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Consolidation in banking and financial stability in Europe: Empirical evidence

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Abstract

Using aggregate balance sheet data from banks across the EU-25 over the period from 1997 to 2005 this paper provides empirical evidence that national banking market concentration has a negative impact on European banks' financial soundness as measured by the Z-score technique while controlling for macroeconomic, bank-specific, regulatory, and institutional factors. Furthermore, we find that Eastern European banking markets exhibiting a lower level of competitive pressure, fewer diversification opportunities and a higher fraction of government-owned banks are more prone to financial fragility whereas capital regulations have supported financial stability across the entire European Union.

JEL classification: G21; G28; G34; L16
Keywords: Market structure; Financial stability; Banking regulation

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1. Introduction

In Europe a likewise high level of mergers and acquisitions in banking has been observed with a remarkable acceleration in consolidation activities in recent years. However, while the number of *domestic* bank mergers still increases for several EU Member States, *cross-border* banking consolidation within Europe peaked around the year of the introduction of the Euro and has continuously decreased since then in particular in Western European countries (Berger, 2007). As a consequence, the European Commission conducted a study in 2005 which elucidated that banks not only complained about unfavorable expectations on revenue enhancements and cost synergies, but also and in particular, about a sparsely transparent and tedious bank merger review process as well as current supervisory arrangements for cross-

border activities in Europe (Commission, 2005). Accounting for this result, the European Commission has revised article 16 of the European Banking Directive in late 2006 in order to accelerate the bank merger review process by setting evaluation criteria to ensure cross-country consistency, reduce regulatory discretion and promote a higher level of transparency (Commission, 2006).

In our opinion, however, the Commission's legal step suffers from inadequacy concerning at least one important aspect. Though competent supervisory authorities are legitimated to examine the financial soundness of the bidding bank *pre-merger*, the Commission has failed to consider the possible impact of promoting banking consolidation (higher market concentration) on systemic stability in Europe *ex post*. Thus, if it is true that the banking market's systemic risk exposure increases with the banks' size promoting cross-border banking consolidation may raise the question of whether the systemic linkages of bank failures will change due to the consolidation process, both domestically and cross-border. These aspects are even more important for Europe since coordination problems among prudential supervisors typically arise due to the so-called "home country principle". This principle provokes that supervisory responsibility remains within the home country's authority whereas the host country's supervisory agency will only have limited powers in the event of a systemic situation caused by a foreign bank. As a consequence, cross-country cooperation between European supervisors and regulators, and in particular the responsibility for prudent regulation and supervision of pan-European banks that emerge from cross-border consolidation, is still vague (Goddard et al., 2007; Čihák and Decressin, 2007).

Against this background this paper empirically investigates the impact of national banking market concentration on financial stability for the 25 Member States of the European Union (henceforth EU-25) over the period from 1997 to 2005. Our analysis complements and extends previous empirical studies on this issue (Schaeck and Čihák, 2007; Beck et al., 2006a, 2006b; Schaeck et al., 2006; De Nicoló et al., 2004) for several specific aspects. *First*,

this is the first study that empirically investigates the relationship between banking market concentration and financial stability using a cross-sectional time-series dataset for the EU-25. While previous empirical literature has examined this relationship for a broader set of countries around the globe covering Europe in parts (Beck et al., 2006a, 2006b; De Nicoló et al., 2004) or Western European countries only (Schaeck and Čihák, 2007; Schaeck et al., 2006), we present novel evidence by exclusively focusing on the EU-25 which allows us to additionally examine country specific effects among Western and Eastern EU Member States. *Second*, while previous studies have either focused on real episodes of banking crises (Beck et al., 2006a, 2006b; Demirgüç-Kunt and Detragiache, 2002) or the banks' capital ratio as a proxy for financial soundness (Schaeck and Čihák, 2007; Schaeck et al., 2006), we extend the analysis by employing the Z-score ratio as a time-variant measure for the bank's distance-to-default. *Third*, by investigating the impact of market concentration on single components of the Z-score ratio (ROAA, capital ratio, ROAA volatility), we try to shed more light on the nexus of concentration, competition and stability in banking. *Finally*, we extend and enhance previous empirical studies by controlling for possible endogeneity problems as well as reverse causality between concentration and stability using instrumental variables regressions.

The remainder of this paper is organized as follows. Section 2 presents related theoretical and empirical literature on the relationship between banking market concentration and financial stability. Section 3 contains our empirical analysis. While section 3.1 describes the data set, section 3.2 introduces the empirical model. Empirical results are presented and discussed in section 3.3. Finally, Section 4 concludes.

2. Related literature

Both economic theory and empirical evidence are inconclusive about the impact of increasing banking market concentration on financial stability.

First, advocates of the "*concentration-stability view*" suggest that larger (monopolistic) banks in concentrated banking systems may *enhance profits* and thus reduce financial fragility by providing higher "*capital buffers*" that protect them against external macroeconomic and liquidity shocks (Boyd et al., 2004). Similarly, Keeley (1990) argues that a higher charter or franchise value may deter excessive risk-taking behavior by the bank's management ("*charter value hypothesis*"). As higher franchise values result in higher opportunity costs when going bankrupt, bank managers or, even more, the bank's shareholders may not accept risky investments that could jeopardize their future profits (Park and Peristiani, 2007). *Second*, it is assumed that larger banks tend to engage in "*credit rationing*" since fewer credit investments of a higher quality will increase the return of the singular investment and hence foster financial soundness (Boot and Thakor, 2000). Additionally, these banks are argued to have comparative advantages in providing *credit monitoring* services. *Third*, larger banks may be able to diversify loan portfolio risks more efficiently due to higher *economies of scale and scope* (Boyd and Prescott, 1986). Apart from these functional *diversification effects*, it is suggested that larger banks engaging in cross-border activities may additionally obtain economies of scale and scope by geographical risk diversification.[1] *Finally*, it is argued, that a market with a few larger banks may be *easier to monitor*. Hence, supervision of banks may be more effective and the risk of a system-wide contagion should presumably recede (Allen and Gale, 2000).

[1] Since Méon and Weill (2005) have shown that economic cycles of many European countries are not perfectly correlated, geographical diversification may play an important role in reducing banks' overall risk exposure. However, Carbó Valverde et al. (2007) conclude that the reliance on economies of scale alone to raise cost efficiency and hence to achieve intra- and inter-country dominance may not be sufficient in the EU banking market. In their view, the full benefits from greater economies of scale are achieved in conjunction with labor market reforms that allow for greater flexibility for banks to reduce their labor costs and to better control their input mix.

In contrast, proponents of the "*concentration-fragility view*" argue that larger banks are often more likely to receive public guarantees or subsidies, which is discussed as the "*too big to fail*"-doctrine (Mishkin, 1999). As a consequence, the moral hazard problem becomes more severe for larger bank's managers who may take on risky investments under a government's safety net. *Second*, it is argued that *higher loan interest rates* granted by monopolistic banks may induce borrowers to take on risky investments to compensate higher loan repayments (Boyd and De Nicoló, 2006). Accordingly, the *likelihood of loan defaults* may increase and induce a higher probability of bank failures. *Third*, Cetorelli et al. (2007) stress that a higher degree of *risk diversification effects* may result in reduced managerial efficiency, less effective internal corporate control and increased operational risk that may be prone to supervisory failures. *Finally*, it is suggested that the bank's size is positively correlated with organizational *complexity* (Beck et al., 2006a, 2006b). Thus, an increasing firm size may be associated with lower transparency since the size allows banks to expand across multiple geographic markets and business lines, using sophisticated financial instruments enabling them to build complex corporate organizations.

Empirical evidence on the relationship between market concentration and financial stability in banking is ambiguous as well. To begin with, using data on more than 100 countries over the period from 1993 to 2000 De Nicoló et al. (2004) provide empirical evidence of increased risk profiles for the five largest conglomerate financial firms and of a higher level of systemic risk potential for more concentrated banking systems.

Similarly, Schaeck and Čihák (2007) and Schaeck et al. (2006) examine the impact of market competition and concentration on systemic stability for more than 2,600 banks in the EU-10 plus Switzerland for the period from 1999 to 2004. They find no evidence for a trade-off between market competition and the banks' risk-taking. Rather, they find that banks tend to hold higher capital buffers when operating in a more competitive environment. These results

prove to be robust when controlling for banking market concentration and for a multitude of further sensitivity analyses.

Finally, Beck et al. (2006a, 2006b) examine the effect of banking market concentration on the likelihood of suffering a systemic banking crisis using data on 69 countries over the period from 1980 to 1997. In contrast to De Nicoló et al. (2004) they provide empirical evidence that an increase in banking concentration does not result in higher banking system fragility. Their result is robust when controlling for differences in bank regulatory policies and national institutions affecting market structures and financial stability.

3. Empirical analysis

3.1. Data

Notes on variables and data sources, descriptive statistics for the entire set of included variables as well as empirical results from main regressions, robustness checks and sensitivity analyses are provided in the Appendix A. Descriptions of banks included into the sample, concentration ratios, results from first stage regressions and correlation matrices are reported in Appendix B.

Our empirical analysis focuses on consolidated balance sheet data from „Monetary Financial Institutions"[2] (MFI) across the EU-25 for the period from 1997 to 2005 following the introduction of the "Single Banking License" in 1997 in Europe. This so-called "single passport" allows a bank licensed in one European country to open as many branches as it wishes anywhere in the community. Banks' balance sheet data was retrieved from *BankScope database* provided by *Fitch-IBCA*. We included commercial banks, savings banks and credit

[2] MFI comprise resident *credit institutions* as defined in European Community Law and other resident financial institutions that receive deposits and/or close substitutes for deposits from entities other than MFIs and, for their own account, to grant credits and/or make investments in securities (ECB, 2001).

cooperatives. Table 1 (Appendix B) reports the number of banks being included into our sample.

In contrast to related empirical work (Beck et al., 2006a, 2006b; Demirgüç-Kunt and Detragiache, 2002) we do not include real episodes of banking crises as a proxy for the bank's *financial soundness*. Though the number of bankruptcies in fact describes an accurate indicator, its significance may be distorted by three aspects. *First*, banking crises are announced and described differently across countries. Hence, it is difficult to define and date the exact beginning and end of a banking failure. *Second*, suffering from a banking crisis may be an implication of regulatory failures. For this reason, competent supervisory authorities will be less interested in completely announcing banking failures that have occurred within their own national borders. *Third*, failures of systemic-important banks are typically prevented by implementing financial restructuring programs in order to avoid contagion and hence systemic crises.

Taking these aspects into account, we rather employ the banks' distance to default as a proxy for financial soundness by employing the *Z-score* technique (e.g. De Nicoló et al., 2004) which is denoted as follows:

$$z \equiv \frac{\mu + k}{\sigma} \tag{1}$$

We construct this indicator per country and time by aggregating the banks' consolidated balance sheet data and define μ as the return on average assets before taxes (ROAA), k as the equity capital in percent of total assets and σ as the standard deviation (volatility) of the ROAA. Hence, the Z-score combines in one single indicator the banks' *profitability* (μ), *capital ratio* (k) and *return volatility* (σ). Obviously, the Z-score will increase with the banks' profitability and capital ratio and decrease with increasing return volatility. From an economic viewpoint the Z-score initially measures the probability of a bank becoming insolvent when the value of assets becomes lower than the value of debt. Hence, a higher

(lower) Z-score implies a lower (higher) probability of insolvency risk. Table 2 (Appendix A) indicates that the Z-score ratio displays a wide variation for European banks in our sample across countries and over time (-0.38 to 105.81).

Measuring *concentration* for European banking markets is exceptional for a number of reasons. To begin with, in several European member states (Germany, Austria and Italy) a comparatively low concentration ratio (e.g., on average 20% for the German banking sector) results from the huge number of savings banks and credit cooperatives primarily acting in local markets. Though these banks are organized under separate banking associations, the member banks' financial statements are not consolidated under the roof of their respective association. Hence, an error in concentration and competition measurement will arise when aggregating balance sheet data for these bank groups. Doing so, market concentration would significantly increase (e.g., for Germany to approx. 67%) and bias concentration and competition measures for these markets. Furthermore, some European countries (especially the UK) exhibit lower banking market concentration ratios, as they host international financial centers with a high presence of foreign banks among only a few domestic banks. In addition, some of the Eastern European Member States (e.g., Estonia) provide high concentration ratios since they are comparatively smaller than most of the Western European countries. The same aspect applies to Western European outskirt countries (e.g., Finland, Cyprus). Finally, in most of the Eastern European Member States formerly large state-owned banks have been privatized after financial deregulation which at first resulted in highly concentrated banking markets. However, with only a few exceptions concentration ratios decreased over time due to increasing foreign bank entry. Taking these aspects into account it seems less surprising that banking market concentration still differs significantly across European countries, ranging from very fragmented banking markets such as in Germany with a minimum ratio of 17% to higher concentrated ones in half of Europe and especially in emerging and outskirt European Member States with the highest concentration ratio of 99%

in Estonia (see Table 2, Appendix B for the wide variation of concentration ratios cross-sectional and over time).

In contrast to previous empirical work (Schaeck and Čihák, 2007; Schaeck et al., 2006; Beck et al., 2006a, 2006b) we do not use data from the *BankScope database* to calculate concentration ratios since the sample of banks reporting to *BankScope* increases over the sample period which forces to calculate average concentration ratios. Instead, we include concentration ratios which we retrieved from the ECB's statistics and reports on EU banking structures and from competent national central banks for many eastern European countries, especially for the period from 1997 to 2000. *Concentration (5) ratios* are calculated as the fraction of assets of the total banking system's assets held by the five largest domestic and foreign banks per country. Calculating concentration in this way addresses to the fact that the banking industry is further globalizing and that banks merge, acquire and compete not only within national boundaries but also cross-border.

When examining the effect of banking market concentration on systemic stability it is imperative to control for macroeconomic, bank-specific, regulatory and institutional factors that are likely to affect market structures, financial stability or both and hence, help to mitigate omitted variable biases. We lagged some of the variables to avoid simultaneity. *Macroeconomic control variables* are retrieved from the *World Development Indicator (WDI) database* provided by the World Bank. We include GDP per capita, the rate of real GDP growth, and the annual change of inflation and short term real interest rates to capture macroeconomic developments that are likely to affect the quality of bank assets. The *rate of growth of real GDP* is a control variable since the banks' investment opportunities may be correlated with business cycles (Laeven and Majoni, 2003). Hence, we expect a positive sign of the coefficient if investment opportunities rise under economic booms. In addition, borrowers' solvency should be higher under increasing economic performance which raises banks' asset quality. Furthermore, banks may pro-cyclically widen their capital under

economic booms and, hence, engage in precautionary measures in anticipation of forthcoming economic downturns. The effect of changes in *inflation rates* depends on whether inflation is anticipated by banks or not and whether it coincides with general economic fragility. Since interest rates tend to rise in the presence of inflation, inflation is probably associated with a higher realization of net interest margins and profitability. However, as the banks' funding costs may also increase under inflation the effect on profitability and bank capital ratios depends on the net effect from increasing net interest margins and costs. Similarly, changes in *real short term interest rates* are likely to implicitly influence asset quality. We include the one-period lagged interest rate changes and expect an ambiguous effect. While a passing through of increasing short term interest rates to deposit rates will raise the banks' funding costs, a handing down to lending rates should raise profitability but might let loan repayment be more difficult for borrowers which may result in higher loan default rates. Nevertheless, the actual effect depends on the differences in the average maturity of assets and liabilities or banks' capability to reprice assets and liabilities. Finally, two-period lagged *credit growth* is included as a control variable since excessive credit lending is suggested to be associated with decreasing capital ratios and hence, financial soundness (Dell'Ariccia and Marquez, 2006).

Due to the fact that MFIs and banking markets vary across the EU-25 we employ further bank-specific variables. We include the banks' *net interest margin* to control for profitability, the banks' *loan loss provisions* as a key measure for credit risk and hence loan-portfolio quality and the banks' *cost-income ratio* to control for the banks' efficiency. We expect a positive sign of the coefficient of net interest margin and a negative sign of the coefficients of loan loss provisions and cost-income ratio. We further include an updated and modified version of the *moral hazard index* developed by Demirgüç-Kunt and Detragiache (2002). In line with a considerable part of theoretical literature greater generosity of the deposit insurance system should contribute to more excessive risk-taking and hence financial

fragility. Thus, we expect a negative sign of the coefficient of moral hazard. However, in contrast, a positive impact is also possible if explicit deposit insurance indicates a commitment that deposit insurance is only limited to insured depositors, which encourages bank managers to be precautious and detain a higher amount of capital (Schaeck et al., 2006; Gropp and Vesala, 2005).

To draw accurate inferences about the impact of concentration on stability we perform a variety of sensitivity analyses. First of all, we control for cross-country differences regarding the regulatory and institutional environment to provide information on possible linkages between banking regulation, national institutions and systemic stability. We use four time-invariant measures of banking regulation and supervision proposed by Barth et al. (2004, 2001). The variable *entry restrictions* describes the fraction of entry applications by domestic or foreign banks that have been denied. We expect an ambiguous effect of this control variable since restricted entry may increase domestic bank profits due to lower competitive pressures but it may also induce market inefficiencies. *Activity restriction*s is a key determinant for the scope of a bank's business by aggregating measures of weather a bank is allowed to engage in securities, insurance and real estate markets. To the extent that activity restrictions keep banks from operating in too risky lines of business, banking systems with greater restrictions may be more stable (Beck et al., 2006a, 2006b; Barth et. al., 2004). In contrast, however, if a high level of activity restrictions prevents banks from diversifying asset risks outside traditional business, banking systems with greater restrictions may become more fragile. We finally include the *capital regulatory index* which is constructed by first principal component analysis following Barth et al. (2004). The index describes a summary measure of initial capital stringency and overall capital requirements. To the extent that greater capital stringency encourages prudent behavior and equity capital is an appropriate measure of the bank's solvency, we expect better capitalized banks to be more stable.

Apart from regulatory aspects we also control for the institutional environment and assume that a greater strength and quality of institutions are further key factors of a well-developed and operating financial system. To begin with, *governmental ownership* measures the extent to which banks are owned by government which is of some importance especially for former-soviet Eastern European countries. We expect a negative sign of the coefficient of government ownership since government-owned banks are suggested to hold a larger amount of non-performing loans (Berger et al., 2004). Moreover, it is assumed that moral hazard dominates in governmental banks. This is due to the fact that these banks may anticipate to be bailed out in case of a financial distress encouraging managers to be less committed to prudent behavior. We further control for a country's level of exhibiting *economic freedom* by including a time-variant composite index of ten single freedoms provided by the *Heritage Foundation*. To the extent that greater freedoms allow banks to improve efficiency by engaging in different business lines next to traditional bank lending (securities, insurance, and real estate) and diversifying their risks, we expect an increased level of freedoms to support a bank's financial soundness. In contrast, however, greater freedoms also allow banks to undertake greater risks, particularly if existing regulations promote risk-taking incentives. Thus, overall greater freedom may also lead to greater bank fragility. Finally, several studies from the "law and finance" research field stress the linkage between the origin of a country's judicial system and financial sector development, e.g. protection of creditor rights (La Porta et al., 1998). Therefore, we separately include five dummy variables that take on the value one if a country has a *British, French, German, Scandinavian or Soviet legal origin* or zero otherwise.

3.2. Empirical model

To test the hypothesis that banking market concentration affects financial stability, we use a country-specific random-effects model. Employing a country-specific rather than a bank-specific random effects model is appropriate since despite similar patterns in the history of

most Eastern European countries, many of these countries differ from each other due to different transition processes to capitalist societies (Blanchard, 1999). In this context Murphy et al. (1992) present a theoretical model which provides arguments why some reforms work in one country, but do not work in other former socialist countries. Their theoretical insights confirm our strategy to control for unobserved heterogeneity on an individual country level.

We estimate systemic stability in country *i* at time *t* as follows:

$$y_{it} = \alpha_{it} + \beta_1 c_{it} + \sum \beta_k x_{it,k} + \varepsilon_{it} \tag{2}$$

where y_{it} represents the Z-score ratio in a country *i* and at time *t* as our measure of banking stability and c_{it} is the banking market concentration rate. The vector $x_{it,k}$ includes control variables described above. ε_{it} is an error term and α and the $\beta's$ denote the parameters to be estimated.

Assuming that α_{it} can be composed into a bank-specific time-invariant component α and a component v_{it} capturing the remaining disturbance that is assumed to be uncorrelated over time so that the equation $\alpha_{it} = \alpha + v_{it}$ holds, the equation can be estimated with the random effects model. The random effects model is a consequent strategy as most variations should be observed over time and random effects allow for the inclusion of time-invariant variables among regressors. Considering banking regulation, all European countries in our sample follow the European Capital Requirement Directive (transformation of "Basel II") and the European Banking Directive respectively. In this context, regulatory policies and national supervisory institutions have remained almost unchanged over the sample period. The absence of time variation in regulatory and supervisory control variables as well as the fact of a considerable time lag between regulatory changes and an effect on banks' performance are commonly accepted in the literature and pointed out by Barth et al. (2004). Hence, from this

point of view, financial markets in Europe form a homogenous entity. As a consequence, variation in the cross-section between regulatory and institutional explanatory variables is low and applying the random effects techniques is appropriate.[3]

3.3. Empirical results

We present empirical results in Table 3 (Appendix A). Regressions (1) and (2) are report main regressions results assessing the impact of banking market concentration on systemic stability as measured by the Z-score-technique. While regression specifications (3)-(5) use different concentration measures and omit bank-specific variables, regression specifications (6)-(7) are additional robustness checks using instrumental variable regressions to control for possible endogeneity of our independent variables. Table 4 reports further empirical results from regressing market concentration on single components of the Z-score, whereas Tables 5 and 6 present empirical results from a variety of sensitivity analyses.

3.3.1. Main findings

As Table 3 (Appendix A) reports, *concentration (5)* enters regression (1) significantly negative at the one-percent level suggesting that increasing banking market concentration has a negative impact on European banks' financial soundness which corresponds to the "concentration-fragility" view in theoretical literature and generally confirms empirical findings by De Nicoló et al. (2004). In contrast, this result does not support theoretical arguments and earlier empirical findings (Beck et al., 2006a, 2006b) promoting the "concentration-stability view".

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[3] As Table 2 (Appendix A) reports, the number of observations varies which especially holds for included variables measuring the regulatory environment. Thus, in addition to random effects, we apply the consistent estimator for the variance components by Baltagi and Chang (1994) as a robustness check to avoid possible biases resulting from our unbalanced panel. However, as results did not differ significantly from the ordinary random effects estimations, we do not comment them in this paper.

Among the control variables, *credit growth* enters the regression significantly positive at the one-percent level, indicating that increasing credit lending is not associated with decreasing capital ratios, higher risk-taking and hence decreasing financial soundness. In contrast, we suggest that increasing credit lending opportunities enable banks to better diversify their loan portfolios which should result in a decreasing return volatility. As expected, *loan loss provisions* and *cost-income ratio* enter the regression significantly negative, suggesting that higher asset quality and operational efficiency have a positive impact on the banks' financial soundness. Introducing the *moral hazard index*, this variable enters the regression significantly positive at the five-percent level and hence, yields no evidence for the popular argument of excessive risk taking under a financial safety net. In contrast, we assume that deposit insurance may encourage bank managers to be precautious and detain a higher amount of capital if one is aware of the fact that deposit insurance is only limited to insured depositors. This is in line with theoretical arguments and previous empirical studies that do not find evidence for a positive impact of deposit insurance on moral hazard nor on the probability of suffering from a systemic crisis (Schaeck et al., 2006; Gropp and Vesala, 2005).

By means of regressions (2)-(7) we investigate the robustness of our main results. As Table 7 (Appendix B) indicates, *GDP per capita* is highly correlated with a couple of our control variables, in particular the concentration measures. Due to this, we do not include GDP per capita into the main regression (1) and further regressions concerning robustness checks and sensitivity analyses. When including GDP per capita in specification (2), the variable enters the regression significantly positive at the one-percent level suggesting that banks in more developed countries exhibit higher financial soundness. However, as specification (2) reiterates the negative relationship between market concentration and financial stability, it is not sensitive to excluding GDP per capita from our main and further regressions.

We additionally control for the robustness of our main findings by the way we define concentration measures. We employ *Concentration (3)* as a measure of concentration ratios for the three largest domestic and foreign banks per country using the same calculation method as the ECB and Eastern European's central banks in regression (3) and the *Herfindahl-Hirschman Index* (HHI) in regression (4). As shown, both measures enter the respective regression significantly negative reconfirming the negative relationship between market concentration and European banks' financial soundness. Hence, our main results are not sensitive to the definition of banking market concentration.

Despite an appropriate definition of market concentration, this variable is likely to suffer from endogeneity with regard to our main regression specification (1). Hence, we first of all address to these statistical problem by eliminating the *bank-specific control variables* in regression specification (5) to examine if bank-specific endogeneity drives our finding of a negative relationship between concentration and stability. As shown, even though bank-specific variables are excluded, our main finding is reiterated suggesting that main results are not driven by bank-specific endogeneity.

We further apply 2SLS instrumental variable techniques in regression (6). We include index variables obtained from the *Comparative Manifesto Project* by the *Manifesto Research Group* which deals with different aspects of parliamentary democracies. The project focuses on content analyses of party manifestos from 50 countries covering all elections since 1945 to measure political positions of all relevant parliamentary parties. The first instrumental variable being included measures if parties of a country favor Keynesian demand management (*basic economic attitude*) or in other words, propose a demand-oriented economic policy. Hence, as countries with demand-oriented economic policy tend to favor less competitive markets, this instrument should have a positive effect on market concentration. The second instrumental variable being employed is *EU-integration* which measures if the parties of a country are in opposition to European integration or specific

European policies. As the rejection of integration policies can be interpreted as an indicator of skepticism against a common market in Europe and competition in general, this variable again should have a positive impact on market concentration. Finally, we include the durability (*duration*) of the current political institutions which we obtained from the *Polity IV Project* database. As reported by the instrumental variable regression (6), results confirm our main finding from the standard random effects model that increasing banking market concentration has a negative impact on the bank's financial soundness. Hence, we rule out that our main finding may be driven by endogeneity.

Despite this, the causality running from market structure to market conduct is not clear since it is not obvious if banking market concentration itself depends on financial stability. Hence, reverse causality may arise, for example, if a large, financial healthy bank decides (or in line with restructuring programs: is encouraged) to merge with a weaker, troubled bank, thereby increasing market concentration. Thus, to address likely reverse causality concerning banking market concentration and stability, we again apply instrumental variable techniques using a 2SLS panel estimator in regression (7) and employ *concentration (I)* as the initial concentration rate from the year 1997 as an instrumental variable (Beck et al., 2006a, 2006b).[4] As indicated by regression (7), the instrumental variable regression reconfirms our main result from the standard random effects model which suggests that the negative relationship between concentration and stability is not biased by reverse causality.

By means of regressions (1)-(4) in Table 4 (Appendix A) we try to gain a better understanding of the relationship between concentration and the Z-score measure regressing the 5-bank concentration variable on single components of the Z-score ratio. To begin with, we include the banks' *ROAA* as the dependent variable in specification (2) and hence,

[4] Table 5 (Appendix B) exhibits correlation matrices of the instrumented variable and all instruments included into regressions (6) and (7). The results of the first stage of the 2SLS regressions confirm the validity of our instrumental variables (Table 3, Appendix B).

simultaneously add an industrial organization perspective to our analysis that allows us to evaluate the relationship between concentration and market efficiency. Applying traditional industrial organization theory to banking, the ROAA should increase for banks gaining market power in less competitive but concentrated banking markets. Even so, we did not observe any significant impact on ROAA when including the five-bank concentration ratio. Hence, in order to test for the effect of remarkably high market concentration on banks' profitability we include *concentration (H)* as a variable for highly concentrated banking industries in specification (2). This concentration variable is computed covering concentration ratios larger than 80% as calculated breaking points. The measure enters the regression significantly positive at the one-percent level, which supports industrial organization models of monopolistic banks gaining higher profits. As expected, the *cost-income ratio* has a negative impact on the banks' profitability. By means of regression (3) we assess the relationship between market concentration and the banks' *capital structure* as the second component of the Z-score's numerator. In correspondence to theoretical predictions (Boyd et al., 2004) and related empirical findings (Schaeck and Čihák, 2007; Schaeck et al., 2006) *concentration (5)* enters the regression significantly positive at the five-percent level. Among the control variables *inflation* and *net interest margi*n enter the regression significantly. The positive sign of the coefficient of net interest margin implies a positive relationship between profitability and the bank's capital ratio which has also been found by other empirical studies (Flannery and Rangan, 2008; Schaeck and Čihák, 2007; Schaeck et al., 2006). We finally include the *volatility of the ROAA* as the Z-score's denominator in specification (4). If it is true that credit risk is the main source of the bank's overall risk exposure, the return volatility is a measure of loan portfolio quality. *Concentration (5)* enters the regression significantly positive but weak at the 10-percent level indicating that higher market concentration increases the volatility of bank asset returns and, hence, decreases loan portfolio quality. As shown, credit growth has a significant negative impact on

the return volatility supporting our findings from our main regression that increasing credit lending is not associated with higher risk-taking and hence, decreasing financial soundness.

To sum up, taking the single results from regressions on Z-score components into account, one reason for the negative impact of market concentration on European banks' financial soundness may be a higher return volatility of larger banks in concentrated markets. This may due to the fact that increasing market concentration has a positive impact on both the banks' ROAA and capital ratios (Z-score's numerator) but also affects the banks' return volatility (Z-score's denominator).

3.3.2. Sensitivity analyses

We perform a large variety of robustness checks. As a general result, our main finding of a negative relationship between concentration and stability holds even when controlling for the regulatory and institutional environment. Due to high correlation between these control variables (Table 7, Appendix B), we include them in turn in separate regressions (Table 5, Appendix A).

First, we introduce *entry and activity restrictions* to control for governmental restrictions on financial openness and banking business. Both variables enter the regressions significantly positive for the EU-15 (Western Europe) but significantly negative for the EU-10 (Eastern Europe). Findings for Eastern Europe indicate that a lower level of competitive pressures and diversification opportunities induces higher fragility for Eastern European banking markets. This result is consistent with theoretical predictions and empirical findings suggesting that restricted market entry and business activity are likely to reduce the banking system's efficiency and stability (Barth et al., 2004). In contrast, findings for Western Europe are in line with the "contestability"-literature stressing that concentration and competition describe two different characteristics of a market. Furthermore, this result supports empirical evidence that emphasizes the stabilizing effects of increasing competitiveness for banking markets (Boyd et al., 2006; Bikker and Haaf, 2002). *Second*, we include the *capital regulatory index*

entering the regressions significantly positive. Hence, our results support the theoretical assumption that higher levels of capital stringency are associated with higher financial soundness and prudential behavior by bank managers. Our findings that capital regulations have a positive effect on financial stability hold for both Western and Eastern European banking markets. *Third*, we control for *governmental ownership*. As expected, this variable enters the regressions negatively but becomes significant for Eastern European countries only. Hence, our results suggest that government-owned banks operating in concentrated Eastern European banking markets are more prone to financial fragility. *Fourth*, we include the *index of economic freedom*. This variable enters the regressions significantly negative for Eastern Europe but significantly positive for Western European countries. Accounting to this result and with regard to theoretical assumptions, we propose that larger banks in Western Europe may predominantly use greater freedoms to improve efficiency and risk diversification, whereas Eastern European banks seem to exploit greater freedoms to undertake greater risks, particularly if existing regulations promote risk-taking incentives. *Finally*, we separately control for the *origin of the judicial systems* several studies from the "law and finance" research field stress the linkage between the origin of a country's judicial system and financial sector development, e.g. protection of creditor rights (La Porta et al., 1998). We find that concentrated banking markets in countries with a soviet legal origin (all Eastern European countries) are more likely to be fragile whereas a French legal origin positively affects financial stability.

4. Conclusion

Using aggregate balance sheet data from more than 2,600 banks across the EU-25 over the period from 1997 to 2005 this paper provides empirical evidence that national banking market concentration has a negative impact on European banks' financial soundness as measured by the Z-score technique while controlling for macroeconomic, bank-specific, regulatory and institutional factors. Empirical results from panel estimations hold when

employing alternative concentration measures, applying instrumental variable techniques to address likely endogeneity as well as possible reverse causality and performing a variety of further sensitivity analyses. Our findings are consistent with the "concentration-fragility view" and confirm empirical findings by De Nicoló et al. (2004). They are in contrast to arguments of the "concentration-stability view" and findings of empirical studies by Schaeck and Čihák (2007); Schaeck et al. (2006) and Beck et al. (2006a, 2006b).

Investigating single Z-score components we additionally find that market concentration has a positive impact on banks' ROAA, capital ratios and the volatility of the ROAA. Hence, we suggest that the negative relationship between concentration and stability may be driven by a higher return volatility of larger banks in concentrated markets. As a result from further sensitivity analyses, we provide empirical evidence that Eastern European banking markets exhibiting a lower level of competitive pressure, fewer diversification opportunities and a higher fraction of government-owned banks are more prone to financial fragility whereas capital regulations support financial stability across whole Europe.

Against the background of our empirical results we deduce the following policy implications. *First*, as the European Commission has failed to do so until now, we stress the necessity of establishing the aspect of systemic stability as a further important criterion within the cross-border bank merger approval process under article 16 of the European Banking Directive. Furthermore, as systemic linkages of bank failures may amplify when fostering cross-border consolidation in European banking, we suggest further improving cross-country cooperation between European regulators and supervisors to clearly define responsibilities for prudential supervision and regulation of pan-European banks acting cross-border.

Second, if it is true that our measure of entry restrictions is an appropriate proxy for a banking market's competitiveness, our empirical analysis reveals a positive relationship between objectives of competition policy (market efficiency) and banking regulation

(systemic stability) for Eastern, but not for Western European countries. Although competent authorities in Europe are legitimated to examine bank mergers under both efficiency and stability aspects (European Council, 1989, Article 5), the European Commission has given no attention to the linkage between efficiency and stability aspects in banking at all when revising article 16 of the European Banking Directive. Hence, as a possible trade-off between efficiency and stability in European banking can not completely be ruled out, it is necessary to additionally foster coordination between national antitrust authorities and supervisory bodies in Europe.

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Statistical appendix A

Table 1
Notes on variables and data sources

Variable	Description	Data Sources
Z-score	Ratio of the sum of equity capital to total assets and ROAA to standard deviation of ROAA	Fitch-IBCA BankScope, own calc.
ROAA	Return on average assets before tax (ROAA)	Fitch-IBCA BankScope KZ 4006
Capital ratio	Ratio of equity capital to total assets	Fitch-IBCA BankScope KZ 2095
sdROAA	Standard deviation of ROAA	Fitch-IBCA BankScope KZ 4006, own calc.
Concentration (5)	EU 25 Concentration: Fraction of assets of a country's total banking system's assets held by the largest 5 domestic banks.	ECB statistics, national central banks
Concentration (3)	EU 25 Concentration: Fraction of assets of a country's total banking system's assets held by the largest 3 domestic banks.	ECB statistics, national central banks, own calc.
Concentration (I)	Initial market concentration (5) in 1997	ECB statistics, national central banks
Concentration (H)	Dummy variable that takes on the value one if the concentration ratio is above 0.8 or zero otherwise.	ECB statistics, national central banks, own calc.
HHI	Herfindahl-Hirschman index computed as the sum of the squared market shares of a country's banks.	ECB statistics, national central banks, own calc.
Basic economic attitude	Index that measures to which extent relevant parties of a country favor Keynesian demand management and propose a demand-oriented economic policy.	Comparative Manifesto Project
EU-integration	Index that measures to which extent relevant parties of a country are in opposition to European integration or specific European policies.	Comparative Manifesto Project
Duration	Index that measures the durability of the current political institutions in a country.	Polity IV Project
GDP per capita	Ratio of GDP to population	World Development Indicators (WDI)
Real GDP growth	Rate of real GDP growth at constant 2000 prices (annual percentage change)	World Development Indicators (WDI)
Inflation	Log of annual change in inflation rate	World Development Indicators (WDI)
Real interest rate (t-1)	Lag (1) of annual change of real short term interest rate, adjusted for inflation (GDP deflator)	World Development Indicators (WDI)
Credit growth (t-2)	Lag (2) of growth rate of domestic credit to the private sector to GDP	World Development Indicators (WDI)
Net interest margin	Log of accounting value of bank's net interest revenue as a share of its interest-bearing (total earning) assets	Fitch-IBCA BankScope KZ 2035
Loan loss provisions	Loan loss provisions in thousand USD	Fitch-IBCA BankScope KZ 2095
Cost-income ratio	Ratio of overhead costs to total revenue	Fitch-IBCA BankScope KZ 4029
Moral hazard index	Index that measures the generosity of the deposit insurance regime. Index is built by first principal component analysis of the following deposit insurance design features: coinsurance, coverage of foreign currency and interbank deposits, type of funding, source of funding, management, membership, and the level of explicit coverage. Higher index values indicate greater moral hazard.	Demirgüç-Kunt and Detragiache (2002)

Table 1 (cont'd)
Notes on variables and data sources

Variable	Description	Data Sources
Entry restrictions	Fraction of entry applications denied (domestic and foreign banks)	Barth et al. (2001, 2004)
Activity restrictions	Index aggregates measures that indicate whether bank activities in the securities, insurance, and real estate markets and ownership and control of non-financial firms are unrestricted, permitted, restricted, or prohibited. The aggregate indicator ranges between (0) and (4), with higher values indicating greater activity restrictions arising from legal requirements.	Barth et al. (2001, 2004)
Capital regulatory index	Index that measures the overall capital stringency. Index is built by first principal component analysis of initial capital stringency and overall capital stringency. Higher index values indicate greater capital stringency.	Barth et al. (2001, 2004)
Governmental ownership	Fraction of assets of a country's total banking system's assets held by government.	Barth et al. (2001, 2004)
Economic freedom	Composite index of ten indicators ranking policies in the areas of trade, government finances, government interventions, monetary policy, capital flows and foreign investment, banking and finance, wages and prices, property rights, regulation, and black market activity. Index scores from 0-100 with higher scores indicating polices being more conducive to competition and economic freedom.	Heritage Foundation
British legal origin	Dummy variable that takes on the value one if the country's legal system is of British legal 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 legal 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 legal 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 legal origin or zero otherwise.	La Porta et al. (1998)
Soviet legal origin	Dummy variable that takes on the value one if the country's legal system is of Soviet legal origin or zero otherwise.	La Porta et al. (1998)

Table 2
Descriptive statistics

Variable	N	Mean	SD	Min	Max
Z-score	225	26.896	20.425	-0.38	105.81
ROAA	225	11.787	17.694	-85.262	113.48
Capital ratio	225	7.002	5.013	0.344	35.163
sdROAA	225	0.985	2.886	0.002	28.7
Concentration (5)	225	0.592	0.21	0.17	0.99
Concentration (3)	225	0.722	0.196	0.237	1
Concentration (H)	225	0.2178	0.414	0	1
HHI	225	1146.636	862.0	114	4067
Basic economic attitude	225	0.516	0.772	0	4.02
EU-integration	225	0.867	1.005	0	5
Duration	207	36.435	29.966	4	125
Concentration (I)	225	0.6072	0.236	0.17	0.97
GDP per capita	225	16625.92	10629.36	2727.392	51590.18
Real GDP growth	225	3.611	2.496	-2.3	11.5
Inflation	225	-3.684	0.775	-6.812	-1.699
Real interest rate (t-1)	200	-0.542	1.961	-9.34	8.54
Credit growth (t-2)	175	93.758	49.33	12.785	237.758
Net interest margin	225	-3.598	0.463	-5.099	-2.432
Loan loss provisions	225	351868.1	588472.5	-648061	2854958
Cost-income ratio	225	66.572	39.69	21.15	588.224
Moral hazard index	225	0.256	2.899	-4.907	5.623
Entry restrictions	180	0.083	0.147	0	0.5
Activity restrictions	189	2.143	1.039	0	4
Capital regulatory index	189	0.442	0.906	-1.389	1.435
Governmental ownership	216	7.967	10.225	0	42.2
Economic freedom	225	66.607	6.374	49	81
British legal origin	225	0.24	0.428	0	1
French legal origin	225	0.28	0.45	0	1
German legal origin	225	0.28	0.45	0	1
Scandinavian legal origin	225	0.12	0.326	0	1
Soviet legal origin	225	0.08	0.272	0	1

Table 3
Z-score and concentration

	(1) Z-score	(2) Z-score	(3) Z-score	(4) Z-score	(5) Z-score	(6) Z-score	(7) Z-score
Concentration (5)	−22.0068	−16.6311			−16.7815	−61.9203	−50.8123
	(0.003)***	(0.027)**			(0.038)**	(0.019)**	(0.009)***
Concentration (3)			−13.7783				
			(0.080)*				
HHI				−0.0041			
				(0.014)**			
GDP per capita		0.0006					
		(0.001)***					
Real GDP growth	−0.0315	0.0554	0.0454	−0.0827	0.0123	−0.1376	−0.0387
	(0.888)	(0.797)	(0.845)	(0.710)	(0.952)	(0.590)	(0.902)
Inflation	−1.5398	−1.4827	−1.7207	−1.7627	−1.9753	−1.4176	−1.3171
	(0.119)	(0.097)*	(0.111)	(0.087)*	(0.022)**	(0.177)	(0.189)
Real interest rate (t-1)	0.2475	0.2016	0.3327	0.1889	0.1557	0.2161	0.2474
	(0.318)	(0.377)	(0.207)	(0.444)	(0.479)	(0.371)	(0.490)
Credit growth (t-2)	0.0756	0.0574	0.0793	0.0678	0.0732	0.0845	0.0754
	(0.003)***	(0.017)**	(0.001)***	(0.006)***	(0.005)***	(0.001)***	(0.018)***
Net interest margin	0.8678	1.6159	0.4461	0.0214		3.6500	2.4889
	(0.660)	(0.407)	(0.807)	(0.991)		(0.189)	(0.277)
Loan loss provisions	−2.58e-06	−2.71e-06	−2.38e-06	−2.68e-06		−2.59e-06	−2.71e-06
	(0.100)*	(0.085)*	(0.131)	(0.089)*		(0.107)	(0.026)**
Cost-income ratio	−0.0143	−0.0138	−0.0133	−0.0128		−0.1460	−0.0152
	(0.050)**	(0.080)*	(0.050)**	(0.062)*		(0.061)*	(0.238)
Moral hazard index	1.8204	1.5213	1.4813	1.8183	1.7034	2.9201	2.2332
	(0.019)**	(0.055)*	(0.058)*	(0.031)**	(0.065)*	(0.020)**	(0.021)**
Time Dummies	yes	yes	yes	yes	yes	yes	yes
No. of Obs.	175	175	175	175	175	161	175
No. of Groups	25	25	25	25	25	23	25
Wald χ^2	173.09***	182.15***	168.43***	157.12***	130.64	124.62***	61.24***
Adj. R^2	0.26	0.37	0.18	0.20	0.29	0.15	0.29

The panel model estimated is Z-score $_{(i=\text{country},\ j=\text{time})} = \alpha + \beta_1$ Concentration $(5)_{i,t} + \beta_2$ Real GDP growth$_{i,t} + \beta_3$ Inflation$_{i,t} + \beta_4$ Real interest rate$_{i,t-1} + \beta_5$ Credit growth$_{i,t-2} + \beta_6$ Net interest margin$_{i,t} + \beta_7$ Loan loss provisions$_{i,t} + \beta_8$ Cost-income ratio$_{i,t} + \beta_9$ Moral hazard index$_{i,t} + \varepsilon_{i,t}$. GDP per capita is additionally included in specification (2).

Concentration (5) is substituted by alternative measures Concentration (3) in specification (3) and HHI in specification (4). Bank-specific variables are omitted in specification (5). Concentration (5) is instrumented using Basic economic attitude, EU-integration and Duration in specification (6) and the initial concentration rate in specification (7). Regressions (6) and (7) are estimated by means of a 2SLS instrumental variable regression. Constant term included but not reported. Heteroscedasticity consistent P-values are in parenthesis. ***, **, *: statistically significant at the 1, 5 and 10% level.

Table 4
Z-score components and concentration

	(1) ROAA	(2) ROAA	(3) Capital Ratio	(4) sdROAA
Concentration (5)	6.3070		8.0015	1.1292
	(0.198)		(0.012)**	(0.085)*
Concentration (H)		6.5973		
		(0.010)***		
Real GDP growth	0.0009	−0.1082	−0.2695	0.0390
	(0.999)	(0.903)	(0.144)	(0.715)
Inflation	2.4458	2.8492	−1.1956	0.1144
	(0.408)	(0.316)	(0.062)*	(0.763)
Real interest rate (t-1)	−0.2163	−0.3116	−0.1365	−0.0753
	(0.832)	(0.763)	(0.421)	(0.438)
Credit growth (t-2)	0.0094	0.0044	−0.0085	−0.0107
	(0.729)	(0.866)	(0.510)	(0.012)**
Net interest margin	1.4748	0.9891	1.3791	−0.1255
	(0.654)	(0.751)	(0.091)*	(0.651)
Loan loss provisions	−5.26e-06	−4.70e-06	−2.09e-07	−2.77e-07
	(0.113)	(0.149)	(0.518)	(0.232)
Cost-income ratio	−0.1840	−0.1785	−0.0016	−0.0044
	(0.011)**	(0.012)**	(0.586)	(0.128)
Moral hazard index	−0.0765	−0.3919	−0.0904	−0.0371
	(0.861)	(0.406)	(0.691)	(0.469)
Time Dummies	yes	yes	yes	yes
No. of Obs.	175	175	175	175
No. of Groups	25	25	25	25
Wald χ^2	365.79***	425.64***	213.72***	45.47***
Adj. R^2	0.28	0.29	0.23	0.17

The panel model estimated is Z-score $_{(i=country,\ j=time)} = \alpha + \beta_1$ Concentration $(5)_{i,t} + \beta_2$ Real GDP growth$_{i,t} + \beta_3$ Inflation$_{i,t} + \beta_4$ Real interest rate$_{i,t-1} + \beta_5$ Credit growth$_{i,t-2} + \beta_6$ Net interest margin$_{i,t} + \beta_7$ Loan loss provisions$_{i,t} + \beta_8$ Cost-income ratio$_{i,t} + \beta_9$ Moral hazard index$_{i,t} + \varepsilon_{i,t}$.
Z-score is substituted by its single components ROAA, Capital ratio and standard deviation of ROAA in specifications (1)-(4).
Concentration (5) is substituted by Concentration (H) as a measure of high concentration in specification (2).
Constant term included but not reported. Heteroscedasticity consistent P-values are in parenthesis. ***, **, *: statistically significant at the 1, 5 and 10% level.

Table 5
Sensitivity analyses: regulatory and institutional environment

	(1) Z-score			(2) Z-score		
Concentration (5)	−29.7474	−27.1192	−22.4910	−30.1786	−26.9300	−27.4448
	(0.027)**	(0.041)**	(0.059)*	(0.005)***	(0.016)**	(0.020)**
Entry restrictions	−9.6524					
	(0.615)					
EU-10		−34.0645				
		(0.019)**				
EU-15			151.2443			
			(0.026)**			
Activity restrictions				−3.1516		
				(0.181)		
EU-10					−5.0131	
					(0.001)***	
EU-15						4.7001
						(0.060)*
Time Dummies	yes	yes	yes	yes	yes	yes
No. of Obs.	140	140	140	147	147	147
No. of Groups	20	20	20	21	21	21
Wald χ^2	123.23***	127.54***	122.21***	218.87***	175.76***	140.35***
Adj. R^2	0.27	0.30	0.41	0.31	0.36	0.31

The panel model estimated is Z-score $_{(i=country,\ j=time)}$ = $\alpha + \beta_1$ Concentration $(5)_{i,t} + \beta_2$ Real GDP growth$_{i,t} + \beta_3$ Inflation$_{i,t} + \beta_4$ Real interest rate$_{i,t-1} + \beta_5$ Credit growth$_{i,t-2} + \beta_6$ Net interest margin$_{i,t} + \beta_7$ Loan loss provisions$_{i,t} + \beta_8$ Cost-income ratio$_{i,t} + \beta_9$ Moral hazard index$_{i,t} + \varepsilon_{i,t}$. Constant term included but not reported. Heteroscedasticity consistent P-values are in parenthesis. ***, **, *: statistically significant at the 1, 5 and 10% level.

Table 5 (cont'd)
Sensitivity analyses: regulatory and institutional environment

	(3) Z-score			(4) Z-score		
Concentration (5)	−26.8870	−34.4601	−21.8623	−20.9535	−18.2986	−19.8980
	(0.017)**	(0.002)***	(0.086)*	(0.011)**	(0.014)**	(0.017)**
Capital regulatory index	8.1576					
	(0.002)***					
EU-10		8.1423				
		(0.001)***				
EU-15			9.2846			
			(0.061)*			
Governmental ownership				−0.4173		
				(0.070)*		
EU-10					−0.6887	
					(0.064)*	
EU-15						−0.2438
						(0.320)
Time Dummies	yes	yes	yes	yes	yes	yes
No. of Obs.	147	147	147	168	168	168
No. of Groups	21	21	21	24	24	24
Wald χ^2	205.82***	228.00***	162.16***	165.52***	150.86***	155.99***
Adj. R^2	0.39	0.35	0.34	0.27	0.27	0.25

The panel model estimated is Z-score $_{(i=country,\ j=time)}$ = $\alpha + \beta_1$ Concentration $(5)_{i,t} + \beta_2$ Real GDP growth$_{i,t} + \beta_3$ Inflation$_{i,t} + \beta_4$ Real interest rate$_{i,t-1} + \beta_5$ Credit growth$_{i,t-2} + \beta_6$ Net interest margin$_{i,t} + \beta_7$ Loan loss provisions$_{i,t} + \beta_8$ Cost-income ratio$_{i,t} + \beta_9$ Moral hazard index$_{i,t} + \varepsilon_{i,t}$. Constant term included but not reported. Heteroscedasticity consistent P-values are in parenthesis. ***, **, *: statistically significant at the 1, 5 and 10% level.

Table 5 (cont'd)
Sensitivity analyses: regulatory and institutional environment

	(5) Z-score			(6) Z-score				
Concentration (5)	−21.8520	−16.2033	−15.9971	−22.0915	−19.3919	−22.1112	−22.0923	−21.7971
	(0.004)***	(0.031)**	(0.037)**	(0.004)***	(0.008)***	(0.003)***	(0.003)***	(0.004)***
Economic freedom	−0.0684							
	(0.736)							
EU-10		−0.2434						
		(0.002)***						
EU-15			0.2102					
			(0.001)***					
British legal origin				−7.9478				
				(0.123)				
French legal origin					15.3706			
					(0.041)**			
German legal origin						−4.5093		
						(0.386)		
Scandinavian legal origin							3.5533	
							(0.657)	
Soviet legal origin								−14.7312
								(0.044)**
Time Dummies	yes	yes	yes	yes	yes	yes	yes	yes
No. of Obs.	175	175	175	175	175	175	175	175
No. of Groups	25	25	25	25	25	25	25	25
Wald χ^2	174.58***	178.38***	181.37***	173.50***	197.08***	180.41***	165.32***	172.19***
Adj. R^2	0.26	0.35	0.33	0.29	0.34	0.26	0.26	0.28

The panel model estimated is Z-score $_{(i=\text{country}, j=\text{time})} = \alpha + \beta_1$ Concentration $(5)_{i,t} + \beta_2$ Real GDP growth$_{i,t} + \beta_3$ Inflation$_{i,t} + \beta_4$ Real interest rate$_{i,t-1} + \beta_5$ Credit growth$_{i,t-2} + \beta_6$ Net interest margin$_{i,t} + \beta_7$ Loan loss provisions$_{i,t} + \beta_8$ Cost-income ratio$_{i,t} + \beta_9$ Moral hazard index$_{i,t} + \varepsilon_{i,t}$.
Constant term included but not reported. Heteroscedasticity consistent P-values are in parenthesis. ***, **, *: statistically significant at the 1, 5 and 10% level.

Statistical appendix B

Table 1
Number of EU-25 MFIs in sample

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005
EU-15									
Austria	133	144	160	187	206	197	157	121	115
Belgium	103	95	94	96	90	81	58	55	51
Denmark	101	105	112	122	113	112	99	65	61
Finland	16	16	15	18	16	15	13	11	12
France	436	420	463	476	477	418	358	199	186
Germany	1698	1655	1634	1550	1479	1414	1343	1309	1237
Greece	22	19	18	18	17	20	16	14	13
Ireland	48	52	62	61	60	60	43	17	15
Italy	648	641	715	718	765	733	315	412	396
Luxembourg	140	133	141	128	113	106	83	77	72
The Netherlands	68	69	73	78	76	76	54	20	13
Portugal	45	46	44	46	40	37	24	21	20
Spain	154	147	136	145	157	153	137	133	128
Sweden	28	30	40	42	123	125	115	109	104
United Kingdom	372	381	376	378	379	371	274	160	147
Total EU-15	4012	3953	4083	4063	4111	3918	3089	2723	2570
EU-10									
Czech Republic	27	25	28	31	32	29	18	14	13
Cyprus	21	23	18	19	19	20	11	14	12
Estonia	11	5	5	6	6	7	7	5	5
Hungary	27	26	30	37	33	32	26	19	19
Latvia	22	19	19	20	22	22	22	10	10
Lithuania	9	9	9	10	10	10	10	7	7
Malta	9	10	9	10	8	8	8	5	5
Poland	43	40	42	46	45	40	29	17	16
Slovakia	21	21	18	22	22	22	12	14	13
Slovenia	26	21	21	21	19	17	17	14	13
Total EU-10	216	199	199	222	216	207	160	119	113
Total EU-25	4228	4152	4282	4285	4327	4125	3249	2842	2683

Source: Number of MFIs reporting to BankScope database over the sample period 1997-2005 (consolidated data).

Table 2
Five-bank concentration ratios across the EU-25 (geographical distribution)

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005
Western Europe									
Austria	0.4424	0.4254	0.4122	0.4356	0.4573	0.4656	0.4412	0.4443	0.4517
Belgium	0.5473	0.6358	0.7611	0.7592	0.7808	0.8235	0.8423	0.8451	0.8552
Cyprus	0.8895	0.8824	0.8761	0.8773	0.6132	0.5784	0.5763	0.5751	0.5982
Denmark	0.7046	0.7147	0.7122	0.6084	0.6835	0.6809	0.6735	0.6713	0.6634
Finland	0.8833	0.8625	0.8641	0.8758	0.8054	0.7943	0.8138	0.8382	0.8335
France	0.4046	0.4144	0.4367	0.4723	0.4745	0.4555	0.4758	0.4540	0.5451
Germany	0.1723	0.1965	0.1972	0.2072	0.2092	0.2146	0.2241	0.2263	0.2146
Greece	0.5646	0.6342	0.6775	0.6557	0.6713	0.6774	0.6729	0.6534	0.6657
Hungary	0.6297	0.6595	0.6721	0.6123	0.5644	0.5455	0.5284	0.5291	0.5322
Ireland	0.4134	0.4044	0.4155	0.4161	0.4371	0.4647	0.4481	0.4476	0.4652
Italy	0.2535	0.2492	0.2535	0.2338	0.2966	0.3142	0.2757	0.2663	0.2748
Luxembourg	0.2346	0.2578	0.2641	0.2648	0.2836	0.3066	0.3276	0.3063	0.3111
Malta	0.9615	0.9341	0.9257	0.8966	0.8114	0.8245	0.7770	0.7851	0.7532
The Netherlands	0.7945	0.8288	0.8213	0.8155	0.8337	0.8366	0.8443	0.8431	0.8583
Portugal	0.4648	0.4563	0.4478	0.5953	0.6044	0.6167	0.6352	0.6768	0.6955
Spain	0.3257	0.3556	0.4168	0.4688	0.4534	0.4467	0.4443	0.4233	0.4236
Sweden	0.5847	0.5656	0.5628	0.5737	0.5522	0.5656	0.5416	0.5489	0.5767
United Kingdom	0.2493	0.2525	0.2836	0.2845	0.2976	0.3044	0.3367	0.3532	0.3634
Eastern Europe									
Czech Republic	0.8385	0.7963	0.7074	0.6058	0.6843	0.6572	0.6581	0.6403	0.6553
Estonia	0.9673	0.9868	0.9869	0.9751	0.9896	0.9955	0.9923	0.9862	0.9877
Latvia	0.4998	0.5574	0.5598	0.5590	0.6341	0.6534	0.6318	0.6243	0.6732
Lithuania	0.9137	0.9384	0.8741	0.8653	0.8760	0.8394	0.8134	0.7890	0.8060
Poland	0.5810	0.5685	0.5597	0.5597	0.5473	0.5342	0.5234	0.5022	0.4865
Slovakia	0.6715	0.6177	0.6790	0.6794	0.6613	0.6644	0.6752	0.6658	0.6772
Slovenia	0.5754	0.6645	0.6659	0.6760	0.6843	0.6642	0.6464	0.6325	0.6235

Source: ECB statistics, national central banks.

Table 3
First stage regressions (instruments)

	(1)	(2)
Basic economic attitude	0.0185	
	(0.027)**	
EU-integration	0.0148	
	(0.079)*	
Duration	−0.0018	
	(0.091)*	
Concentration (I)		0.6279
		(0.000)***
Real GDP growth	−0.0008	−0.0011
	(0.710)	(0.651)
Inflation	0.0090	0.0067
	(0.175)	(0.391)
Real interest rate (t-1)	−0.0007	0.0002
	(0.733)	(0.939)
Credit growth (t-2)	−0.0002	0.0001
	(0.487)	(0.641)
Net interest margin	0.0488	0.0532
	(0.017)**	(0.001)***
Loan loss provisions	3.75e-09	−6.70e-10
	(0.665)	(0.944)
Cost-income ratio	−7.60e-06	−2.27e-05
	(0.864)	(0.823)
Moral hazard index	0.0313	0.0021
	(0.015)**	(0.777)
No. of Obs.	161	175
No. of Groups	23	25
Wald χ^2	265.12	177.56***
Adj. R^2	0.06	0.23

Concentration (5) is instrumented by Basic economic attitude, EU-integration and Duration in specification (1). It is instrumented by the initial concentration ratio in specification (2). P-values are in parenthesis. ***, **, *: statistically significant at the 1, 5 and 10% level.

Table 4
Correlation matrix (Z-score and Z-score components regressions)

	Concentration (5)	ROAA	Capital Ratio	sdROAA	Real GDP growth	Inflation	Real interest rate (t-1)	Credit growth (t-2)	Net interest margin	Loan loss provisions	Cost-income ratio	Moral hazard index
Concentration (5)	1.00											
ROAA	0.07**	1.00										
Capital Ratio	0.37***	0.20***	1.00									
sdROAA	0.15**	0.03*	0.21***	1.00								
Real GDP growth	0.15**	0.12**	0.21***	0.20***	1.00							
Inflation	0.14**	-0.04*	0.19***	0.09*	0.16**	1.00						
Real interest rate (t-1)	0.04*	-0.17**	0.01*	-0.22***	-0.15**	-0.04*	1.00					
Credit growth (t-2)	-0.22***	0.02**	-0.35***	-0.33*	-0.42***	-0.14*	0.19**	1.00				
Net interest margin	0.26***	-0.04	0.29***	0.19**	-0.01*	0.30***	-0.05*	-0.16**	1.00			
Loan loss provisions	-0.13**	-0.21*	-0.12*	-0.09**	-0.22***	0.06*	0.08**	0.09*	-0.02**	1.00		
Cost-income ratio	0.02*	-0.42***	-0.06*	0.14**	-0.02*	0.12**	0.04***	-0.13*	0.11*	-0.04*	1.00	
Moral hazard index	0.11**	-0.06*	-0.10	-0.03***	-0.15**	-0.11**	0.07*	-0.04***	-0.32***	0.03**	0.04*	1.00

Table 5
Correlation matrix (instruments)

	Concentration (5)	Basic economic attitude	EU-integration	Duration	Concentration (I)
Concentration (5)	1.0000				
Basic economic attitude	0.1703**	1.0000			
EU-integration	−0.1431**	0.0387	1.0000		
Duration	−0.2783***	0.1437**	0.5011***	1.0000	
Concentration (I)	0.7493***	0.0386	−0.1681**	−0.3094***	1.0000

Table 6
Correlation matrix (bank level variables)

	Net interest margin	Loan loss provisions	Cost-income ratio
Net interest margin	1.0000		
Loan loss provisions	−0.0218***	1.0000	
Cost-income ratio	0.1056**	−0.0356**	1.0000

Table 7
Correlation matrix (country level variables)

	Concentration (5)	Concentration (3)	HHI	GDP per capita	Real GDP growth	Inflation	Real interest rate (t-1)	Credit growth (t-2)	Moral hazard index	Fraction of entry denied	Activity restrictions	Capital regulatory index	Governmental ownership	Economic freedom	British legal origin	French legal origin	German legal origin	Scandinavian legal origin	Soviet legal origin
Concentration (5)	1.00																		
Concentration (3)	0.65***	1.00																	
HHI	0.89***	0.58***	1.00																
GDP per capita	-0.44***	-0.26***	-0.39***	1.00															
Real GDP growth	0.15**	0.01	0.24***	-0.22***	1.00														
Inflation	0.14**	-0.11	0.10	-0.22***	0.15**	1.00													
Real interest rate (t-1)	0.05	0.12*	0.07	0.15**	-0.15**	-0.04	1.00												
Credit growth (t-2)	-0.23**	0.11	-0.32***	0.44***	-0.42***	-0.14*	0.18**	1.00											
Moral hazard index	0.11*	-0.15**	0.21***	0.15**	-0.14**	-0.11*	0.07	-0.04	1.00										
Entry restrictions	0.11	-0.11	0.07	-0.38***	0.04	0.01	-0.06	-0.37***	-0.18**	1.00									
Activity restrictions	0.14*	0.05	-0.09	-0.27***	-0.12*	0.06	-0.18**	-0.42***	-0.25***	0.51***	1.00								
Capital regulatory index	-0.15**	-0.01	0.03	0.32***	-0.15**	-0.01	0.16**	0.42***	0.12	-0.30***	-0.58***	1.00							
Governmental ownership	-0.32***	-0.11	-0.28***	-0.13*	-0.11	0.05	-0.09	-0.03	-0.05	-0.07	0.06	-0.06	1.00						
Economic freedom	-0.11*	0.02	0.02	0.52***	0.10	-0.23***	0.14**	0.28***	0.03	-0.12	-0.46***	0.18**	-0.26***	1.00					
British legal origin	-0.01	-0.09	-0.09	-0.15**	0.07	0.27***	-0.01	0.29***	-0.14**	0.19**	-0.19***	0.12	-0.22***	0.12*	1.00				
French legal origin	-0.24***	-0.20***	-0.24***	0.36***	-0.22***	-0.15**	0.06	0.26***	0.09	0.18**	-0.19***	0.34***	-0.05	0.01	-0.35***	1.00			
German legal origin	0.10	0.07	0.26***	-0.28***	0.26***	0.06	-0.01	-0.34***	0.13**	-0.01	-0.19***	-0.06	0.33***	-0.11*	-0.35***	-0.39***	1.00		
Scandinavian legal origin	0.17***	0.38***	0.12*	0.36***	-0.11	-0.34***	0.06	-0.02	-0.19***	-0.09	0.34***	-0.17**	-0.25***	0.12*	-0.21***	-0.23***	-0.23***	1.00	
Soviet legal origin	0.03	-0.17**	-0.04	-0.32***	-0.05	0.11*	-0.15**	-0.30***	0.07	0.22***	0.42***	-0.37***	0.17**	0.17**	-0.17**	-0.18**	-0.18***	-0.11	1.00

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