ratio of 25 percent of transactions deposits to total assets. While time and savings deposits represent 83 percent of total assets, the ratio of demand deposits to total assets amounts to 15 percent.

4.2.1. COST OF FAILURE

Our sample consists of different types of banks (community banks, savings banks, commercial banks, etc.) that pursue different types of business activities. Brown and Epstein (1992) point out that a failing bank heavily concentrated in commercial loans is therefore likely to exhibit larger losses than an institution that primarily engages in retail lending activities.[85] Moreover, our sample exhibits large variation with respect to bank size. Bank size, as illustrated by Marino and Bennett (1999), in turn, influences bank liability structure, which ultimately affects the dependent variable in our analyses. Thus, numerous factors suggest that losses vary considerably across the distribution and that a regression technique is required that helps gain detailed insights as to whether the factors driving losses differ systematically across the distribution of the loss variable.

We start analyzing the link between the loss variable and a set of explanatory variables using ordinary least squares regression, similar to the approach pursued in previous work. We model losses as

$$y_i = \alpha + \beta x_i + u_i \qquad (1)$$

whereby y_i denotes the loss incurred by the deposit insurer for bank i, α is the constant term and, β captures the coefficients to be estimated for the explanatory variables x_i; u_i is the error term.

In order to account for the skewed distribution of the loss variable and draw more appropriate inferences about the sensitivity of the losses at the tails of the distribution, we use the conditional quantile regression estimator developed by Koenker and Bassett (1978). Given the heterogeneity of our dataset, conditional quantile regression not only permits drawing more precise inferences about the impact of regressors at certain points of the distribution of the loss variable but also offers an estimation procedure more robust to departures from normality because linear estimators would more likely produce inefficient and biased estimates. Since we are not aware of any study in the banking

[85] Brown and Epstein (1992) compute a loss rate as loss divided by total assets.

literature employing quantile regression, we review the key characteristics of this technique below. [86]

While classical linear regression estimates conditional mean functions, quantile regression permits estimating conditional quantile functions, i.e. models in which quantiles of the dependent variable are expressed as functions of a set of explanatory variables (Koenker and Hallock, 2001).[87] Quantile regression is appropriate when a large degree of variation in the data suggests that there may be more than a single slope parameter describing the relationship between the dependent variable and the regressors. Thus, quantile estimation goes beyond linear regression in that it gives a more complete picture of the effect of a set of regressors on the different quantiles of the dependent variable.

Given that the θth quantile of a conditional distribution of y_i is linear in x_i and assuming (y_i, x_i), $i = 1,...,n$ is drawn from the population of failed institutions whereby x_i is a $K \times 1$ vector of explanatory variables, we write the conditional quantile regression model as

$$y_i = x_i'\beta_\theta + u_{\theta i} \tag{2}$$

$$Quant_\theta(y_i|x_i) \equiv \inf\{y : F_i(y|x)\theta\} = x_i'\beta_\theta \tag{3}$$

$$Quant_\theta(u_{\theta i}|x_i) = 0 \tag{4}$$

where $Quant_\theta(u_{\theta i}|x_i)$ captures the θth conditional quantile of y_i on the regressor vector x_i. The expression β_θ is the vector of parameters to be estimated for different quantiles θ, lying in the range (0;1). The error term u_θ is assumed to have a continuously differentiable c.d.f. $F_{u\theta}(.|x)$ and a density function $f_{u\theta}(.|x)$. The entire distribution of

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[86] Quantile regression has been utilized in labor economics, demand analysis, in empirical finance in the literature on value at risk and in ecology and biostatistics. For recent overviews of applications of quantile regression we refer the interested reader to the surveys by Koenker and Hallock (2001) and Cade and Noon (2003).

[87] Quantiles divide the cumulative distribution function of a random variable into a given number of equally sized segments. Quantiles are the general case of certain other ways of splitting a population into segments. For instance, quartiles divide a population into four segments with equal proportions of the reference population in each segment, and the median divides the population into two equally sized segments (Koenker and Hallock, 2001).

y conditional on x can be traced by moving along the (0;1) interval of θ. To estimate β_θ we proceed as follows and minimize

$$\min \sum_{i}^{n} \rho_\theta (y_i - x_i' \beta_\theta) \tag{5}$$

whereby $\rho_\theta(u)$ is defined as follows

$$\rho_\theta(u) = \begin{cases} \theta u & if\ u \geq 0 \\ (\theta - 1)u & if\ u < 0 \end{cases}. \tag{6}$$

This minimization problem can be solved according to Koenker and Bassett (1978) using linear programming techniques. The covariance matrix of the parameter vector can be obtained using bootstrap methods to calculate standard errors and confidence intervals. We use this quantile estimator to investigate as to whether our assertion of systematic differences of the impact of regressors on the loss variable is correct in Section 4.3.1.

4.2.2. TIMING OF FAILURE

To test the effect of funding structure on time to failure, we utilize an accelerated failure time (AFT) model with time-varying covariates. Such models are called 'accelerated failure time models' because the effect of the independent variables is to rescale time, i.e. to accelerate or decelerate time to failure.

We formalize time until failure as a probability density function of time t. A convenient way of describing survival of a depository past time t is through its survivor function

$$S(t) = P(T \geq t) \tag{7}$$

which equals one minus the cumulative distribution function of T. We then can compute the conditional probability of closure within the time interval t until $t + h$, given survival until time t, as

$$P\{t \leq T \langle t \langle t + h | T \geq t\}. \tag{8}$$

This probability can be divided by h, to calculate the instantaneous rate of failure, i. e. the average probability of leaving per unit time period over the interval t until $t + h$ such that the hazard function can be written as

$$\lambda(t) = \lim_{h \downarrow 0} \frac{P\{t \leq T < t+h | T \geq t\}}{h} = \frac{-d \log S(t)}{dt} = \frac{f(t)}{S(t)}. \qquad (9)$$

Accelerated failure time models are written in the form

$$\ln(t_j) = x_j \beta_x + \tau_j \qquad (10)$$

where $\ln(t_j)$ is the log of time to failure, x_j denotes our explanatory variables, β_x are the parameters to be estimated and τ_j is a random variable that follows a distribution. Thus, to estimate the model, we need to determine the distribution of τ_j and specify τ_j to follow the log-logistic distribution. This distribution is rather flexible since it permits two inflexion points for the hazard function. The log-logistic distribution was utilized in previous work on bank failures and bank exit (Cole and Gunther, 1995; DeYoung, 2003). The parameters of interest can be obtained using maximum likelihood estimation technique.

The sampling period for this analysis starts in 1982 and we use the same set of failed institutions that underlie the cost equations. The starting year 1982 is chosen to assert that we have at least eight quarterly observations for the banks that fail during the first quarter in 1984. Since supervisors cannot discriminate between sound and failing banks ex-ante, we additionally include non-failed institutions into the duration model. Using quarterly data obtained from Call Reports, we can draw upon a large dataset of more than 456,000 bank-quarter observations for more than 13,000 banks. The richness of the dataset gives our tests considerable statistical power. The set of institutions is sampled until 1996 when the last bank remaining in the dataset fails or censoring takes place. The minimum duration is therefore *t=8* if the bank failed in the first quarter of 1984 and the maximum duration is *t=56* if the institution failed in the last quarter 1996. The choice of a duration model is also driven by policy considerations: knowledge of the factors that drive time to failure of banks helps obtain better estimates of when the losses will occur to the deposit insurer. This enables the insurance fund to adjust resources more effectively.[88]

[88] Oshinsky and Olin (2005) provide an in-depth analysis of the factors that determine whether troubled institutions recover, merge, continue as a problem bank or eventually fail. They report that the Office of the Comptroller of the Currency (OCC) highlights reliance on volatile liabilities as important cause of bank failure. However, Oshinsky and Olin's (2005) empirical analysis suggests that failing banks do

4.3. EMPIRICAL RESULTS

We report the results for the analysis of the effect of funding structure on the loss rate in Section 4.3.1. and discuss the impact of funding structure on time to failure in Section 4.3.2.

4.3.1. BANK FUNDING STRUCTURE AND COST OF FAILURE

Table 4.2. presents the results obtained using OLS regression to enable comparison with previous studies. We estimate five setups for the loss equation. Specification (1) draws upon a parsimonious set of variables previously found to be significant determinants of the deposit insurer's loss. Due to the fact that the regulatory environment regarding resolution of bank failures changed considerably with enactment of FDICIA in 1991, we also include a dummy variable that takes on the value one if the failure occurred in the period after FDICIA or zero otherwise. Variables for liability structure are introduced in Specification (2). Additional control variables are used in Specifications (3), (4), and (5) to test for possible omitted variable bias. The variable that captures bank size, the log of total assets, is adjusted for inflation using the GDP deflator.

Specification (1) confirms findings by Osterberg and Thomson (1994) and McDill (2004) that higher levels of other real estate owned increase FDIC losses. Similarly, uncollected income, as reported in many previous studies (e.g. James, 1991; Osterberg and Thomson, 1994; McDill, 2004) also enters with a positive and significant sign and so does the ratio of loans past due to total assets. Unsurprisingly, larger banks, measured by the log of total assets, tend to cause higher losses to the deposit insurer. This reflects that we model the dollar value of losses, instead of loss rates.[89] The dummy for the period following enactment of FDICA enters with a negative sign and assumes significance at the one percent level. This underscores that FDICIA, designed to reduce losses arising from bank failures, helped decrease the losses born by the insurance fund (see also Benston and Kaufman, 1997).

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not experience increases in volatile liabilities. This result may be due to regulatory reasons. The Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA) restricts the use of brokered deposits of critically undercapitalized depositories. Thus, exploring the nexus between liability structure and its implications for the timing of failure is a fruitful avenue for research.

[89] Note however, that there is an inverse relationship between loss rates and bank size since it is well established that larger banks have lower loss rates (e.g. Shibut, 2002).

Table 4.2 Ordinary Least Squares Regressions

	(1)	(2)	(3)	(4)	(5)
	Cost (log)	Cost (log)	Cost (log)	Cost (log)	Cost (log)
Total assets (deflated)	0.8968	0.8376	0.8215	0.8191	0.8340
	(0.0329)***	(0.0313)***	(0.0338)***	(0.0337)***	(0.0320)***
Real estate owned/Total assets	4.4190	3.5666	4.0795	4.0322	4.0092
	(0.6888)***	(0.5030)***	(0.4841)***	(0.4883)***	(0.4678)***
Equity/Total assets	-1.4808	-8.3374	-7.3869	-7.3147	-7.7015
	(1.5465)	(1.7583)***	(1.6475)***	(1.6598)***	(1.5635)***
Loans past due/Total assets	2.6701	1.9981	1.0039	1.0091	0.6931
	(1.0608)**	(1.0187)*	(0.8654)	(0.8608)	(0.8021)
Income earned, not collected/Total assets	32.4485	33.6278	25.9984	25.8933	23.8104
	(5.0442)***	(3.9075)***	(4.3290)***	(4.3262)***	(4.2849)***
Asset growth 2 years prior to failure	0.1623	0.2821	0.2533	0.2395	0.2663
	(0.1019)	(0.0790)***	(0.0689)***	(0.0685)***	(0.0643)***
FDICIA dummy	-1.4311	-0.9515	-0.9667	-0.9531	-0.9427
	(0.1467)***	(0.1596)***	(0.1569)***	(0.1599)***	(0.1630)***
Fed funds purchased/Total assets		-2.3840	-3.2451	-3.1941	-3.5057
		(2.1937)	(2.0853)	(2.0866)	(1.9566)*
Brokered deposits/Total assets		0.7000	0.2963	0.3078	0.4287
		(0.6008)	(0.5188)	(0.5153)	(0.4237)
Transactions deposits/Total assets		-2.0234	-1.0983	-1.0734	-0.5216
		(0.5240)***	(0.5070)**	(0.5014)**	(0.4524)
Time and savings deposits/Total assets		-5.9227	-5.6922	-5.6822	-5.8544
		(1.6514)***	(1.5456)***	(1.5581)***	(1.4452)***
Demand deposits/Total assets		-4.1961	-5.6017	-5.6453	-6.1340
		(1.8182)**	(1.6974)***	(1.7101)***	(1.5921)***
Subordinated debt/Total assets		-5.0942	-4.8766	-4.5684	-2.6518
		(15.9163)	(15.7139)	(15.5896)	(13.6435)
Other liabilities/Total assets		-3.5719	-3.3345	-3.2954	-4.3538
		(1.9382)*	(1.7924)*	(1.8055)*	(1.7119)**
C&I loans/Total assets			3.1892	3.2256	2.9026
			(0.3509)***	(0.3508)***	(0.3301)***
Agricultural loans/Total assets			0.9254	0.9793	1.3805
			(0.4434)**	(0.4415)**	(0.4420)***
Real estate loans/Total assets			1.0856	1.0954	0.8580
			(0.3537)***	(0.3526)***	(0.3473)**
Individual loans/Total assets			0.8364	0.8201	0.5868
			(0.4054)**	(0.4080)**	(0.4045)
Depositor preference law				-0.0745	-0.0750
				(0.0637)	(0.0640)
Personal Income Growth (lagged)					-0.3457
					(1.0125)
Bankruptcy Growth Rate					0.7166
					(0.2196)***
Unemployment Rate					0.1405
					(0.0231)***
Observations/Number of failures	1066	1024	1023	1023	1023
Adjusted R square	0.5302	0.6002	0.6390	0.6392	0.6704
AIC	3081.723	2781.438	2672.087	2672.444	2582.824

We estimate OLS regressions in column (1) - (5) for the period 1984 - 1996. The dependent variable is the log of the dollar value of losses in the quarter prior to failure. Specification (1) is the baseline model that includes covariates used in previous studies. We additionally incorporate a dummy variable that takes on the value one if the failure occurred in the period following enactment of the Federal Deposit Insurance Corporation Improvement Act in 1991. Specification (2) includes variables that capture liability structure. We include additional control variables in Specification (3) to capture asset composition. Specification (4) includes a dummy variable that takes on the value one if depositor preference law was in place in the state in which the bank is located or zero otherwise. In Specification (5) we account for the macroeconomic environment on the federal state level and include variables that capture personal income growth, bankruptcy growth and unemployment. Robust standard errors are reported in parentheses. Significance levels of 1, 5 and ten percent are indicated by ***, **, and *.

In Specification (2) the ratio of transactions deposits to total assets enters with a negative sign and is highly significant. This finding can be explained by the fact that transactions deposits resemble core deposits, often used as a proxy for the franchise value of financial institutions. This result is aligned with Osterberg and Thomson (1994) and James (1991). Additionally, the ratios of time and savings deposits, and demand deposits to total assets also enter with a negative and significant sign. It is important to note that these deposit categories also contain jumbo CDs and large money market deposit accounts, which are typically not insured by the FDIC. Thus, to the extent to which these deposits are not insured, they decrease FDIC costs. Moreover, this result also indicates that holders of insured deposits withdraw large volumes in the run-up to a failure as reported by Davenport and McDill (2006), resulting in a large proportion of deposits being uninsured at the time of failure. Insured depositors' withdrawals are due to a liquidity effect. They may be concerned about delayed redemption of their holdings following failure. The ratio of other liabilities to total assets also enters significantly with a negative sign. This result is fully aligned with theory as this variable consists of other, not insured liabilities in the failed institutions. None of the other regressors that capture bank funding structure assumes significance in this setup. In particular, we do not find a significant role of brokered deposits, a finding that contrasts with Osterberg and Thomson (1994) who contend that brokered deposits are a source of market discipline. Our result may be due to the longer sampling horizon in the present study: critically undercapitalized institutions face restrictions regarding the use of brokered deposits since FDICIA became effective and therefore may not be able to make extensive use of this type of funding.

In addition, Specification (2) also suggests that asset growth over eight quarters prior to failure increases losses, whereas the level of capitalization enters now significantly with a negative sign. Both results are aligned with previous studies. In terms of the magnitude of the coefficients, the proxy for uncollected income dominates the other coefficients, this is consistent with the results obtained by McDill (2004), Osterberg and Thomson (1994) and Bovenzi and Murton (1988).

Controlling for additional variables in Specification (3) does not change our inferences. We find that C&I loans, agricultural loans, real estate loans, and individual loans all have significant bearing for the deposit insurer's loss. Specification (4) furthermore includes a

dummy variable for the effect of depositor preference law, to test whether the law meets its objective of decreasing resolution costs. The dummy takes on the value one if depositor preference law was in place at the time of failure or zero otherwise. The variable enters with the anticipated negative sign, but it remains insignificant. McDill (2004) has shown that a sluggish macroeconomic environment plays an important role for explaining FDIC losses. Therefore, Specification (5) considers the effect of the macroeconomic setting and includes additional variables that capture information on personal income growth (lagged by two periods), bankruptcy growth, and unemployment rates on the state level. The results suggest that bankruptcy growth and the unemployment rate significantly increase losses. While controlling for the effect of the macroeconomic environment renders the ratio of transaction deposits to total assets insignificant, it highlights a weakly negative association of the ratio of Fed funds to total assets with the deposit insurer's loss. This result is intuitive: Fed funds are uninsured liabilities and therefore decrease FDIC losses. The adjusted R^2 and the Akaike Information Criterion (AIC) indicate that Specification (5) is the most appropriate setup for the model.

As alluded to previously, estimates obtained from the OLS regression only approximate the central tendency of the distribution and are unsuitable to account for heterogeneous data with outliers. Furthermore, deposit insurers and bank supervisors are particularly concerned about high-cost failures and have therefore a vested interest in the factors driving losses of those costly failures. We therefore employ quantile regression models that aim to obtain better estimates for the determinants of the factors for high-cost failures. We present the results using quantile regression estimators in Table 4.3.

In order to evaluate the effect of our explanatory variables at different quantiles of the distribution on the loss variable, we estimate quantile regression models to obtain coefficients for the 5^{th}, 10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th}, and 95^{th} quantile. The estimation is based on the regression setup of Specification (5) in Table 4.2. This regression setup includes additional control variables for the composition of the failed banks' loan portfolios, takes account of depositor preference law, and also includes variables that capture information from the macroeconomic environment. We report the results in Table 4.3. and also include the coefficients obtained with the OLS estimator for comparability.

In order to further illustrate the use of quantile regression, Figures 1 a) - 1 v) plot the estimated coefficients of interest obtained with the quantile estimator against the different quantiles as the solid curve. These point estimates can be interpreted as the impact of a one-unit change of the regressor on the loss variable with the other covariates held constant. The vertical axis indicates the effect of the regressor and the horizontal line represents the quantile θ scale. The gray shaded area shows a 95 percent confidence band based on bootstrapped standard errors for the quantile estimates and the dashed line represents the OLS estimator. The plots also contain a 95 percent confidence band for the OLS estimator.

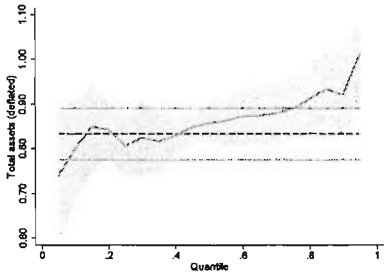
Table 4.3 Ordinary least squares and quantile regressions

Quantile regressions	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	q. 05	q. 10	q.25	q.50	q.75	q.90	q.95
Total assets (deflated)	0.8340	0.7403	0.8015	0.8063	0.8579	0.8918	0.9209	1.0129
	(0.0320)***	(0.0847)***	(0.0640)***	(0.0402)***	(0.0239)***	(0.0351)***	(0.0456)***	(0.0515)***
Real estate owned/Total assets	4.0092	6.7291	6.5193	4.5904	2.9859	1.8738	1.8825	1.5987
	(0.4678)***	(0.9792)***	(0.7745)***	(0.5553)***	(0.4281)***	(0.4966)***	(0.6697)***	(0.8276)*
Equity/Total assets	-7.7015	-7.2358	-6.6059	-8.5075	-7.8334	-6.8643	-3.5968	-4.2023
	(1.5635)***	(2.8537)**	(2.3610)***	(2.5157)***	(2.2400)***	(1.7194)***	(2.9675)	(4.4366)
Loans past due/Total assets	0.6931	0.2315	1.5355	1.3033	1.0914	0.5320	0.2952	0.6637
	(0.8021)	(1.9248)	(1.3278)	(0.8923)	(0.8109)	(0.6891)	(0.7305)	(1.1217)
Income earned, not collected/Total assets	23.8104	36.0187	29.4740	24.1902	22.1033	19.6424	22.1703	25.9112
	(4.2849)***	(9.1994)***	(6.5363)***	(6.8902)***	(4.7023)***	(4.0406)***	(6.5240)***	(7.8535)***
Asset growth 2 years prior to failure	0.2663	0.4111	0.4538	0.3671	0.3298	0.2178	0.2938	0.2801
	(0.0643)***	(0.2347)*	(0.1460)***	(0.0959)***	(0.0728)***	(0.0746)***	(0.1174)**	(0.1360)**
FDICIA dummy	-0.9427	-1.1659	-1.0773	-0.7134	-0.8173	-0.9233	-0.9165	-0.9617
	(0.1630)***	(0.8986)	(0.3769)***	(0.2409)***	(0.0956)***	(0.1270)***	(0.1715)***	(0.1766)***
Fed funds purchased/Total assets	-3.5057	-8.1590	-2.1938	-5.4359	-4.8779	-2.1017	1.3986	1.0921
	(1.9566)*	(4.2730)*	(3.2500)	(2.9549)*	(2.8823)*	(2.5713)	(3.6287)	(4.7254)
Brokered deposits/Total assets	0.4287	0.0911	0.2265	-0.0146	0.3525	0.5377	0.5904	0.4716
	(0.4237)	(0.8823)	(0.7512)	(0.3891)	(0.3365)	(0.3353)	(0.3271)*	(0.5471)
Transactions deposits/Total assets	-0.5216	-0.8848	-0.7037	0.2218	-0.4324	-0.4575	0.1078	-0.0317
	(0.4524)	(1.1475)	(0.9034)	(0.5554)	(0.3675)	(0.4055)	(0.4773)	(0.4769)
Time and savings deposits/Total assets	-5.8544	-4.3576	-3.5360	-6.0386	-5.8508	-5.3294	-2.4002	-3.2440
	(1.4452)***	(2.7063)	(2.3136)	(2.4556)**	(2.2177)***	(1.6621)***	(2.9580)	(4.4287)
Demand deposits/Total assets	-6.1340	-5.0309	-4.1395	-6.9371	-6.2356	-5.7975	-3.5546	-3.4712
	(1.5921)***	(3.6641)	(2.7069)	(2.5368)***	(2.2349)***	(1.7827)***	(3.1100)	(4.6504)
Subordinated debt/Total assets	-2.6518	3.5393	-4.7926	-13.8004	6.9646	12.2365	20.4744	-8.1534
	(13.6435)	(97.3029)	(15.1688)	(23.0044)	(15.6175)	(16.8075)	(13.3333)	(17.2878)
Other liabilities/Total assets	-4.3538	-3.2741	-3.6733	-5.4101	-4.5460	-4.4378	-1.5226	-1.9883
	(1.7119)**	(3.2161)	(2.6510)	(2.7791)*	(2.3535)*	(1.8795)**	(3.0351)	(4.5531)
C&I loans/Total assets	2.9026	5.3493	4.3623	3.4037	2.4651	1.7890	1.6688	1.1402
	(0.3301)***	(0.7568)***	(0.5050)***	(0.4247)***	(0.2882)***	(0.2900)***	(0.3454)***	(0.4462)**
Agricultural loans/Total assets	1.3805	2.9269	2.7507	1.8543	0.9489	1.0318	0.6080	0.2667
	(0.4420)***	(1.0947)***	(0.7062)***	(0.6918)***	(0.4197)**	(0.3883)***	(0.4515)	(0.4837)
Real estate loans/Total assets	0.8580	2.7866	1.9997	1.3929	0.3933	0.1232	0.0554	-0.1137
	(0.3473)**	(0.8140)***	(0.5359)***	(0.4092)***	(0.2574)	(0.2824)	(0.3700)	(0.4528)
Individual loans/Total assets	0.5868	2.3054	1.4029	1.3813	0.7519	0.2609	0.1795	-0.0232
	(0.4045)	(1.3410)*	(0.7012)**	(0.5262)***	(0.3188)**	(0.2893)	(0.3765)	(0.4649)
Depositor preference law	-0.0750	-0.3129	-0.2317	-0.1348	-0.0167	0.0143	0.0490	-0.0321
	(0.0640)	(0.1892)*	(0.1226)*	(0.0754)*	(0.0499)	(0.0590)	(0.0545)	(0.0595)
Personal Income Growth (lagged)	-0.3457	4.2330	1.3258	-0.5994	-3.0264	-1.2976	1.3482	1.2370
	(1.0125)	(2.5839)	(2.2323)	(1.6325)	(0.9345)***	(0.8257)	(0.7840)*	(0.7426)*
Bankruptcy Growth Rate	0.7166	-0.2030	0.2878	0.4985	1.0041	0.8800	0.6011	0.7352
	(0.2196)***	(0.4309)	(0.3384)	(0.3051)	(0.2088)***	(0.1872)***	(0.2100)***	(0.2653)***
Unemployment Rate	0.1405	0.2299	0.1928	0.1717	0.1283	0.1520	0.1459	0.1048
	(0.0231)***	(0.0655)***	(0.0358)***	(0.0256)***	(0.0184)***	(0.0212)***	(0.0237)***	(0.0245)***
Observations	1023	1023	1023	1023	1023	1023	1023	1023
R square/Pseudo R square	0.6704	0.3384	0.3727	0.4251	0.5043	0.5702	0.6353	0.6661

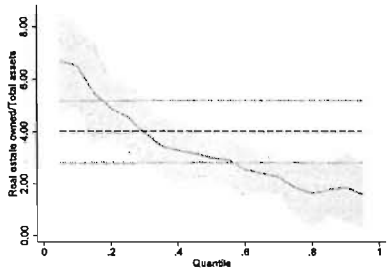
We report OLS regressions in column (1) and quantile regression estimates in column (2) - (8). The dependent variable is the log of the loss on assets. Robust standard errors are reported in parentheses for OLS regressions and bootstrapped standard errors based on 500 replications are reported in parentheses for the quantile regressions. Pseudo R square reported for quantile regressions. The pseudo R square is calculated as 1-(sum of the weighted deviations about estimated quantile/sum of weighted deviations about raw quantile). Significance levels of 1, 5 and ten percent are indicated by ***, **, and *.

Figure 1: Quantile regression estimators

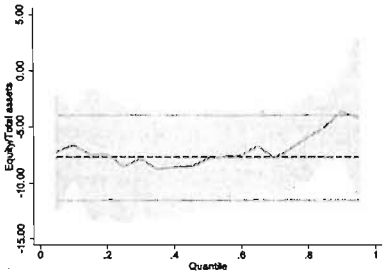
a) Total assets (log), deflated



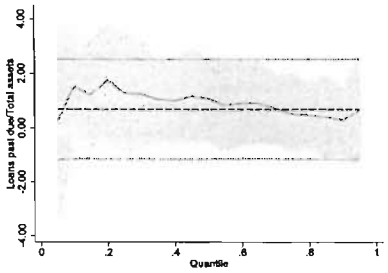
b) Real estate owned/Total assets



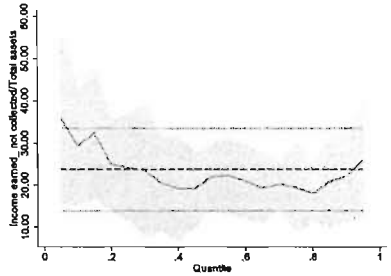
c) Equity capital/Total assets



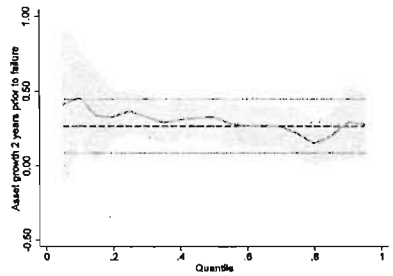
d) Loans past due (90 days+)/Total assets



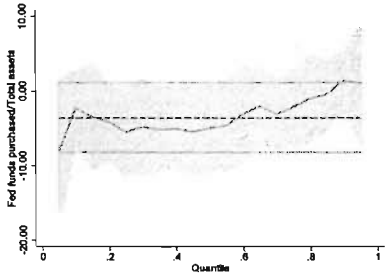
e) Income earned, not collected/Total assets



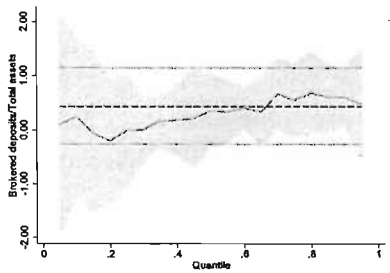
f) Asset growth, 8 quarters prior to failure



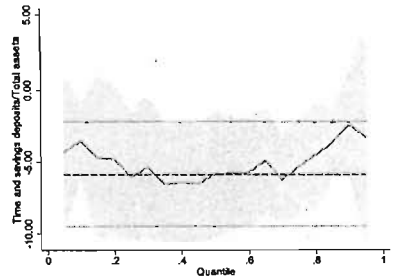
g) Fed Funds purchased/Total assets



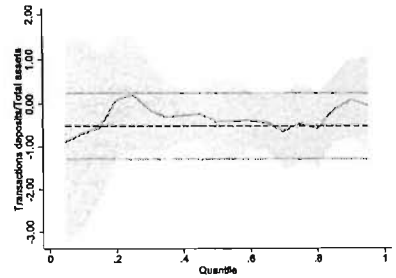
h) Brokered deposits/Total assets



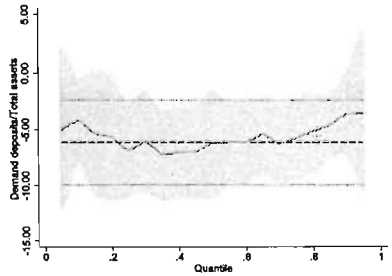
i) Time and savings deposits/Total assets



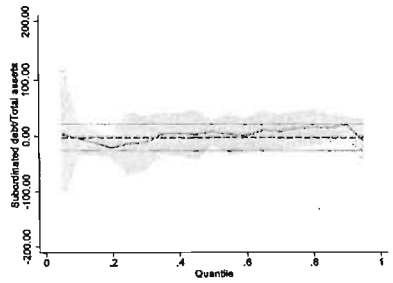
j) Transactions deposits/Total assets



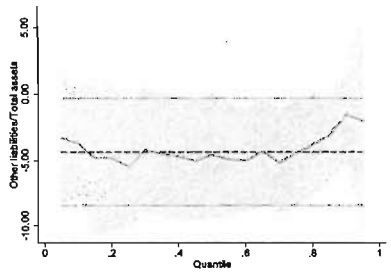
k) Demand deposits/Total assets



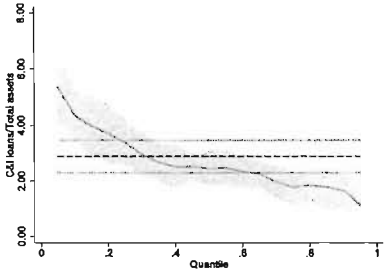
l) Subordinated debt/Total assets



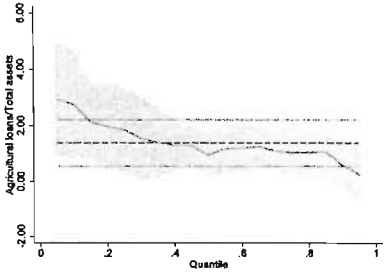
m) Other liabilities/Total assets



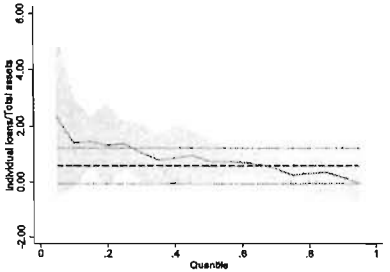
n) C&I loans /Total assets



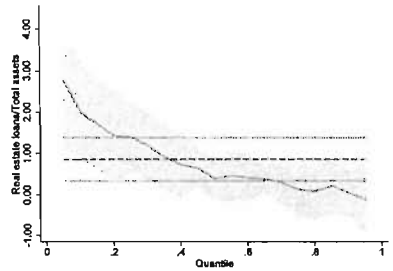
o) Agricultural loans/Total assets



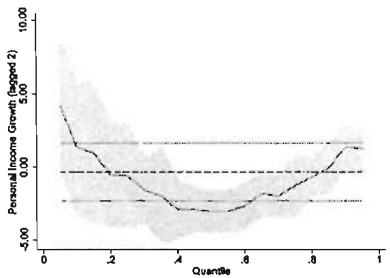
p) Individual loans/Total assets



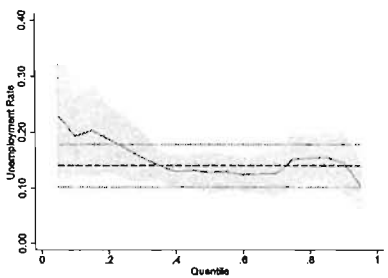
q) Real estate loans/Total assets



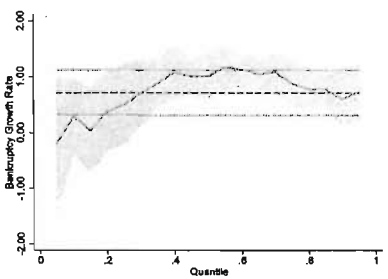
r) Personal income growth (2 year lag)



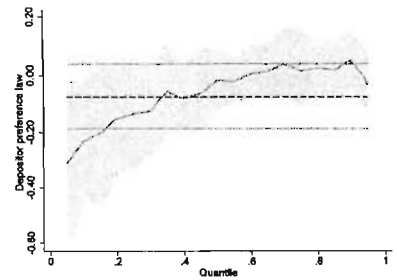
s) Unemployment rate



t) Bankruptcy growth rate



u) Depositor preference law dummy



v) FDICIA dummy

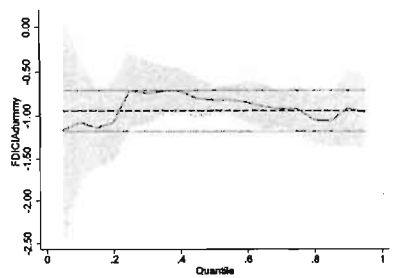


Table 4.3. provides an illustration of the differences in magnitude, significance and change in direction of the relationship between the loss variable and our regressors as we move along the distribution.

Bank size, measured by the deflated log of total assets, shows a stronger effect on FDIC loss for more costly failures and remains significant across all quantiles. As mentioned previously, larger banks tend to cause larger losses to the deposit insurer, this indicates a size-effect. Moreover, plot 1 a) illustrates that the coefficient obtained in the quantile regression procedure clearly departs from the coefficient resulting from the OLS estimator, highlighting that reliance on OLS estimates can easily give rise to inappropriate inferences.

Figure 1 b) also shows a highly nonlinear relationship between the ratio of real estate owned to total assets and its impact upon FDIC loss. Exhibiting significance across all quantiles, the effect is decreasing steadily. This finding indicates that the variable is less important in explaining high-cost failures. Such failures may be more strongly influenced by other determinants, e.g. composition of the loan portfolio.

The impact of equity to total assets is significant and negative across all quantiles but the upper tail of the distribution. This effect does not vary much in terms of magnitude as the quantile regression estimator remains within the confidence band of the OLS estimator. In a similar vein to the results obtained in Specification (5) presented in Table 4.2., the ratio of loans past due to total assets remains insignificant in the quantile regressions. While the ratio of uncollected income to total assets retains its highly significant effect on the loss variable across all quantiles, it also remains within the confidence band of the OLS estimator in Figure 1e), suggesting no marked differences between the impact on high and low-cost failures. Likewise, Figure 1 f) shows that asset growth over the 24 months prior to failure remains significant across all quantiles. However, this variable exhibits not much variation as we move up the distribution.

In terms of the liability structure, the quantile regressions generally do not suggest that variables that capture liability structure have a varying effect (in terms of magnitude) upon high-cost and low-cost failures. According to the quantile regression estimator, the ratio of Fed funds to total assets is weakly and negatively associated with losses for low-cost and

moderate-cost failures, whereas the effect is rendered insignificant as we move up the distribution. The negative effect of Fed funds on losses is aligned with the statement by Osterberg (1996), who argues that Fed funds are highly liquid and that failing banks able to borrow such funds will have lower resolution costs. The ratios of time and savings as well as demand deposits to total assets also significantly decrease FDIC loss for moderate-cost failures as the large proportion of these types of deposits is unlikely to be insured at the time of failure (Davenport and McDill, 2006). Likewise, the ratio of other liabilities to total assets has a weakly decreasing effect on moderate-cost failures. This suggests that these variables are only of moderate importance for explaining high-cost failures. Moreover, given the width of the confidence intervals for the quantile regression estimators, caution has to be exercised when drawing inferences.

The ratio C&I loans to total assets is positive and significant across all quantiles. Figure 1 n) illustrates a considerable departure of the quantile estimator from the OLS estimator at the lower and upper tail of the distribution. This suggests that C&I loans have a much stronger effect on low-cost failures than on high-cost failures, indicating marked differences in the loan portfolios between high-cost and low-cost failures. The ratio of agricultural loans to total assets in Figure 1 o) exhibits a similar pattern, indicating a stronger effect of this type of loan on losses caused by low-cost failures than on moderate and high-cost failures. Figure 1 p) challenges the result obtained with the OLS estimator in Specification (5) in Table 4.2. The quantile regression estimator underscores that this variable markedly increases losses for low and moderate-cost failures, whereas it is only insignificant at the upper tail of the distribution. Figure 1 q) plots the ratio of real estate loans to total assets and also resembles the behaviour of the other variables that capture composition of the loan portfolio. Real estate loans also play an important role for low-cost failures whereas they do not significantly affect high-cost failures.

While the lagged personal income growth variable is only significant at the median and at the upper tail of the loss variable, the unemployment rate is significant across all quantiles. Bankruptcy growth, however, is only of relevance for the costly failures. The increasing effect of bankruptcy growth and unemployment rates on costly-failures is not surprising. In states where the economy is performing poorly, defaults of individual and corporate borrowers will also adversely affect other banks. McDill (2004) has shown that the pool of

potential buyers of failed institutions is a further key determinant for the deposit insurer's loss. Thus, if the pool of potential buyers is operating in the same economic environment than the failed institution, these institutions may be restrained in their ability to pay high prices for the failed bank's assets. This will not only affect recovery rates but it will ultimately adversely affect FDIC losses as well.

Figure 1 u) highlights a nonlinear relationship between depositor preference law and the loss variable. While the OLS model indicates no independent effect of depositor preference law on FDIC loss, our quantile regressions underscore that depositor preference law significantly decreases failure cost only at the lower tail of the distribution. This implies that the law meets the objective of decreasing FDIC loss exclusively for low-cost failures. This finding may be affected by the way a failed institution is resolved. In instances where an assisted merger (or purchase and assumption transaction) took place, all depositors may have been treated as if they were insured so that the effect of the law was limited. By contrast, if the FDIC liquidated the failed bank and paid off depositors, the law might have lived up to its expectations.[90] Finally, the FDICIA dummy enters across all quantiles with a negative sign. This coefficient remains within the OLS confidence band and does not exhibit much variation as we move up the distribution.

While visual inspection of the individual plots in Figure 1 already suggests important non-linear relationships between FDIC losses and several explanatory variables, the following section presents additional tests to validate these inferences. First, we run F-tests to investigate if the coefficients are jointly statistically different from zero across all quantiles for each variable. Second, we test if the coefficients at the median and at the tails are jointly significantly different from zero to evaluate if median FDIC losses are affected differently by the variables from the losses in the tails of the distribution of the dependent variable. Third, F-tests are also utilized to investigate if there are significant differences for each coefficient in the tails of the distribution. This test helps ascertain if there are systematic differences in the factors that drive high-cost and low-cost failures.

[90] See Osterberg (1996) for the link between bank resolution and depositor preference law.

Table 4.4 F-Tests for the equality of coefficients across quantiles

Variable	(1)	(2)	(3)
	F-test (equality across all quantiles)	F-test (equality between 5^{th}, 50^{th}, and 95^{th} quantile)	F-test (equality across tails)
Total assets (log) (deflated)	2.58**	6.12***	8.97***
Real estate owned/Total assets	5.25***	8.57***	16.34***
Equity/Total assets	0.33	0.28	0.31
Loans past due/Total assets	0.30	0.14	0.04
Uncollected income/Total assets	0.61	1.03	0.76
Asset growth	0.59	0.12	0.23
Fed funds/Total assets	1.05	1.04	2.04
Transactions deposits/Total assets	0.85	0.44	0.45
Brokered deposits/Total assets	0.45	0.06	0.13
Demand deposits/Total assets	0.23	0.19	0.07
Time and savings deposits/Total assets	0.30	0.22	0.04
Subordinated debt/Total assets	0.92	0.25	0.02
Other liabilities/Total assets	0.22	0.17	0.05
C&I loans/Total assets	5.57***	12.87***	25.74***
Agricultural loans/Total assets	1.75	2.67*	5.27**
Real estate loans/Total assets	3.01***	6.22***	11.98***
Individual loans/Total assets	1.04	2.00	3.01*
Personal income growth (lagged)	4.39***	11.36***	1.15
Bankruptcy growth rate	2.23**	4.67***	3.23*
Unemployment rate	1.77	1.71	3.41*
Depositor preference law dummy	1.59	1.52	2.43
FDICIA dummy	0.36	0.42	0.06

This table presents F-tests for the equality of the slope coefficients for the explanatory variables used in the cost equations. The F-tests are based on the coefficients reported in Table 4.3. Column (1) reports F-tests for the equality of coefficients across all quantiles from the 5^{th} - 95^{th} quantile; column (2) presents F-tests for the equality of the coefficients for the 5^{th}, 50^{th} and the 95^{th} quantile and column (3) presents F-tests for the equality of the coefficients for low-cost (5^{th} quantile) and high-cost (95^{th} quantile) failures.

The inferences from our visual inspection are corroborated by the additional tests. The F-tests reject the null hypothesis for the equality of the coefficients across all quantiles in six instances at the one and at the five percent level. The results further improve when testing the null hypothesis that the coefficients are jointly different from zero between the median and the tails (5^{th}, 50^{th} and 95^{th} quantile) of the distribution. The F-tests indicate in seven instances statistical significance. Finally, the results are even stronger when we focus on the tails of the distribution (5^{th} and 95^{th} quantile) to establish whether the explanatory variables impact high-cost and low-cost failures differently. These tests suggest a statistically significantly different impact of eight variables on losses in high-cost and low-cost failures. In particular, bank size, and the ratio of real estate owned to total assets exhibit varying impact on high-cost and low-cost failures. Whereas the effect of liability structure does not appear to have varying effects on the deposit insurer's loss, variables that capture composition of the loan portfolio do. It is important to note that FDIC losses are

influenced by a variety of factors such as how quickly an ailing institution is put into receivership, the claim structure of the bank's (insured and uninsured) creditors, and, finally, the FDIC's ability to sell the whole bank or its assets (Kaufman, 2004). Thus, the longer a troubled bank can operate freely, the higher the losses.[91] This is due to the existing bank managers' increased propensity to engage in 'gambling for resurrection', thereby taking on additional credit risk. This phenomenon may be amplified by regulatory forbearance (e.g. inappropriate closure rules). Moreover, bad market conditions after resolution can further increase losses. Ultimately, this affects the recovery value of the assets in the receivership negatively. Consequently, our finding indicates that the effect of variables that capture composition of the asset portfolio dominates the effect of liability variables on FDIC losses.

In summary, our results provide clear empirical evidence for the important bearing of certain types of liabilities on the deposit insurer's loss. This finding is consistent with the assertion by Shibut (2002) that liability structure influences the deposit insurer's loss since it determines which claimants have to be compensated in case of bank failure. For instance, Fed funds significantly decrease low and moderate-cost failures, a finding that is only observable through the use of quantile regression estimators. Moreover, the findings illustrate that reliance on standard econometric techniques to assess the determinants of the deposit insurer's loss can give rise to misleading inferences as several explanatory variables exhibit a varying effect on FDIC loss. The observed non-linearities are not surprising: failed depositories exhibit different characteristics regarding bank type, business activities and size that all affect the loss variable. The proposed quantile regression estimators accommodate the heterogeneity of the data and offer more detailed insights into the factors driving FDIC losses across the distribution. This is of particular importance for determining how the explanatory variables influence high-cost failures. While we find that variables that capture composition of the loan portfolio have a strong discriminatory effect for low-cost and high-cost failures, no such effect can be established for the variables that capture liability structure. In particular, costly failures are largely

[91] Note that the guidelines for prompt corrective action still provide some regulatory discretion in declaring an institution insolvent.

determined by C&I loans, uncollected income and asset growth. In addition, costly failures are also affected by a weak macroeconomic environment.

4.3.2. BANK FUNDING STRUCTURE AND TIME TO FAILURE

We employ the AFT model in this section to test the effect of bank funding structure on time to failure. While previous studies investigate the price and quantity effects of risk on bank funding structure (e.g. Park and Peristiani, 1998; Maechler and McDill, 2006), the nexus between bank funding structure and time to failure is an alternative way of assessing the role of market discipline. In addition, with the exception of the work by Davenport and McDill (2006), the relationship between market discipline and different types of accounts has been left largely untouched in the literature.

These questions have gained increasing prominence with the advent of the new Basel Capital Accord. For instance, Maechler and McDill (2006) argue that very risky institutions cannot increase the volume of insured deposits by offering higher interest rates to compensate outflows of uninsured deposits. Thus, troubled banks that rely heavily on uninsured deposits might fail faster due to their inability to substitute such cash outflows with other types of funds. This may be interpreted as a signal for the presence of market discipline and underscores the importance of Pillar 3 in the new Basel Capital Accord. Furthermore, evidence that holders of certain account types withdraw deposits in the period prior to failure would present evidence that these account holders are also sensitive to the bank's financial condition.

Table 4.5. presents the results of our duration analysis whereby we use data for the failed institutions that also underlie the cost equations.[92] As highlighted in Section 4.2.2., this dataset also includes non-failed institutions to avoid problems arising from sample selectivity. This reflects that regulators cannot discriminate ex-ante between failed and non-failed institutions.

[92] Note that availability of the explanatory variables for the AFT model slightly reduces the number of failed institutions for our analysis of depositor discipline in comparison to the cost-equations.

Table 4.5 Duration analysis

	(1)	(2)	(3)	(4)	(5)
Equity/Total assets	37.1454	29.9544	30.8770	30.6854	29.5171
	(20.7265)***	(12.6300)***	(14.3502)***	(14.2993)***	(13.5246)***
Troubled assets/Total assets	-12.6529	-11.9390	-11.5690	-11.6190	-10.6854
	(9.8235)***	(9.4432)***	(9.1905)***	(9.1827)***	(8.7001)***
Operating income/Total assets	0.9341	1.1782	0.9808	0.9426	0.9921
	(1.0061)	(1.3997)	(1.1754)	(1.1314)	(1.2236)
Total assets (deflated)	0.4373	0.4457	0.3228	0.3217	0.3112
	(11.8921)***	(13.9652)***	(9.8552)***	(9.9368)***	(9.7646)***
FDICIA dummy	-0.0289	-0.0461	-0.0007	-0.0081	-0.0920
	(0.2786)	(0.5087)	(0.0082)	(0.0924)	(1.0014)
Liquidity/Total assets	2.6032	2.0650	1.7574	1.7235	1.5961
	(10.4516)***	(8.7665)***	(4.9666)***	(4.8987)***	(4.6106)***
Fed funds purchased/Total assets		-6.1681	-4.6112	-4.6097	-4.3518
		(2.9673)***	(3.3117)***	(3.3486)***	(2.9097)***
Brokered deposits/Total assets		-3.1782	-3.5328	-3.5055	-3.7120
		(5.7138)***	(4.8869)***	(5.1768)***	(5.1444)***
Transactions deposits/Total assets		2.0229	1.9269	1.8574	1.5842
		(4.2117)***	(3.7594)***	(3.6785)***	(3.2263)***
Time and savings deposits/Total assets		-5.7039	-4.5549	-4.5582	-4.2282
		(2.8552)***	(3.5269)***	(3.5712)***	(3.0154)***
Demand deposits/Total assets		-6.7986	-5.9254	-5.8616	-5.4670
		(3.1883)***	(4.0635)***	(4.0685)***	(3.4914)***
Subordinated debt/Total assets		23.6120	24.1684	23.5373	22.0041
		(3.1029)***	(3.3877)***	(3.3287)***	(3.2729)***
Other liabilities/Total assets		-7.3790	-5.9387	-5.9451	-5.6141
		(3.4404)***	(4.0911)***	(4.1714)***	(3.6829)***
C&I loans/Total assets			-1.6225	-1.6529	-1.5139
			(4.0377)***	(4.1485)***	(3.8332)***
Agricultural loans/Total assets			-1.8482	-1.9151	-1.9812
			(4.2057)***	(4.3598)***	(4.5789)***
Individual loans/Total assets			0.0646	0.0790	0.0588
			(0.1607)	(0.1978)	(0.1506)
Real estate loans/Total assets			0.6243	0.6161	0.6214
			(1.5734)	(1.5664)	(1.6149)
Depositor preference law				0.0895	0.0873
				(1.7933)*	(1.7491)*
Personal Income Growth (lagged)					2.4948
					(2.5798)***
Bankruptcy Growth Rate					-0.7044
					(4.3396)***
Unemployment Rate					-0.0238
					(1.7039)*
Observations	456857	444315	444315	444315	443823
Number of banks	13884	13884	13884	13884	13870
Number of failures	922	903	903	903	903
AIC	2253.704	2037.574	1904.514	1903.011	1876.775
Log likelihood function	-1118.852	-1003.786	-933.256	-931.505	-915.387

We report duration models with time-varying covariates based on the log-logistic distribution in column (1) - (5) for the period 1982 - 1996. The dependent variable is the log of time to failure. Specification (1) contains variables used in previous studies and a dummy that takes on the value one if the observation is from the period following enactment of the Federal Deposit Insurance Corporation Improvement Act in 1991. Specification (2) includes covariates that capture the funding structure. Additional control variables are included in Specification (3) to capture composition of the loan portfolio. We incorporate a dummy variable for depositor preference in Specification (4) that takes the value one if depositor preference law is in place or zero otherwise. Specification (5) additionally includes variables that capture the macroeconomic setting on the federal state level. Robust standard errors are reported in parentheses. Significance levels of 1, 5 and ten percent are indicated by ***, **, and *.

The set of explanatory variables includes regressors that capture liability structure, composition of the loan portfolio, variables that provide information on the macroeconomic environment on the federal state level, and a dummy that takes on the value one if the observation is from the period following enactment of FDICIA or zero otherwise. We also include a dummy that takes on the value one if the federal state had depositor preference law in place at the time of the observation or zero otherwise. The log of total assets is included to control for bank size. We augment these specifications by additional variables to capture information that is commonly used by bank supervisors to predict failures of depositories. Bank supervisors refer to these variables as CAMEL[93] variables. We use the ratio capital to total assets as a proxy for the level of capitalization. The variable troubled assets is calculated as the sum of real estate owned and loans past due over total assets to measure asset quality. The ratio of operating income to total assets is used as proxy for earnings. We capture the effect of liquidity with a variable that is calculated as the sum of securities and cash over total assets. We do not include a proxy for management quality as this would require detailed qualitative information not contained in publicly available Call Reports. The results of the AFT models are to be interpreted as follows: A positive coefficient indicates a decelerating effect of the variable on time to failure whereas a negative coefficient indicates shortened survival time.

Specification (1) in Table 4.5. is our canonical model that only uses a parsimonious set of variables based on previous studies of bank failure, augmented by the FDICIA dummy. Four of the six regressors are significant at the one percent level and show the anticipated sign. Unsurprisingly, banks with a large proportion of troubled assets tend to fail faster. The proxies for capitalization and liquidity enter the equation with a positive sign, indicating increased survival time. Clearly, better capitalized banks are better able to absorb shocks. Similarly, more liquid institutions are in a better position to accommodate sudden cash outflows than less liquid depositories. The positive coefficient of the proxy

[93] CAMEL is an acronym for components of the regulatory rating system employed to assess soundness of financial institutions: Capital adequacy, Asset quality, Management, Earnings, and Liquidity. The rating system has been augmented in 1997 by adding a component that captures Sensitivity to market risk. The system is therefore now referred to as CAMELS rating system. The ratings assigned to banks range from 1 - 5, whereby 1 denotes a sound institution and banks rated 5 are considered extremely risky and unsound.

for bank size indicates that larger banks exhibit increased survival time. This may be due to their ability to reap benefits from diversification.

We introduce variables that capture funding structure in Specification (2). This augmented specification not only underscores a considerable impact of funding structure on time to failure, but also highlights the presence of omitted variable bias in Specification (1). The magnitude of our measure for capitalization used in the canonical model declines approximately 20 percent upon controlling for liability structure in Specification (2). The ratio of Fed funds to total assets enters the equation at the one percent level with a negative sign. This result empirically substantiates that banks funded by such deposits tend to fail faster. This is aligned with research on market discipline: Fed funds are not insured and holders of uninsured claims tend to withdraw their funds from ailing institutions as documented in several studies (e.g. Goldberg and Hudgins, 1996, 2002; Jordan, 2000; Davenport and McDill, 2006). In this respect, our findings can be interpreted as empirical evidence for the presence of market discipline. Cash outflows in seriously troubled banks may not longer be offset by either substituting uninsured deposits or by offering higher interest rates. Indeed, Maechler and McDill (2006) show that particularly weak banks, i.e. banks with CAMEL ratings 4 or 5, face severe constraints in offsetting declines in uninsured deposits by offering higher interest rates. This indicates a potentially non-linear relationship between bank risk and the cost of uninsured funds. Furthermore, banks obviously trying to circumvent market discipline might attract additional regulatory scrutiny and regulators may be ultimately forced to act and close these institutions faster.

The ratio of transactions deposits to total assets enters positively at the one percent level, suggesting that more transactions deposits tend to increase time to failure. This result can be explained with the fact that transactions deposits are a proxy for a bank's charter value. Higher bank charter values are likely to encourage prudent behaviour by bank managers, thus curtailing risk-taking behaviour and increasing time to failure.

The ratio of brokered deposits to total assets enters the equation negatively at the one percent level. It is well documented that liability shifting occurs prior to the failure of depositories (e.g. Marino and Bennett, 1999). Although FDICIA limits the use of brokered deposits by critically undercapitalized banks, institutions not subject to this classification may be nevertheless able to turn to brokered deposits to compensate

outflows of other types of deposits. To the extent to which these deposits are insured, they are not priced according to the borrower's default risk. Thus, use of brokered deposits can be interpreted as evidence of distress such that the regulator's propensity to close a troubled bank faster increases.

Similarly, the ratios time and savings deposits, and demand deposits to total assets adversely impact upon time to failure and assume statistical significance at the one percent level. These variables capture both insured and uninsured deposits. Thus, to the extent they capture uninsured deposits such as jumbo CDs, the results indicate that uninsured depositors withdraw their funds in the run-up to failure. However, there is also good reason to believe that deposits covered by deposit insurance can shorten time to failure. First, recent evidence by Davenport and McDill (2006) suggests that the majority of deposits withdrawn from ailing banks are fully insured. Second, Park and Peristiani (1998) underscore that insured depositors may be unwilling to supply funds to banks if they become aware of an impending failure. For instance, they argue that even insured depositors may be reluctant to supply funds to ailing institutions, which, in turn, could accelerate time to failure. Park and Peristiani (1998) also find adverse effects of bank risk on the pricing and growth of insured deposits and propose that insured depositors may be concerned about the insurer's solvency or try to avoid other indirect costs arising from the delay in deposit redemption after failure.

The ratio of subordinated debt to total assets exhibits a positive and significant sign suggesting that reliance on subordinated debt increases survival time. This may be explained with a signaling effect: an institution's ability to attract subordinated debt could indicate that they are less risky and that large and sophisticated debt holders with advanced monitoring abilities are willing to lend to these institutions. Moreover, the typically longer maturity of these liabilities means that these liabilities cannot exit the bank at short notice.

The remaining category that captures other liabilities to total assets enters negatively and significantly at the one percent level. These liabilities are not insured and creditors have therefore an incentive to obtain their funds prior to failure. All our control variables found to be significant in Specification (1) remain significant in Specification (2).

To test robustness of these results, we include additional control variables in Specifications (3), (4) and (5). In Specification (3), we additionally employ several variables that capture composition of the loan portfolio. While controlling for additional variables decreases the magnitude of several coefficients, our results regarding the funding structure are robust. Among the additional control variables, the ratios of C&I loans and agricultural loans to total assets enter with a significant and negative coefficient, suggesting lending in these areas shortens survival time. Depositor preference law, included in Specification (4), increases time to failure significantly. This may be due to depositor's lower propensity to run when such law is in place. Finally, Specification (5) indicates that the macroeconomic environment has indeed some bearing on failure time. As anticipated, a weaker macroeconomic setting, reflected in higher bankruptcy growth rates and higher rates of unemployment shortens time to failure of banks whereas an economic upswing, proxied by personal income growth, will increase time to failure. Both the log likelihood function and the Akaike Information Criterion indicate that Specification (5) is the most appropriate setup for our AFT model.

To verify our results, we perform an additional robustness test by examining whether the timing of the onset of risk impacts our inferences. This additional test redefines the onset of risk for each institution to be the period when the ratio of equity capital to total assets falls below eight percent.[94] The results are virtually identical to those reported in Table 4.5., see Appendix 4.C.

In sum, the findings from our AFT model provide empirical evidence that controlling for liability structure when estimating time to failure increases the explanatory power of the presented model. Our results indicate the presence of market discipline: uninsured liabilities such as Fed funds decrease time to failure. In addition, our findings are suggestive for a substitution effect of uninsured deposits with insured liabilities such as brokered deposits. Similarly, time and savings deposits, and demand deposits are found to adversely impact survival time of financial institutions. These results suggest that not only holders of uninsured credits but also insured depositors are a source of market discipline.

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[94] The eight percent ratio is chosen since prompt corrective action capital guidelines in FDICIA necessitate regulatory action such as increased monitoring or restrictions on asset growth when the (risk-based) capital ratio falls below eight percent.

In terms of policy implications, the findings suggest that liability structure deserves more attention by regulatory bodies. Monitoring of the behaviour of certain types of deposits can provide better insights into time to failure of financial institutions. Moreover, applying capital charges to liabilities that tend to leave a bank faster might curb depositories' risk-taking behaviour. Pillar 3 of the new Basel Capital Accord currently neglects disclosure of insured and uninsured deposits.[95] In light of our findings, disclosing the levels of insured and uninsured deposits to the public may further enhance market discipline.

4.4. Concluding Remarks

This chapter analyses the extent to which bank liability structure impacts on the deposit insurer's loss in case of failure of individual financial institutions and how bank liability structure affects time to failure. These questions are pertinent to the estimation of loss given default since depositories' liability structure not only determines which depositors have to be compensated in case of failure but also impacts upon financial institutions' risk-taking behaviour.

Using quantile regression analysis that permits taking account of the non-normal distribution of the deposit insurer's losses incurred from bank failures, we explore how the deposit insurer's loss varies across the distribution and illustrate its sensitivity towards several explanatory variables across different quantiles. This examination is beneficial for bank regulators, supervisory agencies and deposit insurers as they are particularly concerned about high-cost failures. Our analysis extends previous work in that it presents empirical evidence for non-linear relationships between losses and a number of explanatory variables. To that extent, our findings highlight the shortcomings associated with standard econometric techniques due to the better use of the information in the sample distribution. The discovered non-linearities are not surprising: failed depositories exhibit different characteristics regarding bank type, business activities and size that all impact upon the deposit insurer's loss. In particular, we present evidence that losses are

[95] Neither the Consultative Document Pillar 3 (Market Discipline), (Basel Committee on Banking Supervision, 2001a), nor the Working Paper on Pillar 3 - Market discipline, (Basel Committee on Banking Supervision, 2001b) mention disclosure rules with respect to financial institutions' liability/deposit structure regarding their status of deposit insurance. This insufficient consideration of bank liability structure in the context of market discipline in general and deposit insurance in particular is also documented in Pennacchi (2005), who underscores that the Third Consultative Paper on the new Basel Capital Accord (Basel Committee on Banking Supervision, 2003) contains no reference to deposit insurance.

not homogeneously driven by the same set of determinants. C&I loans, uncollected income, and a weak macroeconomic environment are main determinants for very costly bank failures.

Investigating the nexus between liability structure and time to failure, we offer evidence for the presence of depositor discipline: uninsured liabilities such as Fed funds decrease time to failure. Brokered deposits, time and savings, and demand deposits are also found to adversely impact survival time of financial institutions. To the extent to which insured deposits decrease survival time, we assign this finding to market discipline arising from insured depositors and to liability shifting of troubled banks. These results are robust to controlling for numerous covariates that capture bank asset quality and the composition of the failed institutions' loan portfolio. Furthermore, performing a sensitivity check that redefines the onset of risk for the banks in the sample yields virtually identical results. Finally, the results from our AFT model provide empirical evidence that consideration of bank liability structure when estimating time to failure of financial institutions increases the explanatory power of the presented model.

The findings regarding time to failure bear important policy implications. If banks that are heavily reliant on short-term and uninsured funds tend to fail faster, there is a case to make them subject to additional means of prompt corrective action. The monitoring of ailing financial institutions should therefore be extended to their use of certain types of deposits. Moreover, while Pillar 3 in the Basel II framework underscores disclosure as an integral component to enhance market discipline, it widely ignores financial institutions' liability structure. Thus, our findings indicate that disclosure of the levels of insured and uninsured deposits could further strengthen depositor discipline. In addition, capital charges may be appropriate for certain types of liabilities to police institutions against risk-taking behaviour.

One caveat remains. Since quantile regression conditions on the dependent variable its use as a predictive tool is limited. Nonetheless, this study points out that there exist systematic differences between the factors that drive high-cost and low-cost failures. Thus, to that extent, our results suggest closer monitoring of certain categories of the loan portfolio of weak depositories to mitigate the losses that will arise to the deposit insurer when these ailing institutions eventually fail.

Our analysis focuses on the non-linear effect of certain variables on the deposit insurer's loss and on the impact of liability structure on time to failure. Future research could build on these results and examine the link between time to failure and the loss variable and evaluate the implications for the regulatory environment in greater detail.

Data Appendix

Depositor Preference Laws

State	Date effective
Alaska	October 15, 1978
Arizona	September 21, 1991
California	June 27, 1986
Colorado	May 1, 1987
Connecticut	May 22, 1991
Florida	July 3, 1992
Georgia	1974[a]
Hawaii	June 24, 1987
Idaho	1979[b]
Iowa	January 1, 1970
Kansas	July 1, 1985
Louisiana	January 1, 1985
Maine	April 16, 1991
Minnesota	April 24, 1990
Missouri	September 1, 1993
Montana	1927[c]
Nebraska	1909[c]
New Hampshire	June 10, 1991
New Mexico	June 30, 1963
North Dakota	July 1, 1987
Oklahoma	May 26, 1965
Oregon	January 1, 1974
Rhode Island	February 8, 1991
South Dakota	July 1, 1969
Tennessee	1969[c]
Utah	1983[c]
Virginia	July 1, 1983
West Virginia	May 11, 1981

a. Legislation became effective on either January 1 or July 1.
b. Passed by both houses of the state legislature on July 1; enactment date is unclear.
c. Neither the month nor the day of enactment is available.
SOURCE: Osterberg (1996)

Appendix 4.A. Correlation Matrix

	Loss on assets (log)	Total assets (log)	Real estate owned	Equity	Loans past due	Uncollected income	Asset growth in percent	C&I loans	Agricultural loans	Real estate loans	Individual loans	Fed funds	Demand deposits	Brokered deposits	Transactions deposits	Time and savings deposits	Subordinated debt	Other liabilities
Loss on assets (log)	1.00																	
Total assets (log)	0.61***	1.00																
Real estate owned	0.28***	0.13***	1.00															
Equity	-0.17***	-0.01	-0.32***	1.00														
Loans past due	0.04	-0.18***	0.01	-0.04	1.00													
Uncollected income	-0.08***	-0.40***	-0.15***	0.12***	0.47***	1.00												
Asset growth in percent	0.03	0.05*	-0.23***	0.28***	-0.04	0.07***	1.00											
C&I loans	0.21***	-0.07**	-0.06**	-0.11***	0.12***	0.10***	0.05*	1.00										
Agricultural loans	-0.26***	-0.37***	-0.24***	0.19***	0.14***	0.65***	0.01	-0.20***	1.00									
Real estate loans	0.35***	0.50***	0.28***	-0.20***	-0.06*	-0.31***	-0.09***	-0.20***	-0.44***	1.00								
Individual loans	-0.12***	-0.17***	-0.14***	-0.02	0.08***	-0.02	0.12***	-0.01	-0.17***	-0.26***	1.00							
Fed funds	0.26***	0.23***	0.00	-0.11***	-0.06**	-0.07**	0.02	0.13***	-0.09***	0.05*	-0.06*	1.00						
Demand deposits	-0.14***	-0.08***	0.01	-0.14***	-0.09***	-0.22***	-0.15***	0.17***	-0.22***	-0.10***	0.06**	-0.01	1.00					
Brokered deposits	0.22***	0.12***	0.08***	-0.22***	0.09***	-0.02	0.11***	0.12***	-0.14***	0.16***	0.06**	0.08***	-0.09***	1.00				
Transactions deposits	-0.27***	-0.16***	0.00	-0.07**	-0.11***	-0.13***	-0.16***	0.00	-0.05*	-0.16***	0.00	-0.11***	0.74***	-0.19***	1.00			
Time and savings deposits	0.05	-0.03	0.15***	-0.50***	0.11***	0.07**	-0.05*	-0.10***	0.06**	0.15***	0.00	-0.24***	-0.62***	0.19***	-0.42***	1.00		
Subordinated debt	0.16***	0.22***	0.01	0.02	-0.03	-0.03	-0.02	0.04	-0.05	0.06**	-0.06*	0.14***	0.01	0.00	-0.05	-0.11***	1.00	
Other liabilities	0.28***	0.22***	0.09***	-0.12***	-0.04	0.00	-0.07**	0.02	-0.03	0.14***	-0.08***	0.20***	-0.14***	0.05	-0.19***	-0.25***	0.07***	1.00

All variables normalized by total assets unless otherwise stated.

Panel B: State level variables and dummy variables

	Loss on assets	Depositor preference law dummy	FDICIA dummy	Unemployment rate	Personal income growth (lagged)	Bankruptcy growth rate
Loss on assets	1.00					
Depositor preference law dummy	-0.10***	1.00				
FDICIA dummy	0.06**	0.18***	1.00			
Unemployment rate	0.24***	-0.02	-0.02	1.00		
Personal income growth (lagged)	0.07**	-0.12***	-0.02	0.01	1.00	
Bankruptcy growth rate	0.16***	-0.05*	-0.10***	0.17***	0.57***	1.00

Significance levels of 1, 5 and ten percent are indicated by ***, **, and *.

Appendix 4.B. Overview of fraud cases, cross-guarantee failures and multi-bank holding company failures (Information based on publicly available data)

Panel A: Fraud Cases

Bank	Location	Source
INDIAN SPRINGS STATE BANK	KANSAS CITY, KS	Gup (1995)
THE REXFORD STATE BANK	REXFORD, KS	Gup (1995)
THE AURORA BANK	AURORA, CO	Gup (1995)
FIRST COMMERCIAL BANK OF TEXAS	HOUSTON, TX	Gup (1995)
METROBANK OF PHILADELPHIA	PHILADELPHIA, PA	FDIC press release
FIRST NB OF THE PANHANDLE	PANHANDLE, TX	FDIC press release
BESTBANK	BOULDER, CO	FDIC press release
FIRST NB OF KEYSTONE	KEYSTONE, WV	FDIC press release
VICTORY STATE BANK	COLUMBIA, SC	FDIC press release
BANK OF FALKNER	FALKNER, MS	FDIC press release
OAKWOOD DEPOSIT BANK	OAKWOOD, OH	FDIC press release
CONNECTICUT BANK OF COMMERCE	STAMFORD, CT	FDIC press release

Panel B: Cross-guarantee Failures

Bank	Location	Source
FIRST REPUBLICBANK-MIDLAND, N.A.	MIDLAND, TX	FDCI press release
FIRST REPUBLICBANK-EL PASO, N.A.	EL PASO, TX	FDCI press release
FIRST REPUBLICBANK-WILLIAMSON CN	AUSTIN, TX	FDCI press release
FIRST REPUBLICBANK-MALAKOFF, N.A	MALAKOFF, TX	FDCI press release
FIRST REPUBLICBANK-SAN ANTONIO	SAN ANTONIO, TX	FDCI press release
FIRST REPUBLICBANK-HILLSBORO	HILLSBORO, TX	FDCI press release
FIRST REPUBLICBANK-CLEBURNE, N.A	CLEBURNE, TX	FDCI press release
FIRST REPUBLICBANK-LUFKIN	LUFKIN, TX	FDCI press release
FIRST REPUBLICBANK-STEPHENVILLE	STEPHENVILLE, TX	FDCI press release
FIRST REPUBLICBANK-TYLER, N.A.	TYLER, TX	FDCI press release
FIRST REPUBLICBANK-WACO, N.A.	WACO, TX	FDCI press release
FIRST REPUBLICBANK-WICHITA FALLS	WICHITA FALLS, TX	FDCI press release
FIRST REPUBLICBANK-GREENVILLE	GREENVILLE, TX	FDCI press release
FIRST REPUBLICBANK-HARLINGEN	HARLINGEN, TX	FDCI press release
FIRST REPUBLICBANK-HENDERSON	HENDERSON, TX	FDCI press release
FIRST REPUBLICBANK-LUBBOCK, N.A.	LUBBUCK, TX	FDCI press release
FIRST REPUBLICBANK-MINERAL WELLS	MINERAL WELLS, TX	FDCI press release
FIRST REPUBLICBANK-MT. PLEASANT	MT. PLEASANT, TX	FDCI press release
FIRST REPUBLICBANK-ODESSA, N.A.	ODESSA, TX	FDCI press release
FIRST REPUBLICBANK-PLANO, N.A.	PLANO, TX	FDCI press release
FIRST REPUBLICBANK-RICHMOND, N.A	RICHMOND, TX	FDCI press release
FIRST REPUBLICBANK-VICTORIA	VICTORIA, TX	FDCI press release
FIRST REPUBLICBANK-JEFFERSON	BEAUMONT, TX	FDCI press release
FIRST REPUBLICBANK-A&M	COLLEGE STN,TX	FDCI press release
FIRST REPUBLICBANK-PARIS	PARIS, TX	FDCI press release
FIRST REPUBLICBANK-CLIFTON	CLIFTON, TX	FDCI press release
FIRST REPUBLICBANK-FORNEY	FORNEY, TX	FDCI press release
FIRST REPUBLICBANK-TEMPLE, N.A.	TEMPLE, TX	FDCI press release
FIRST REPUBLICBANK-ABILENE, N.A.	ABILENE, TX	FDCI press release
FIRST REPUBLICBANK- AUSTIN, N.A.	AUSTIN, TX	FDCI press release
FIRST REPUBLICBANK-BROWNWOOD	BROWNWOOD, TX	FDCI press release
FIRST REPUBLICBANK-CONROE, N.A.	CONROE, TX	FDCI press release
FIRST REPUBLICBANK-CORSICANA	CORSICANA, TX	FDCI press release
FIRST REPUBLICBANK-DENISON, N.A.	DENISON, TX	FDCI press release
FIRST REPUBLICBANK-ENNIS, N.A.	ENNIS, TX	FDCI press release
FIRST REPUBLICBANK-FT. WORTH	FT. WORTH, TX	FDCI press release
FIRST REPUBLICBANK-GALVESTON	GALVESTON, TX	FDCI press release
FIRST CITY, TEXAS - BEAR CREEK	HARRIS COUNTY, TX	FDCI press release
FIRST CITY, TEXAS - SAN ANTONIO	SAN ANTONIO, TX	FDCI press release
FIRST CITY, TEXAS - NORTHWEST	AUSTIN, TX	FDCI press release
FIRST CITY, TEXAS - FORT WORTH	FORT WORTH, TX	FDCI press release
FIRST CITY, TEXAS - PLANO	PLANO, TX	FDCI press release
FIRST CITY, TEXAS - CENTRAL PARK	SAN ANTONIO, TX	FDCI press release
FIRST CITY, TEXAS - LANCASTER	LANCASTER, TX	FDCI press release

Panel B: Cross-guarantee failures (cont'd)

Bank	Location	Source
FIRST CITY, TEXAS - ARANSAS PASS	ARANSAS PASS, TX	FDCI press release
FIRST CITY, TEXAS - COLLEYVILLE	COLLEYVILLE, TX	FDCI press release
FIRST CITY, TEXAS - BELLAIRE	BELLAIRE, TX	FDCI press release
FIRST CITY, TEXAS - CORPUS CHRISTI	CORPUS CHRISTI, TX	FDCI press release
FIRST CITY, TEXAS - CENTRAL ARLI NGTON	ARLINGTON, TX	FDCI press release
FIRST CITY, TEXAS - FOREST HILL	FOREST HILL, TX	FDCI press release
FIRST CITY, TEXAS - ARLINGTON	ARLINGTON, TX	FDCI press release
FIRST CITY, TEXAS - LAKE JACKSON	LAKE JACKSON, TX	FDCI press release
FIRST CITY, TEXAS - GRAND PRAIRIE	GRAND PRAIRIE, TX	FDCI press release
FIRST CITY, TEXAS - EL PASO	EL PASO, TX	FDCI press release
FIRST CITY, TEXAS - KOUNTZE	KOUNTZE, TX	FDCI press release
FIRST CITY, TEXAS - ALICE	ALICE, TX	FDCI press release
FIRST CITY, TEXAS - FARMERS BRANCH	FARMERS BRANCH, TX	FDCI press release
FIRST CITY, TEXAS - GATEWAY	BEAUMONT, TX	FDCI press release
FIRST CITY, TEXAS - CENTRAL	BEAUMONT, TX	FDCI press release
FIRST CITY, TEXAS - GARLAND	GARLAND, TX	FDCI press release
FIRST CITY, TEXAS - WINDSOR PARK	SAN ANTONIO, TX	FDCI press release
FIRST CITY, TEXAS - SOUR LAKE	SOUR LAKE, TX	FDCI press release
FIRST CITY, TEXAS - LEWISVILLE	LEWISVILLE, TX	FDCI press release
FIRST CITY, TEXAS - HUMBLE	HUMBLE, TX	FDCI press release
FIRST CITY, TEXAS - AUSTIN	AUSTIN, TX	FDCI press release
FIRST CITY, TEXAS - SAN ANGELO	SAN ANGELO, TX	FDCI press release
FIRST CITY, TEXAS - TYLER	TYLER, TX	FDCI press release
FIRST CITY, TEXAS - RICHMOND	RICHMOND, TX	FDCI press release
FIRST CITY, TEXAS - ORANGE	ORANGE, TX	FDCI press release
FIRST CITY, TEXAS - LUFKIN	LUFKIN, TX	FDCI press release
FIRST CITY, TEXAS - MADISONVILLE	MADISONVILLE, TX	FDCI press release
FIRST CITY, TEXAS - MIDLAND	MIDLAND, TX	FDCI press release
FIRST CITY, TEXAS - GRAHAM	GRAHAM, TX	FDCI press release
FIRST CITY, TEXAS - BRYAN	BRYAN, TX	FDCI press release
FIRST CITY, TEXAS - BEAUMONT	BEAUMONT, TX	FDCI press release
FIRST CITY, TEXAS - RICHARDSON	RICHARDSON, TX	FDCI press release
BANK OF NEW ENGLAND	BOSTON, MA	FDCI press release
THE CONNECTICUT BANK & TRUST	HARTFORD, CT	FDCI press release
MAINE NATIONAL BANK	PORTLAND, ME	FDCI press release
SOUTHEAST BANK OF WEST FLORIDA	PENSACOLA, FL	FDCI press release
THE MERIDEN TRUST AND SAFE DEP.	MERIDEN, CT	FDCI press release

Panel C: Multi-bank holding company failures

Bank	Location	Source
MBANK THE WOODLANDS, NATIONAL AS.	WOODLANDS, TX	FDCI press release
MBANK HOUSTON, NATIONAL AS.	HOUSTON, TX	FDCI press release
MBANK ABILENE, NATIONAL AS.	ABILENE, TX	FDCI press release
MBANK MIDCITIES, NATIONAL AS.	ARLINGTON, TX	FDCI press release
MBANK DENTON COUNTY, NATIONAL AS.	LEWISVILLE, TX	FDCI press release
MBANK ODESSA, NATIONAL AS.	ODESSA, TX	FDCI press release
MBANK ORANGE, NATIONAL AS.	ORANGE, TX	FDCI press release
MBANK ROUND ROCK, NATIONAL AS.	ROUND ROCK, TX	FDCI press release
MBANK JEFFERSON CTY, NATIONAL AS.	PORT ARTHUR, TX	FDCI press release
MBANK ALAMO, NATIONAL AS.	SAN ANTONIO, TX	FDCI press release
MBANK SHERMAN, NATIONAL AS.	SHERMAN, TX	FDCI press release
MBANK WICHITA FALLS, NATIONAL AS.	WICHITA FALLS, TX	FDCI press release
MBANK AUSTIN, NATIONAL AS.	AUSTIN, TX	FDCI press release
MBANK BRENHAM, NATIONAL AS.	BRENHAM, TX	FDCI press release
MBANK GREENVILLE, NATIONAL AS.	GREENVILLE, TX	FDCI press release
MBANK LONGVIEW, NATIONAL AS.	LONGVIEW, TX	FDCI press release
MBANK MARSHALL, NATIONAL AS.	MARSHALL, TX	FDCI press release
MBANK FORT WORTH, NATIONAL AS.	FORT WORTH, TX	FDCI press release
MBANK CORSICANA, NATIONAL AS.	CORSICANA, TX	FDCI press release
MBANK DALLAS, NATIONAL AS.	DALLAS, TX	FDCI press release
TEXAS AMERICAN BANK/FARMERS B.	FARMERS B.., TX	FDCI press release
TEXAS AMERICAN BANK/LBJ, NATIONA	DALLAS, TX	FDCI press release
TEXAS AMERICAN BANK/PRESTONWOOD,	DALLAS, TX	FDCI press release
TEXAS AMERICAN BANK/RICHARDSON	RICHARDSON, TX	FDCI press release
TEXAS AMERICAN BANK/LONGVIEW, NA	LONGVIEW, TX	FDCI press release

Panel C: Multi-bank holding company failures (con'td)		
Bank	Location	Source
TEXAS AMERICAN BANK/GREATER S.	GRAND PRAIRIE, TX	FDCI press release
TEXAS AMERICAN BANK/PLANO	PLANO, TX	FDCI press release
TEXAS AMERICAN BANK/SOUTHWEST	STAFFORD, TX	FDCI press release
TEXAS AMERICAN BANK/TYLER	TYLER, TX	FDCI press release
TEXAS AMERICAN BANK/FORUM	ARLINGTON, TX	FDCI press release
TEXAS AMERICAN BANK/TEMPLE	TEMPLE, TX	FDCI press release
TEXAS AMERICAN BANK/MIDLAND	MIDLAND, TX	FDCI press release
TEXAS AMERICAN BANK/GALLERIA	HOUSTON, TX	FDCI press release
TEXAS AMERICAN BANK/WICHITA FALLS	WICHITA FALLS, TX	FDCI press release
TEXAS AMERICAN BANK/DUNCANVILLE	DUNCANVILLE, TX	FDCI press release
TEXAS AMERICAN BANK/BRECKENRIDGE	BRECKENRIDGE, TX	FDCI press release
TEXAS AMERICAN BANK/AMARILLO	AMARILLO, TX	FDCI press release
TEXAS AMERICAN BANK/DALLAS	DALLAS, TX	FDCI press release
TEXAS AMERICAN BANK/LEVELLAND	LEVELLAND, TX	FDCI press release
TEXAS AMERICAN BANK/AUSTIN	AUSTIN, TX	FDCI press release
TEXAS AMERICAN BANK/DENISON	DENISON, TX	FDCI press release
TEXAS AMERICAN BANK/FORT WORTH	FORT WORTH, TX	FDCI press release
TEXAS AMERICAN BANK/FREDERICKSB.	FREDERICKSB., TX	FDCI press release
TEXAS AMERICAN BANK/MCKINNEY	MCKINNEY, TX	FDCI press release

Appendix 4.C. Duration model with alternative onset of risk (Equity ratio < 8 percent)

Duration model	
Equity/Total assets	5.4210
	(15.9534)***
Troubled assets/Total assets	-1.7934
	(9.1075)***
Operating income/Total assets	0.2261
	(1.6420)
Total assets (deflated)	0.0682
	(12.4008)***
FDICIA dummy	0.0230
	(1.5094)
Liquidity/Total assets	0.2777
	(4.5763)***
Fed funds purchased/Total assets	-0.4847
	(2.3528)**
Brokered deposits/Total assets	-0.6138
	(4.4438)***
Transactions deposits/Total assets	0.3054
	(3.6418)***
Time and savings deposits/Total assets	-0.3858
	(1.9883)**
Demand deposits/Total assets	-0.6060
	(2.6951)***
Subordinated debt/Total assets	3.7433
	(3.3411)***
Other liabilities/Total assets	-0.7136
	(3.1020)***
C&I loans/Total assets	-0.2738
	(4.0767)***
Agricultural loans/Total assets	-0.3234
	(4.4882)***
Individual loans/Total assets	0.0416
	(0.6071)
Real estate loans/Total assets	0.1324
	(1.9437)*
Depositor preference law	0.0187
	(2.1533)**
Personal Income Growth (lagged 2 years)	0.3879
	(2.2983)**
Bankruptcy Growth Rate	-0.1538
	(5.5242)***
Unemployment Rate	-0.0082
	(3.4286)***
Observations	443823
Number of banks	13870
Number of failures	903
AIC	-1398.391
Log likelihood function	722.19568

Robust z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.
Coefficients reported in the accelerated failure time metric.

Chapter V

CONCLUSION

5. INTRODUCTION

This final chapter provides overall concluding remarks for each one of the three preceding chapters. In particular, this conclusion not only highlights the individual chapters' idiosyncratic contributions to the literature but also acknowledges the limitations of the chosen methods. Finally, this chapter reiterates public policy implications of the presented research and offers a variety of avenues for future research.

5.1. CHAPTER II: ARE MORE COMPETITIVE BANKING SYSTEMS MORE STABLE?

Chapter II provides the 'point of departure' for the analysis of the link between bank market structure, competition and bank soundness. While previous studies heavily draw upon measures of concentration to proxy the degree of competition in banking systems, this chapter offers the first empirical analysis of the relationship between a direct measure of competitive conduct of financial institutions, the Panzar and Rosse (1987) H-Statistic, and systemic risk in a cross-country setting. This chapter additionally presents a methodological advancement in the literature on systemic financial crises in that it not only uses the widely used logit modelling technique but also employs duration analysis to investigate the effect of competition on the timing of systemic crises. Furthermore, this research helps disentangle the impact of concentration and competition on systemic risk and finally considers the impact of the regulatory and institutional environment on the timing of systemic banking problems.

Using a dataset consisting of 38 countries that experienced 28 systemic banking crises over the sampling period 1980 - 2003, this chapter presents evidence that higher degrees of competition are associated with a lower probability of observing systemic crises and an increasing survival time of banking systems. This finding is insensitive to using numerous alternative samples, different methods for the coding of the macroeconomic control variables, several alternative sampling periods, and explicitly controlling for the depth of the banking system and competition arising from stock markets. Moreover, the core result for the positive effect of competition on banking system soundness is corroborated when a broad set of institutional and regulatory control variables is accounted for. The empirical analysis further suggests that concentration has no significant bearing on the probability and the timing of systemic crises. To this extent, the results cast serious doubt on previous

research that suggests concentrated banking systems are more stable. Thus, the findings present empirical evidence in a cross-country setting that concentration and competition embody different characteristics of banking systems.

In terms of economic magnitude, the results indicate that a one standard deviation increase in competition tends to decrease the probability of suffering a systemic crisis by 1.8 percent. This is considerable, given that the overall crisis probability in the dataset is below 5 percent.

5.2. CHAPTER III: COMPETITION, CONCENTRATION AND BANK SOUNDNESS: NEW EVIDENCE FROM THE MICRO-LEVEL.

Chapter III builds upon the results obtained in Chapter II and extends the analysis of the nexus between competition, market structure and bank soundness to the bank level, thereby adding an additional dimension to the study of this important relationship. To this end, this chapter tests the hypothesis that increased competition among financial institutions, measured by the Panzar and Rosse (1987) H-Statistic, provides incentives for banks to hold higher levels of capital as a buffer against default. Importantly, this chapter also stresses a previously neglected endogeneity problem in the literature on concentration, competition and bank soundness, highlighting that concentration, competition and the proxy for bank soundness are jointly determined. Furthermore, this chapter sheds new light on the association of capital ratios with the level of concentration in banking systems and finally offers insights into the impact of characteristics of the wider financial system and the institutional and regulatory environment on bank capital ratios.

Drawing upon a large dataset with more than 8,500 bank-year observations for ten European countries during the period 1999 - 2004, this chapter distinguishes between competitive conduct of small and large banks to account for differences in the way such institutions compete with each other. The estimation procedure using an instrumental variables estimator for panel data with random effects presents robust evidence that financial institutions hold higher capital ratios when operating in a more competitive environment. This effect is only dampened in countries with a high level of economic development and when the banking system is more highly concentrated. A vast array of robustness checks confirms the core result for a positive effect of competition on bank

capital ratios. Precisely, re-estimation the econometric analyses with alternative H-Statistics, alternative measures of concentration, an alternative dependent variable, omission of bank-specific control variables and alternative samples all corroborate the basic result. In two additional extensions, the chapter examines the effect of the wider characteristics of the financial system and of the regulatory and institutional environment on bank capital ratios and again confirms the finding for the positive effect arising from competition on bank capital ratios. However, no consistent relationship between the degree of concentration in banking systems and capital ratios is found. In line with the results presented in Chapter II, these findings therefore indicate a need to re-examine the view that a positive link exists between concentration and bank soundness as highlighted in the earlier literature.

The positive impact of competition on capital ratios is significant. Increasing competition by one percent tends to increase the capital ratio for the median bank in the sample from 5.6 to 5.9 percent.

5.3. CHAPTER IV: BANK LIABILITY STRUCTURE, FDIC LOSS, AND TIME TO FAILURE: A QUANTILE REGRESSION APPROACH.

Chapter IV takes the view of a deposit insurance agency and examines the role of bank liability structure for the deposit insurer's loss in case of bank failure. This is due to the following two reasons: First, liability structure directly impacts upon the deposit insurance scheme's obligations and the deposit insurer's relative position among the failed bank's creditors. Second, liability structure also indirectly affects losses born by the insurer through market discipline and the impact on asset quality. In addition, this chapter introduces a methodological innovation into the banking literature using quantile regression. This is attributable to the fact that deposit insurers are particularly concerned about high-cost failures in terms of absolute dollar value losses. To further investigate the role of bank liability structure, this chapter contains an examination of the impact of bank liability structure on time to failure of individual financial institutions.

Using a sample of more than 1,000 failures of banks in the US between 1984 and 1996, the proposed quantile regression estimator illustrates the sensitivity of the dollar value of losses in different quantiles of the set of explanatory variables. To that extent, these

findings underscore that losses for particularly costly failures are driven by factors that do not necessarily drive less expensive failures. Precisely, the quantile regression results offer evidence that costly failures are strongly influenced by the level of uncollected income in failed banks, and the ratio of commercial and industrial loans to total assets. A weak macroeconomic environment further increases the cost incurred arising from costly bank failures. Regarding the effect of liability structure on time to failure, the results suggest that consideration of bank liability structure not only improves the explanatory power of the proposed model but the findings also indicate that both insured and uninsured depositors are a source of market discipline. This results is aligned with recent evidence of micro-level studies of individual bank failures in the US. This finding is robust to sensitivity checks that take account of the macroeconomic environment which banks operate in and to a further test that redefines the onset of risk for the banks in the sample.

5.4. SUMMARY AND PUBLIC POLICY IMPLICATIONS

This thesis offers several important contributions to the literature on banking stability. To this end, several different econometric approaches (logit analysis, duration analysis, instrumental variable estimation for panel data, and quantile regression technique) and a set of different samples (international, European, and US sample) are employed for the purpose of this thesis.

Throughout Chapter II and Chapter III, robust empirical evidence is found that higher levels of competition tend to go hand in hand with increased banking stability, both on the systemic and on the individual bank level. These results offer initial empirical support in a cross-country setting for what is referred to in the literature review in Chapter II as 'competition-stability' view in theoretical research. Chapter IV focuses on bank liability structure and furthermore aims to disentangle the factors that drive high-cost failures from the factors that drive less expensive failures. In addition, this chapter proposes an alternative way of assessing the role of market discipline. The results indicate that reliance on standard econometric techniques yields inappropriate inferences regarding the impact of certain variables on the deposit insurer's loss given bank default. Moreover, evidence is presented for a disciplinary effect on bank risk arising from insured depositors.

These results give rise to important public policy considerations: First, it is pertinent to note that the robustly positive association between competition and bank soundness in

Chapter II and Chapter III stands in contrast to the extant literature as no evidence is found for a negative trade-off between competition and bank soundness. While the established literature considerably influenced bank regulation and supervision regarding restrictions imposed on competitive conduct of financial institutions, the results offered in this thesis indicate that there is no compelling reason to restrain bank competition. Rather, the results suggest that competition is positively associated with bank soundness. Consequently, many normative analyses of bank regulation based on the predominant view in the literature may need to be re-evaluated. Se cond, the results presented in Chapter IV have implications for deposit insurers, supervisory agencies and bank regulators. The varying impact on the deposit insurer's loss of certain variables that capture information about the loan portfolio indicates that composition of the lending portfolio and classification of assets deserve more regulatory scrutiny. Third, the findings regarding time to failure furthermore suggest that banks that are increasingly reliant on short-term unsecured credits might have to be subject to additional means of prompt corrective action. Moreover, the monitoring of financial institutions should be extended to their use of certain types of deposits. Finally, Chapter IV points out serious omissions in Pillar 3 of the new Basel Capital Accord. While Pillar 3 is explicitly concerned with disclosure as a means to enhanced market discipline, it is underscored that current disclosure requirements ignore financial institutions' liability structure although disclosure of the levels of insured and uninsured deposits might further strengthen market discipline.

5.5. LIMITATIONS

While this thesis presents very strong results and wide ranging implications for regulatory oversight and industrial organisation of banking systems, a critical assessment and review of the chosen methods and techniques is in order.

The Panzar and Rosse (1987) H-Statistic, employed in Chapter II and Chapter III is known among economists to be sensitive as a measure of competitive conduct.[96] Both chapters therefore contain a large set of robustness tests to examine the sensitivity of the inferences drawn. In addition, it has to be emphasised that different measures of competition often tend to yield different inferences regarding the level of competitive

[96] Discussion between the author and economists at the International Monetary Fund (Martin Cihak) and academics from the University of Amsterdam (Rocco Huang) during the course of this research.

conduct in the banking industry; see Carbo et al. (2006) for additional details. Furthermore, researchers using the H-Statistic ought to be aware of a number of important assumptions. First, the statistic is equal to one in long-run equilibrium only if one or more of the following three assertions holds: i) the bank produces a single output, ii) the production function is homothetic, and iii) factor prices change equally across the observations (Molyneux et al., 1994, 1996).[97] Second, Shaffer (2004a) highlights possible sensitivity of the H-Statistic to the accurate measurement of input prices. Sensitivity checks using alternative ways of computing the H-Statistics used in this thesis are therefore performed.[98] It is therefore advocated in Section 5.6 below that future research is advisable to verify the inferences based on the H-Statistic utilised in this thesis with alternative (non-structural) measures of competitive conduct.

In a similar vein, Chapter II and Chapter III draw upon an array of regulatory and institutional variables that are only available as cross-sectional data. Therefore, a note of caution is appropriate when drawing inferences based on the regressions where these variables enter the econometric analyses.

Finally, the notion of financial, or, more precisely, banking stability is not clear-cut in the literature. For the definition of systemic banking crises a standard approach as pursued in the established literature is therefore employed in this thesis. To measure individual bank stability, a common way of proxying individual bank stability is utilised (see Nier and Baumann, 2006).

Nevertheless, alternative views exist that are more comprehensive than the classification and definition employed in this thesis. For instance, Goodhart (2006, p. 3417) reports that the following alternative definitions of the concept of financial stability have also been proposed:

A. *"The absence of an adverse impact on the real economy from dysfunction in the financial system, or risk thereof [...]*

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[97] While assumption i) and ii) may be inappropriate, there is evidence in the literature and in our data that assumption iii) holds, see also Molyneux et al. (1994, 1996).

[98] See Shaffer (2004a) for the checks undertaken by Claessens and Laeven and Section 3.5. in this thesis for the test undertaken by the author. Note however that Shaffer (2004a) mentions evidence in the 'new empirical industrial organisation literature' that these new measures such as the H-Statistic are generally robust with respect to measurement error of input prices.

B. *[...] (1) Financial stability is the absence of financial crises, and (2) A financial crisis is defined as a sequence of events, or the risk thereof, that impairs credit intermediation or capital allocation."*

Similarly, Allen and Wood (2006) also stress that despite an increased public policy interest in safeguarding financial stability no common agreement has been reached on what constitutes financial stability. They emphasise that financial stability is a macro-economic phenomenon, and argue that an exclusive focus on financial institutions is too narrow.[99] Consequently the research presented in this thesis therefore explicitly analyses banking stability and does not aim to present a holistic view of financial stability.

Furthermore, the duration model in Chapter II assumes a constant hazard rate. Robustness checks are therefore performed with alternative specifications of the hazard rate. However, these additional tests do not markedly change the inferences drawn.

The panel data models presented in Chapter III utilise a random effects specification that assumes no correlation between the explanatory variables and the bank-specific effect. While this is a rigid assumption, the setup with a random effects specification is the only possible way of accounting for numerous time-invariant but important explanatory variables in Chapter III (see also Nier and Baumann, 2006).

Finally, the use of quantile regression in Chapter IV gives rise to one caveat. Quantile regression conditions on the dependent variable. Therefore, its use as a predictive tool is limited. Nevertheless, this chapter points out that there exist systematic differences between the factors that drive costly and low-cost failures. In addition, changing liability structure and different depositor behaviour in the future do not guarantee that the inferences drawn in Chapter IV will hold in the long run.

5.6. AVENUES FOR FUTURE RESEARCH

Any comprehensive research project tends to give rise to additional questions. This thesis is no exception and a number of valuable avenues for future research are therefore proposed.

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[99] In a very recent paper, Illing and Liu (2006) propose a continuous measure of fragility, a so called Financial Stress Index (FSI) for Canada that not only aims to capture vulnerabilities in the banking system but also extends to equity, debt and foreign exchange markets.

First, future work is advisable to investigate in more detail the nature of the relationship between competition and stability in banking. While it is beyond the scope of this thesis, it seems logical to verify the inferences obtained through the use of the Panzar and Rosse (1987) H-Statistic with alternative measures of (non-structural) competition such as the Iwata (1974) or perhaps the Breshanan model (1989) to confirm the results presented in this study.

Second, to address limitations associated with the utilised measure of systemic risk, it appears interesting to draw upon a continuous measure of fragility such as the distance-to-default to validate our inferences. In this context, quantile regression could be employed to focus on the (lower) tail of the distribution of the distance-to-default variable so as to discern the factors that determine particularly short horizons of the distance-to-default.

Third, while this thesis offers robust evidence for a positive impact of competition on bank soundness, it does not aim to understand the transmission mechanism by which increased competition contributes to enhanced soundness. The result presented here may be due to prudent behaviour of bank managers, increased efficiency triggered by a more competitive environment, and the presence of economies of scale. The future research agenda of the author of this thesis therefore embodies an analysis of the link between bank efficiency, competition, and bank soundness.

Fourth, the analysis in Chapter IV stresses the varying effect of a number of variables on the deposit insurer's loss and the impact of bank liability structure on time to failure of individual financial institutions. Future research could model the link between time to failure and the loss variable explicitly and propose detailed means of prompt corrective action arising from the finding of the accelerating effect of certain types of liabilities on time to failure. It is noteworthy to mention that many of these ideas for future research are an integral part of the author's current and future research agenda for the years ahead.

Finally, the result that competition and concentration appear to embody different characteristics of banking systems may be exploited for additional empirical work on the relationship between concentration, competition and access to finance. While there exists a considerable body of literature suggesting that increased concentration and consolidation in banking systems restricts access to finance in particular for small and

medium-sized enterprises (SMEs) (e.g. Berger et al., 1998; Peek and Rosengren, 1998), this adverse effect may be offset by increased competition. The research agenda of the author and two collaborators therefore includes an analysis of the association of market structure, competition and access to finance for SMEs.

BIBLIOGRAPHY

Al-Muharrami, S. K. Matthews, and Y. Khabari (2006) Market structure and competitive conditions in the Arab GCC banking system. Journal of Banking and Finance, Vol. 30, pp. 3487 - 3501

Allen, F., and D. Gale (2004) Competition and financial stability. Journal of Money, Credit, and Banking, Vol. 36 (3), pp. 453 - 480

Allen, F., and D. Gale (2000) Financial contagion. Journal of Political Economy, Vol. 108, pp. 1 - 29

Allen, W.A., and G. Wood (2006) Defining and achieving financial stability. Journal of Financial Stability, Vol. 2, pp. 152 - 172

Ashcraft, A. (2003) Are banks really special? New evidence from the FDIC-induced failure of healthy banks. Federal Reserve Bank of New York Staff Reports, No. 176, December 2003

Ayuso, J., D. Perez, and J. Saurina (2004) Are capital buffers procyclical? Evidence from Spanish panel data. Journal of Financial Intermediation, Vol. 13, pp. 249 - 264

Barth, J. R., P. F. Bartholomew, and M. G. Bradley (1990) Determinants of thrift institution resolution costs. Journal of Finance, Vol. 45, pp. 731 - 754

Barth, J. R., G. Caprio Jr., and R. Levine (2005) Rethinking bank supervision and regulation: Until angels govern. Cambridge: University Press

Barth, J. R., G. Caprio Jr., and R. Levine (2004) Bank regulation and supervision: What works best? Journal of Financial Intermediation, Vol. 13, pp. 205 - 248

Barth, J. R., G. Caprio, Jr., and R. Levine (2001) The regulation and supervision of banks around the world - A new database (Vol.1). World Bank. Mimeo.

Basel Committee on Banking Supervision (2003) The New Basel Capital Accord. Technical report third consultative paper. Basel: Bank for International Settlements

Basel Committee on Banking Supervision (2001a) Consultative document: Pillar 3 (Market Discipline). Basel: Bank for International Settlements

Basel Committee on Banking Supervision (2001b) Working Paper on Pillar 3 - Market Discipline. Basel: Bank for International Settlements

Baumol, W., J. C. Panzar, and R. D. Willig (1982) Contestable markets and the theory of industry structure. New York: Harcourt Brace Jovanovic

Beck, T., A. Demirgüç-Kunt, and R. Levine (2006) Bank concentration, competition, and crises: First results. Journal of Banking and Finance, Vol. 30, pp. 1581 - 1603

Beck, T., A. Demirgüç-Kunt, and R. Levine (forthcoming) Bank Concentration and Fragility: Impact and Mechanics. In: Carey, M. and R. Stulz (forthcoming) The Risks of financial institutions. Cambridge, Massachusetts: National Bureau of Economic Research (forthcoming)

Beck, T., A. Demirgüc-Kunt, and R. Levine (2003) Law, endowments and finance. Journal of Financial Economics, Vol. 70. pp. 137 - 181

Beck, T., A. Demirgüç-Kunt, and R. Levine, (2000) A New Database on Financial Development and Structure, World Bank Economic Review, Vol. 14, pp. 597 - 605

Bennett, R. L., M. D. Vaughan, and T. J. Yeager (2005) Should the FDIC worry about the FHLB? The impact of Federal Home Loan Board Advances on the Bank Insurance Fund. FDIC CFR Working Paper 2005-10

Benston, G. W., W. C. Hunter, and L. D. Wall (1995) Motivations for bank mergers and acquisitions: Enhancing the deposit insurance put option versus earnings diversification. Journal of Money, Credit, and Banking, Vol. 27 (3), pp. 777 - 788

Benston, G., and G. G. Kaufman (1997) FDICIA after five years. Journal of Economic Perspectives, Vol. 11, pp. 139 - 158

Berger, A. N. (1995) The profit-structure relationship in banking-tests of market power and efficient-structure hypotheses. Journal of Money, Credit, and Banking, Vol. 27, pp. 404 - 431

Berger, A. N., and T. H. Hannan (1989) The price-concentration relationship in banking. Review of Economics and Statistics, Vol. 71, pp. 291 - 299

Berger, A. N., G. R. G. Clarke, R. Cull, L. Klapper, G. F. Udell (2005) Corporate governance and bank performance: A joint analysis of the static, selection, and dynamic effects of domestic, foreign, and state ownership. Journal of Banking and Finance, Vol. 29, pp. 2179 - 2221

Berger, A. N., and G. F. Udell (2002) Small business credit availability and relationship lending: The importance of bank organisational structure. Economic Journal, Vol. 112, F32 - F53

Berger, A. N., R. DeYoung, H. Genay, and G. F. Udell (2000) The globalization of financial institutions: Evidence from cross-border banking performance. Brookings - Wharton Papers on Financial Services. Vol. 3, pp. 23 - 158

Berger, A., N., I. Hasan, and L. F. Klapper (2004) Further evidence on the link between finance and growth: An international analysis of community banking and economic performance. Journal of Financial Services Research, Vol. 25, pp. 169 - 202

Berger, A. N., A. Demirgüç-Kunt, R. Levine, and J. G. Haubrich (2004) Bank concentration and competition: An evolution in the making. Journal of Money, Credit, and Banking, Vol. 36 (3), pp. 434 - 450

Berger, A. N., A. Saunders, J. M. Scalise, and G. F. Udell (1998) The effects of bank mergers and acquisitions on small business lending. Journal of Financial Economics, Vol. 50, pp. 187 - 229

Besanko, D., and A. V. Thakor (1993) Relationship banking, deposit insurance, and bank portfolio. In Mayer, C. and X. Vives (eds.) Capital markets and financial intermediation. Cambridge: University Press, pp. 292 - 318

Bikker, J. A. (2004) Competition and efficiency in a unified European banking market. Cheltenham: Edward Elgar

Bikker, J. A., and K. Haaf (2002) Competition, concentration and their relationship: An empirical analysis of the banking industry. Journal of Banking and Finance, Vol. 26, pp. 2191 - 2214

Bikker, J. A., and P. A. J. Metzemakers (2005) Bank provisioning behaviour and procyclicality. Journal of International Financial Markets, Institutions, and Money, Vol. 15, pp. 141 - 157

Bikker, J. A., and H. Hu (2002) Cyclical patterns in profits, provisioning and lending of banks and procyclicality of the new Basel capital requirements. Banca Nazionale del Lavaro Quarterly Review, Vol. 55, pp. 143 - 175

Billet, M. T., J. A. Garfinkel, and E. S. O'Neal (1998) The cost of market versus regulatory discipline in banking. Journal of Financial Economics, Vol. 48, pp. 333 - 358

Blalock, J. B., T. J. Curry, and P. J. Elmer (1991) Resolution costs of thrift failures. FDIC Banking Review, Vol. 4, pp. 15 - 26

Blum, J. (2002) Subordinated debt, market discipline, and banks' risk taking. Journal of Banking and Finance, Vol. 26, pp. 1427 - 1441

Bongini, P., S. Claessens, and G. Ferri (2001) The Political Economy of Distress in East Asian Financial Institutions. Journal of Financial Services Research, Vol. 19 (1), pp. 5 - 25

Boot, A., and S. Greenbaum (1993) Bank regulation, reputation and rents: Theory and policy implications. In: Mayer, C. and X. Vives (eds.) Capital markets and financial intermediation. Cambridge: University Press, pp. 262 - 285

Bordo, M., A. Redish and H. Rockoff (1995) A comparison of the United States and Canadian banking systems in the twentieth century: Stability vs. efficiency. in: Bordo, M. and R. Sylla (eds.) Anglo-American financial systems: Institutions and markets in the twentieth century. New York: Irvine, pp. 11 - 40

Borio, C. (2006) Monetary and financial stability: Here to stay? Journal of Banking and Finance, Vol. 30, pp. 3407 - 3414

Borio, C., C. Furfine, and P. Lowe (2001) Procyclicality of the financial system and financial stability: Issues and policy options. Basel: Bank for International Settlements BIS Paper 1.

Bovenzi, J. F. and A. J. Murton (1988) Resolution costs of bank failures. FDIC Banking Review, Vol. 1, pp. 1 - 13

Boyd, J. H., and G. de Nicoló (2005) The theory of bank risk-taking and competition revisited. Journal of Finance, Vol. 60, pp. 1329 - 1342

Boyd, J. H., G. de Nicoló, and B. D. Smith (2004) Crises in competitive versus monopolistic banking systems. Journal of Money, Credit and Banking, Vol. 36 (3), pp. 487 - 506

Boyd, J. H., and S. L. Graham (1996) Consolidation in U.S. banking: Implications for efficiency and risk. Federal Reserve Bank of Minneapolis Working Paper No. 572

Boyd, J. H., and S. L. Graham (1991) Investigating the banking consolidation trend. Federal Reserve Bank of Minneapolis Quarterly Review, Spring, pp. 1 - 15

Boyd, J. H., and E. Prescott (1986) Financial Intermediary Coalitions. Journal of Economic Theory, Vol. 38, pp. 211 - 232

Breshanan, T. F. (1989) The oligopoly solution concept is identified. Economics Letters, Vol. 10, pp. 87 - 92

Brown, R. A., and S. Epstein (1992) Resolution costs of bank failures: An update of the FDIC historical loss model. FDIC Banking Review, Vol. 5, pp. 1 - 16

Brunner, A., J. Decressin, D. Hardy, and B. Kudela (2004) Germany's Three-Pillar Banking System: Cross-Country Perspectives in Europe. IMF Occasional Paper 23, Washington, D.C.: International Monetary Fund

Cade, B., and B. R. Noon, (2003) A gentle introduction to quantile regression for ecologists. Frontiers in Ecology and the Environment, Vol. 1, pp. 412 - 420

Caminal, R. and C. Matutes (2002) Market power and bank failures. International Journal of Industrial Organisation, Vol. 20 (9), pp. 1341 - 1361

Capie, F. (1995) Prudent and stable (but inefficient?): Commercial banks in Britain, 1890-1940. in: Bordo, M. and R. Sylla (eds.) Anglo-American financial systems: Institutions and markets in the twentieth century. New York: Irvine, pp. 41 - 64

Carbo, S., D. Humphrey, J. Maudos, and P. Molyneux (2006) Cross-country comparisons of competition and pricing power in European banking. Paper available at: http://www.unicatt.it/convegno/UC-LSE/paper/Carbo-Humphrey-Maudosc-Molyneux.pdf, accessed on 14th October 2006.

Carletti, E., and P. Hartmann (2003) Competition and stability: What's special about banking? In Mizen, P. D. (ed.) Monetary History, Exchanges Rates and Financial Markets: Essays in Honour of Charles Goodhart, Vol. 2, Cheltenham: Edward Elgar, pp. 202 - 229

Cetorelli, N. (2003) Life-cycle dynamics in industrial sectors: The role of banking market structure. Federal Reserve Bank of St. Louis Review, Vol. 85, pp. 135 - 147

Cetorelli, N. (1999) Competitive analysis in banking: Appraisal of the methodologies. Federal Reserve Bank of Chicago Economic Perspectives, Vol. 23, pp. 2 - 15

Cihak, M. (2006) How do Central Banks write on financial stability? IMF Working Paper, WP/06/163, Washington, D.C.: International Monetary Fund

Claessens, S., and L. Laeven (2005) Financial dependence, banking sector competition and economic growth. Journal of the European Economic Association, Vol. 31, pp. 179 - 207

Claessens, S., and L. Laeven (2004) What drives bank competition? Some international evidence. Journal of Money, Credit, and Banking, Vol. 36 (3), pp. 563 - 583

Claessens, S., A. Demirgüç-Kunt, and H. Huizinga (2001) How does foreign entry affect domestic banking markets? Journal of Banking and Finance, Vol. 25, pp. 891 - 911

Cleves, M. A, W. W. Gould, and R. A. Gutierrez (2004) An introduction to survival analysis using STATA. Revised Edition. College Station, Texas: Stata Press

Coccorese, P. (2004) Banking competition and macroeconomic conditions: A disaggregate analysis. Journal of International Financial Markets, Institutions, and Money, Vol. 14, pp 203 - 214

Cole, R. A., and J. W. Gunther (1995) Separating the likelihood and timing of bank failure. Journal of Banking and Finance, Vol. 19, pp. 1073 - 1089

Cordella, T. and E. L. Yeyati (2002) Financial opening, deposit insurance and risk in a model of banking competition. European Economic Review, Vol. 46 (3), pp. 471 - 485

Cowling, K., and M. Waterson (1976) Price-cost margins and market structure. Economica, Vol. 43, pp. 267 - 274

Craig, B., and J. C. dos Santos (1997) The risk effects of bank acquisitions. Federal Reserve Bank of Cleveland Economic Review, Vol. 33, pp. 25 - 35

Danielsson, J., P. Embrechts, C. A. E. Goodhart, C. Keating, F. Muennich, O. Renault, H. S. Shin, (2001) An academic response to Basel II. Special paper No. 130. London School of Economics Financial Markets Group.

Davenport, A. M., and K. M. McDill (2006) The depositor behind the discipline: A micro-level case study of Hamilton Bank. Journal of Financial Services Research, Vol. 30, pp. 93 - 109

De Bandt, O., and E. P. Davis (2000) Competition, contestability and market structure in European banking sectors on the eve of EMU. Journal of Banking and Finance, Vol. 24, pp. 1045 - 1066

Dell'Ariccia, G., and R. S. Marquez (2006) Lending Booms and Lending Standards. Journal of Finance, Vol. 61, pp. 2511 - 2546

Demirgüç-Kunt, A., and E. Detragiache (2005) Cross-country empirical studies of systemic bank distress: A survey. IMF Working Paper 05/96, Washington, D. C.: International Monetary Fund

Demirgüç-Kunt, A., and E. Detragiache (2002) Does deposit insurance increase banking system stability? An empirical investigation. Journal of Monetary Economics, Vol. 49, pp. 1373 - 1406

Demirgüç-Kunt, A., and E. Detragiache (1998) The determinants of banking crises in developing and developed countries. IMF Staff Papers, Vol. 45 (1), pp. 81 - 109, Washington, D. C.: International Monetary Fund

Demirgüç-Kunt, A., L. Laeven, and R. Levine (2004) Regulations, market structure, institutions, and the cost of financial intermediation. Journal of Money, Credit, and Banking, Vol. 36, pp. 593 - 622

Demsetz, H. (1973) Industry structure, market rivalry, and public policy. Journal of Law and Economics, Vol. 16, pp. 1 - 9.

Demsetz, R. S., and P. E. Strahan (1997) Diversification, size, and risk at U.S. bank holding companies. Journal of Money, Credit, and Banking, Vol. 29, pp. 300 - 313

De Nicoló, G., P. Bartholomew, J. Zaman, and M. Zephirin (2004) Bank consolidation, internationalization, and conglomerization: Trends and implications for financial risk. Financial Markets, Institutions and Instruments, Vol. 13 (4), pp. 173 - 217

De Nicoló, G. and M. L. Kwast (2002) Systemic risk and financial consolidation: Are they related? Journal of Banking and Finance, Vol. 26, pp. 861 - 880

Detragiache, E., and A. Spilimbergo (2001) Crises and liquidity-evidence and interpretation. IMF Working Paper 01/2, Washington, D. C.: International Monetary Fund

DeYoung, R. (2003) The failure of new entrants in commercial banking markets: a split-population duration analysis. Review of Financial Economics, Vol. 12, pp. 7 - 33

DeYoung, R., W. C. Hunter, and G. F. Udell (2004) The past, present and probable future for community banks. Journal of Financial Services Research, Vol. 25, pp. 85 - 133

DeYoung, R., and D. E. Nolle (1996) Foreign-owned banks in the U.S.: Earning market share or buying it? Journal of Money, Credit, and Banking, Vol. 28, pp. 622 - 636

Diamond, D.W. (1984) Financial Intermediation and Delegated Monitoring. Review of Economic Studies, Vol. 51, pp. 393-414

Diamond, D. W., and P. H. Dybvig (1983) Bank runs, deposit insurance, and liquidity. Journal of Political Economy, Vol. 91 (3), pp. 401 - 419

Dinç I. S. (2000) Bank reputation, bank commitment, and the effects of competition in credit markets. Review of Financial Studies, Vol. 13, pp. 781 - 812.

Drees, B. and C. Pazarbasioglu (1998) The Nordic Banking Crises: Pitfalls in Financial Liberalization? IMF Occasional Paper 161/1998, Washington, D. C.: International Monetary Fund

Eichengreen, B. M., and C. Arteta (2000) Banking crises in emerging markets: Presumptions and evidence. Center for International and Development Economics Research, University of California, Berkeley, Paper C00'115

Evanoff, D., and L. D. Wall (2002) Measures of the riskiness of banking organizations: Subordinated debt yields, risk-based capital, and examination ratings. Journal of Banking and Finance, Vol. 26, pp. 989 - 1009

Fischer, K. P., and M. Chenard (1997) Financial liberalisation causes banking system fragility. Working Paper No 97-14, Faculté des sciences de l'administration. Universite Laval

Flannery, M., and K. Rangan (2004) What caused the capital build-up of the 1990? Working Paper No. 2004-03-03. FDIC Center for Financial Research

Flannery, M. J., and S. M. Sorescu (1996) Evidence of bank market discipline of subordinated debenture yields: 1983 -1991, Journal of Finance, Vol. 51, pp. 1347 -1377

Frame, S. W., and D. R. Kamerschen (1997) The profit-structure relationship in legally protected banking markets using efficiency measures. Review of Industrial Organization, Vol. 12, pp. 9 - 22

Gilbert, R. A. (1984) Bank market structure and competition: A survey. Journal of Money, Credit, and Banking, Vol. 16, pp. 617 - 645

Goldberg, L. G., and S. C. Hudgins (2002) Depositor discipline and changing strategies for regulating thrift institutions. Journal of Financial Economics, Vol. 63, pp. 263 - 274

Goldberg, L. G., and S. C. Hudgins (1996) Response of uninsured depositors to impending S&L failures: evidence of depositor discipline. Quarterly Review of Economics and Finance, Vol. 36 (3), pp. 311 - 325

Goldberg, L. G., and A. Rai (1996) The structure-performance relationship for European banking, Vol. 20, pp. 745 - 771

Goodhart, C. A. E. (2006) A framework for assessing financial stability? Journal of Banking and Finance, Vol. 30, pp. 3415 - 3422

Gropp, R., and J. Vesala (2004) Deposit insurance, moral hazard, and market monitoring. Review of Finance, Vol. 8, pp. 571 - 602

Group of Ten (2001) Report on consolidation in the financial sector. Basel: Bank for International Settlements

Gup, B. E. (1995) Targeting Fraud: Uncovering and deterring fraud in financial institutions. Chicago: Probus

Hellman, T. F., K. Murdoch, and J. E. Stiglitz (2000) Liberalization, moral hazard in banking and prudential regulation: Are capital requirements enough? American Economic Review, Vol. 90 (1), pp. 147 - 165

Hirschhorn, E. and D. Zervos (1990) Policies to change the priority of claimants: the case of depositor preference laws. Journal of Financial Services Research, Vol. 4, pp. 111 - 125

Hoggarth, G. A., A. Milne, and G. E. Wood (1998) Alternative routes to banking stability: A comparison of UK and German banking systems. Financial Stability Review, Vol. 5, pp. 55 - 68

Hortlund, P. (2005) Do Inflation and High Taxes Increase Bank Leverage? Stockholm School of Economics Working Paper Series in Economics and Finance, No 612

Hovakimian, A., E. Kane, and L. Laeven (2003) How country and safety-net characteristics affect bank risk-shifting. Journal of Financial Services Research, Vol. 23, pp. 177 - 204

Hutchinson, M. M., and K. M. McDill (1999) Are All Banking Crises Alike? The Japanese Experience in International Comparison. Journal of the Japanese and International Economies, Vol. 13, pp. 155 - 180

Illing, M., and Y. Liu (2006) Measuring financial stress in a developed country: An application to Canada. Journal of Financial Stability, Vol. 2, pp. 243 - 265

International Monetary Fund (2004) Compilation Guide on Financial Soundness Indicators, available from http://www.imf.org/external/np/sta/fsi/eng/2004/guide/index.htm, accessed on 15th September 2006

International Monetary Fund (2001) Financial sector consolidation in emerging markets, Chapter V, International Capital Market Report, Washington, D.C.: International Monetary Fund

Iwata, G. (1974) Measurement of conjectural variations in oligopoly. Econometrica, Vol. 42, pp. 947 - 966

James, C. (1991) The losses realized in bank failures. Journal of Finance, Vol. 46, pp. 1223 - 1242

Jordan, J. S. (2000) Depositor discipline at failing banks. New England Economic Review, March/April 2000, pp. 15 - 28

Jayaratne, J., and P. E. Strahan (1998) Entry restrictions, industry evolution, and dynamic efficiency: Evidence from commercial banking. Journal of Law and Economics, Vol. 41, pp. 239 - 273

Jayaratne, J. and P. E. Strahan (1996) The finance-growth nexus: Evidence from bank branch deregulation. Quarterly Journal of Economics, Vol. 111, pp. 639 - 670

Kaufman, G. (2004) FDIC losses in bank failures: Has FDICIA made a difference? Working Paper, Loyola University Chicago, http://gsbdata.wt.luc.edu/%7Egkaufma/workpap.htm, accessed on 10th October 2006

Keeley, M. C. (1990) Deposit insurance, risk and market power in banking. American Economic Review, Vol. 80, pp. 1183 - 1200

Keeton, W. R. (1999) Does faster loan growth lead to higher loan losses? Federal Reserve Bank of Kansas City Economic Review, pp. 57 - 75

King, T. B., D. A. Nuxoll, and T. J. Yeager (2006) Are the causes of bank distress changing? Can researchers keep up? Federal Reserve Bank of St. Louis Review, January/February 2006, pp. 57 - 80

Koenker, R., and G. Bassett (1978) Regression quantiles. Econometrica, Vol. 46, pp. 33 - 50

Koenker, R., and K. F. Hallock (2001) Quantile regression. Journal of Economic Perspectives, Vol. 15, pp. 143 - 156

Koskela, E. and R. Stenbacka (2000) Is there a trade-off between bank competition and financial fragility? Journal of Banking and Finance, Vol. 24, pp. 1853 - 1873

Lane, W. R., S. W. Looney, and J. W. Wansley (1986) An application of the Cox proportional hazards model to bank failure. Journal of Banking and Finance, Vol. 10, pp. 511 - 531

La Porta, R., F. Lopez-des-Silanes, and A. Shleifer (2002) Government ownership of banks. Journal of Finance, Vol. 57 (1), pp. 265 - 301

La Porta, R., F. Lopez-de-Silanes, and A. Shleifer (1998) Law and finance. Journal of Political Economy, Vol. 106, pp. 1113 - 1155

Laeven, L., and G. Majoni (2003) Loan loss provisioning and economic slowdowns: Too much, too late? Journal of Financial Intermediation, Vol. 12, pp. 178 - 197

Levine, R. (1998) The legal environment, banks, and long-run economic growth. Journal of Money, Credit, and Banking, Vol. 30, pp. 596 - 613

Logan, A. (2000) The Early 1990s Small Banking Crisis: Leading Indicators. Bank of England Financial Stability Review: December 2000, pp. 130 - 145

Lowe, P. (2003) Credit risk measurement and procyclicality. In: Kuppers, J. G., H. N. Prast, and A. A. T. Wesseling (eds.) Supervision on a cross-road. Cheltenham: Edward Elgar, pp. 136 - 163

Maechler, A. M., and K. M. McDill (2006) Dynamic depositor discipline in US banks. Journal of Banking and Finance, Vol. 30, pp. 1871 - 1891

Marino, J. A. and R. L. Bennett (1999) The consequences of national depositor preference. FDIC Banking Review, Vol. 12, pp. 19 - 38

Martin, D. (1977) Early Warning of Bank Failure: A Logit Regression Approach. Journal of Banking and Finance, Vol. 1, pp. 249 - 276

Matutes, C. and X. Vives (2000) Imperfect competition, risk taking and regulation in banking. European Economic Review, Vol. 44 (1), pp. 1-34

Matutes, C. and X. Vives (1996) Competition for deposits, fragility and insurance. Journal of Financial Intermediation, Vol. 5 (2), pp. 184 - 216

McDill, K. M. (2004) Resolution costs and the business cycle. FDIC Working Paper 2004-01

Mercieca, S., K. Schaeck, and S. Wolfe (forthcoming) Small banks in Europe: Benefits from diversification? Journal of Banking and Finance.

Merton, R. C. (1977) An analytic derivation of the cost of deposit insurance loan guarantees. Journal of Banking and Finance, Vol. 1, pp. 3 - 11

Mishkin, F. S. (1999) Financial consolidation: Dangers and opportunities. Journal of Banking and Finance, Vol. 23, pp. 675 - 691

Molyneux, P., J. Thornton, and D. M. Lloyd-Williams (1996) Competition and market contestability in Japanese commercial banking. Journal of Economics and Business, Vol. 48, pp. 33 - 45

Molyneux, P., D. M. Lloyd-Williams, and J Thornton (1994) Competitive conditions in European banking. Journal of Banking and Finance, Vol. 18, pp. 445 - 459

Myers, S. C. (1984) The Capital Structure Puzzle. Journal of Finance, Vol. 39, pp. 575 - 592

Myers, S. C., and N. S. Majluf (1984) Corporate financing and investment decisions when firms have information investors do not have. Journal of Financial Economics, Vol. 13, pp. 187 - 221

Nagarajan, S. and C. W. Sealey (1995) Forbearance, deposit insurance pricing and incentive compatible bank regulation. Journal of Banking and Finance, Vol. 19, pp. 1109 - 1130

Nathan, A., and E. H. Neave (1989) Competition and contestability in Canada's financial system: empirical results. Canadian Journal of Economics, Vol. 22, pp. 567 - 594

Neumark, D., and S. A. Sharpe (1992) Market structure and the nature of price rigidity: Evidence from the market for consumer deposits. Quarterly Journal of Economics, Vol. 107, pp. 657 - 680

Nier, E., and U. Baumann (2006) Market discipline, disclosure and moral hazard in banking. Journal of Financial Intermediation, Vol. 15, pp. 332 - 361

Oshinsky, R. (1999) Effects of bank consolidation on the bank insurance fund. FDIC Working Paper 1999-03

Oshinsky, R. and Virginia Olin (2005) Troubled banks: Why don't they all fail? FDIC Working Paper 2005-03

Osterberg, W. P. (1996) The impact of depositor preference laws. Federal Reserve Bank of Cleveland Economic Review, Vol. 12, pp. 1 - 12

Osterberg, W. P., and J. B. Thomson (1994) Underlying determinants of closed-bank resolution costs. Federal Reserve Bank of Cleveland Working Paper 9403

Panzar, J. C., and J. N. Rosse (1987) Testing for monopoly equilibrium. Journal of Industrial Economics, Vol. 35, pp. 443 - 456

Park, S., and S. Peristiani (1998) Market discipline by thrift depositors. Journal of Money, Credit, and Banking, Vol. 30, pp. 347 - 364

Paroush, J. (1995) The effects of mergers and acquisition activity on the safety and soundness of a banking system. Review of Industrial Organisation, Vol. 10, pp. 53 - 67

Peek J., and E. S. Rosengren (1998) Bank consolidation and small business lending: It's not just bank size that matters. Journal of Banking and Finance, Vol. 22, pp. 799 - 819

Pennacchi, G. G. (2005) Risk-based capital standards, deposit insurance, and procyclicality. Journal of Financial Intermediation, Vol. 14, pp. 432 - 465

Perotti, E. C., and J. Suarez (2002) Last bank standing: What do I gain if you fail? European Economic Review, Vol. 46 (9), pp. 1599 - 1622

Petersen, M. A., and R. G. Rajan (1995) The effect of credit market competition on lending relationships. Quarterly Journal of Economics, Vol. 110, pp. 407 - 443

Petersen, T. (1986) Fitting parametric survival models with time-dependent covariates. Applied Statistics, Vol. 35 (3), pp. 281 - 288

Podpiera, R. (2004) Does compliance with Basel Core Principles bring any measurable benefits? IMF Working Paper 04/204, Washington, D. C.: International Monetary Fund

Repullo, R. (2004) Capital requirements, market power, and risk-taking in banking. Journal of Financial Intermediation, Vol. 13, pp. 156 - 182.

Rime, B. (1998) Mesure de degree de concurrence dans le system bancaire Suisse a la ide du modele de Panzar et Rosse. Revue Suisse d'Economie Politique et de Statistique, Vol. 135, pp. 21 - 40

Ruckes, M. (2004) Bank competition and credit standards. Review of Financial Studies, Vol. 17, pp. 1073 - 1102

Schaeck, K. (2006) Bank liability structure, FDIC loss, and time to failure: A quantile regression approach. University of Southampton. Mimeo.

Schaeck, K., M. Cihak, and S. Wolfe (2006) Are more competitive banking systems more stable? IMF Working Paper, WP/06/143, Washington, D.C.: International Monetary Fund

Schmidt, R. H., A. Hackethal, and M. Tyrell (1999) Disintermediation and the role of banks in Europe: An international comparison. Journal of Financial Intermediation, Vol. 8, pp. 36 - 67

Shaffer, S. (2004a) Comment on "What drives bank competition? Some international evidence" by Stijn Claessens and Luc Laeven. Journal of Money, Credit, and Banking, Vol. 36 (3), pp. 585 - 592

Shaffer, S. (2004b) Patterns of competition in banking. Journal of Economics and Business, Vol. 56, pp. 287 - 313

Shaffer, S. (1993) A test of competition in Canadian banking. Journal of Money, Credit, and Banking, Vol. 25, pp. 49 - 61

Shaffer, S. (1982) A non-structural test for competition in financial markets. Federal Reserve Bank of Chicago. In: Proceedings of a conference on bank structure and competition, pp. 225 - 243

Shibut, L. (2002) Should bank liability structure influence deposit insurance pricing? FDIC Working Paper 2002-01

Shibut, L., T. Critchfield, and S. Bohn (2003) Differentiating among critically undercapitalized banks and thrifts. FDIC Banking Review, Vol. 15 (2), pp. 1 - 38

Shrieves, R E., and D. Dahl (1992) The relationship between risk and capital in commercial banks. Journal of Banking and Finance, Vol. 16, pp. 439 - 457

Smith, B. D. (1984) Private information, deposit interest rates, and the 'stability' of the banking system. Journal of Monetary Economics, Vol. 14, pp. 293 - 317

Staikouras, C. and A. Koutsomanoli-Fillipaki (2006) Competition and concentration in the new European banking landscape. European Financial Management, Vol. 12, pp. 443 - 482

Staikouras, C. and G. E. Wood (2000) Competition and banking stability in Greece and Spain. Journal of International Banking Regulation, Vol. 2 (1), pp. 14 - 29

Stiroh, K. J. (2004a) Do community banks benefit from diversification? Journal of Financial Services Research, Vol. 25, pp. 135 - 160

Stiroh, K. J. (2004b) Diversification in banking: Is noninterest income the answer? Journal of Money, Credit, and Banking, Vol. 36, pp. 853 - 882

Stiroh, K. J., and A. Rumble, (2006) The dark side of diversification: The case of U.S. financial holding companies. Journal of Banking and Finance, Vol. 30, pp. 2131 - 2161

The World Bank - International Monetary Fund (2005) Financial sector assessment: A handbook. Washington, D. C.: The World Bank/International Monetary Fund

Tirole, J. (1988) Theory of Industrial Organisation. Boston, Massachusetts: MIT Press

Trivieri, F. (forthcoming) Does cross-ownership affect competition? Evidence from the Italian banking industry. Journal of International Financial Markets, Institutions, and Money, forthcoming

Verbeek, M. (2004) A guide to modern econometrics. 2nd ed. Chichester: John Wiley and Sons

Vesala, J. (1995) Testing for competition in banking: Behavioural evidence from Finland. Helsinki: Bank of Finland

Vives, X. (2001) Competition in the changing world of banking. Oxford Review of Economic Policy, Vol. 17, pp. 535 - 547

Whalen, G. (1991) A proportional hazards model of bank failure: An examination of its usefulness as an early warning tool. Federal Reserve Bank of Cleveland Economic Review, pp. 21 - 39