Profitability of Western European banking systems: panel evidence on structural and cyclical determinants

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Abstract

This paper analyses structural and cyclical determinants of banking profitability in 16 Western European countries. We find that financial structure matters, particularly through the beneficial effect of the capital market orientation in the respective national financial system. Furthermore, higher diversification regarding banks' income sources shows a positive effect. The industry concentration of national banking systems, though, does not significantly affect aggregate profitability. Business cycle effects, in particular lagged GDP growth, display a substantial procyclical impact on bank profits. These results are obtained in a single equation panel framework using the Hausman-Taylor instrument variable estimator. The data set comprises aggregate annual country data and banking group data (commercial banks, cooperative banks and savings banks) over the period 1979-2003.

JEL classification: E 32, G21, L11

Keywords: bank profits, financial structure, business cycle

Non technical summary

This study analyses structural and cyclical determinants of banking systems' aggregate return on assets (ROA). Applying a macroeconomic panel approach with annual data, we examine 16 Western European countries over the period 1979-2003. The principal research question is to what extent key structural characteristics of national financial systems contribute to the profitability of national banking systems. Among the explanatory variables, we nevertheless place strong emphasis on a broad coverage of the macroeconomic environment, e.g. GDP growth and interest rate effects. With respect to financial structure, the focus is on those characteristics that are considered to be essential in distinguishing European financial systems. First, this is the industry structure of national banking systems. It is proxied by the concentration ratio CR5, i.e. the aggregated market share of the five biggest banks. Second, financial structure represents the extent to which a financial system is bank-based or market-based.

Regarding the empirical set-up, the issue is to deal with time-invariant variables in a model that in other respects is frequently estimated by using a fixed effects panel model. In our case, yet, the latter is inappropriate since the fixed effects would remove the (time-invariant) variables of interest. We tackle this problem primarily by applying an instrument variable estimator proposed by Hausman and Taylor (1981). The specifications of the ROA model differ with respect to the inclusion of financial structure variables. Furthermore, a differentiation is made between estimation at the country level and at the level of banking groups within countries. The latter enables us to control for banking group effects (commercial banks, savings banks and cooperative banks) and also to include banking group specific variables, e.g. the capital ratio.

We find that financial structure matters to some extent while business cycle effects display a substantial impact. The main partial results are as follows. First, banking profitability is higher in market-based financial systems relative to bank-based systems. One has to bear in mind, however, that our sample ends in 2003. Accordingly, the tremendous growth in markets for financial innovations in recent years, especially regarding the credit derivatives segment, is hardly reflected in our results, let alone the most recent turmoil in securitisation and structured credit markets in summer 2007. It is therefore an open question to what extent such developments would have influenced our results.

Second, a stronger diversification with respect to the sources of banks' income is associated with higher profitability. The latter result is in line with recent microeconomic evidence on the impact of income diversification on bank profits (Carbo-Valverde et al., 2007 and Elsas et al., 2006). These studies identify a "diversification premium", i.e. banks are more successful

when their income streams are widely spread over various income sources. Third, the industry concentration in national banking markets does not significantly affect profitability. Fourth, business cycle effects can especially be attributed to lagged GDP growth and real interest rates. Fifth, the main results on the country level are confirmed by the banking group analysis.

Nichttechnische Zusammenfassung

Diese Studie analysiert strukturelle und zyklische Determinanten der aggregierten Gesamtkapitalrentabilität (ROA) nationaler Bankensysteme. Auf der Basis von Jahresdaten (1979-2003) verwenden wir makroökonomische Panelmodelle in einem Sample von 16 westeuropäischen Ländern. Die Forschungsfrage zielt insbesondere darauf ab, den Beitrag struktureller Charakteristika nationaler Finanzsysteme zur Erklärung der aggregierten Bankenergebnisse aufzuzeigen. Als erklärende Variablen ziehen wir gleichwohl auch das makroökonomische Umfeld in starkem Maße in Betracht (z.B. die Wachstumsrate des Bruttoinlandsprodukts (BIP) und Zinseffekte). Bezüglich der Finanzstrukturvariablen fokussieren wir auf Merkmale, die zur Unterscheidung der untersuchten Finanzsysteme zentral sind. Einerseits ist hier die Industriestruktur nationaler Bankenmärkte kennzeichnend. Der Konzentrationsgrad dieser Bankenmärkte – abgebildet als der Marktanteil der fünf größten Banken (CR5) – dient dabei als Proxy-Variable. Andererseits wird Finanzstruktur als Kapitalmarktorientierung eines Finanzsystems verstanden. Dies ist ein Gradmesser, inwieweit ein System bankbasiert oder kapitalmarktbasiert ist.

Auf der methodischen Ebene tritt das Problem auf, Finanzstrukturvariablen zu berücksichtigen, die keine Variabilität über die Zeit aufweisen. Im Gegensatz zum ansonsten häufig verwendeten Panelmodell mit fixen (Länder-)Effekten ermöglicht das hier verwendete Instrumentvariablenverfahren von Hausman und Taylor (1981) die Identifikation der zeitinvarianten Variablen. Die empirischen Spezifikationen des ROA-Modells unterscheiden sich hinsichtlich der Einbeziehung der Finanzstrukturvariablen. Darüber hinaus wird zwischen der Länderebene und der Ebene von Bankengruppen innerhalb der Länder differenziert. Letzteres ermöglicht es, Bankengruppeneffekte (Geschäftsbanken, Sparkassen und Genossenschaftsbanken) und gruppenspezifische Variablen, wie z.B. der Kapitalquote, zu berücksichtigen.

Es stellt sich heraus, dass Finanzstruktur bedeutsam ist. Zyklische Faktoren üben jedoch den wesentlichen Einfluss aus. Die wichtigsten Teilergebnisse lassen sich wie folgt zusammenfassen. Erstens ist die Profitabilität von Bankensystemen in kapitalmarktbasierten Finanzsystemen höher als in bankbasierten Finanzsystemen. Es ist allerdings zu berücksichtigen, dass unser Schätzzeitraum 2003 endet. Das enorme Wachstum der Märkte für Finanzinnovationen in den unmittelbar zurückliegenden Jahren – insbesondere im Segment der Kreditderivate – kann sich demzufolge in unseren Ergebnissen ebenso wenig niederschlagen wie die Anspannungen an den Verbriefungsmärkten im Sommer 2007. Es bleibt daher offen, in welchem Ausmaß solche Entwicklungen unsere Ergebnisse beeinflussen würden.

Zweitens hat die Einkommensdiversifikation der Banken einen positiven Einfluss auf die Profitabilität. Dieses Ergebnis steht im Einklang mit aktueller Evidenz aus mikroökonomischen Studien (Carbo-Valverde et al., 2007, and Elsas et al., 2006). Dort wird eine „Diversifikationsprämie“ identifiziert, die besagt, dass Banken ertragreicher sind, wenn ihre Einkommensströme breiter über die verschiedenen Einkommensquellen verteilt sind. Drittens hat der Konzentrationsgrad nationaler Bankensysteme keinen signifikanten Einfluss auf die Profitabilität. Viertens können die zyklischen Effekte insbesondere auf das verzögerte BIP-Wachstum und den Realzins zurückgeführt werden. Fünftens werden die Ergebnisse auf der Länderebene im Wesentlichen durch die Analysen auf der Bankengruppenebene bestätigt.

Contents

Profitability of Western European banking systems: Panel evidence on structural and cyclical determinants

1 Introduction[1]

Determinants of bank profits have for a long time attracted the interests of bank supervisors and academic researchers. Traditionally, research has been conducted on the individual bank level. During the recent decade though, the macroprudential perspective on the stability of financial systems has gained in importance. In this paper, we take on this aggregated view to analyse the profitability of national banking systems.

It has often been discussed if the relatively weak performance of the German banking system at the beginning of this century can be attributed to sluggish cyclical developments in Germany or if structural characteristics have also played a role. A convenient way to address this issue is to conduct country panel analyses and at the same time to account for both cyclical and structural variables. The empirical cross-country literature on banking profitability is for the most part split between business cycle studies and financial structure studies, however.

Existing business cycle studies (e.g. Arpa et al., 2001, Bikker, 2004, Pesola, 2005) primarily discuss the resilience of banking systems in times of macroeconomic stress. These studies are motivated by concerns that procyclical patterns in banking could become stronger due to the implementation of the new Basel capital accord. A common empirical result is that already in the current regime bank profits are procyclically driven, especially by GDP growth. Yet, to what extent these results are influenced by the structure of financial systems is for the most part disregarded.[2] In contrast, financial structure studies focus on the impact of institutional characteristics of financial systems on banking efficiency and profitability (e.g. Demirgüc-Kunt and Levine, 2001, and Demirgüc-Kunt et al., 2004). These studies extend the discussion on the finance-growth nexus towards a finance-profitability nexus by pointing to banking profitability as a potential transmission channel for growth. Due to the small time dimension used in these studies, cyclical relations are typically not adequately considered. The evidence regarding financial structure effects on bank profits is rather mixed. Especially the effects of banking sector concentration and capital market orientation are ambiguous.

The main objective of this paper is to bring elements of both strands together. This is accomplished by using a basic business cycle framework and at the same time extending this framework to financial structure aspects. We thereby point out that the explicit incorporation

[1] I thank Ben Craig, Jörg Breitung, Heinz Herrmann, the participants of the Seminar Series of the Research Centre of Deutsche Bundesbank and the participants of the International Central Banking Seminar on Financial Stability (May 2006) for helpful comments and suggestions. Of course, all remaining errors are mine.

[2] Athanasoglou et al. (2005) are an exception to this. The focus of their study, however, is limited to the analysis of the Greek banking sector.

of financial structure variables into a cyclical model yields insights that otherwise would be hidden behind country dummy variables (fixed effects). In addition, we clarify if existing macroprudential profitability studies (e.g. Bikker, 2004) are robust regarding their business cycle results if financial structure explicitly enters the regressions. Furthermore, we explore whether the business cycle impact depends upon the financial structure in the respective countries. To tackle these issues, we utilise annual data from 16 Western European countries over the time period 1979-2003. We estimate reduced form profitability models on the country level and also on the level of banking groups within these countries (i.e. commercial banks, savings banks and cooperative banks).

The contribution to the empirical literature is threefold. First, we extend the scope of analysis from a highly aggregated country level to a partly disaggregated banking group level. Heterogeneity in the banking business is thereby taken into account to some extent while taking advantage of the high coverage of country data (OECD Bank Profitability, 2005) compared to aggregating single bank data, e.g. from the BankScope database. Second, we promote the idea of considering financial structure further by incorporating those variables explicitly into the panel model that in our view are key in characterising European national financial systems. These variables are the capital market orientation, i.e. the extent to which a financial system is market-based or bank-based, and the banking industry structure, i.e. its concentration ratio. Third, the Hausman-Taylor estimates of the coefficients of time-invariant variables are cross-checked by a recently developed panel estimator that deals precisely with the problem of time-invariant variables in fixed effects panel models (Plümper and Tröger, 2007).

The paper is structured as follows. The second section presents stylized facts on banking profitability in Western European countries and discusses the theoretical and empirical literature. In the third section, we develop the empirical framework and describe the data. Empirical results and robustness checks are presented in the fourth section. In section five we summarize our findings and conclude.

2 Stylized facts and literature review

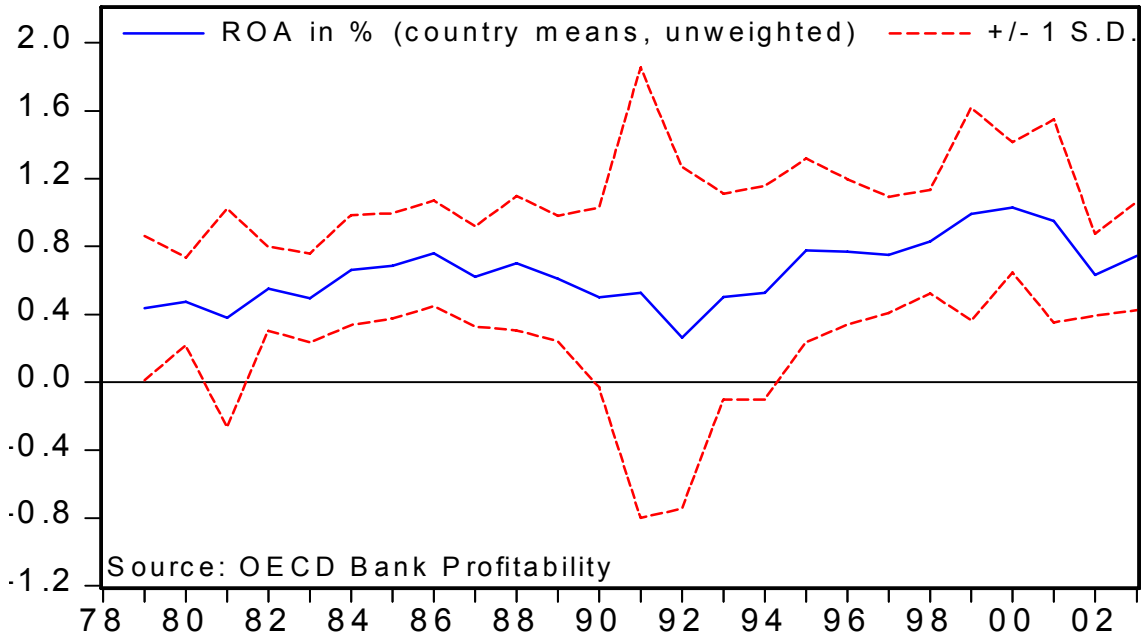
2.1 Stylized facts

To get a notion of the profitability patterns in Western European banking during the past 25 years, we briefly point to some stylized facts regarding aggregate return on assets before taxes (ROA) in the countries under review. Figures 1 and 2 show aggregate ROA, computed as the unweighted average of 16 Western European countries.[3] Information is given according to

[3] The names of the countries considered are given in the notes to Figure 2 and in the data section in 3.3.

ROA variation over time as well as to cross country variation. The Figures display considerable fluctuations in profitability in the period between 1979 and 2003.

Figure 1: ROA development in 16 Western European countries, 1979-2003

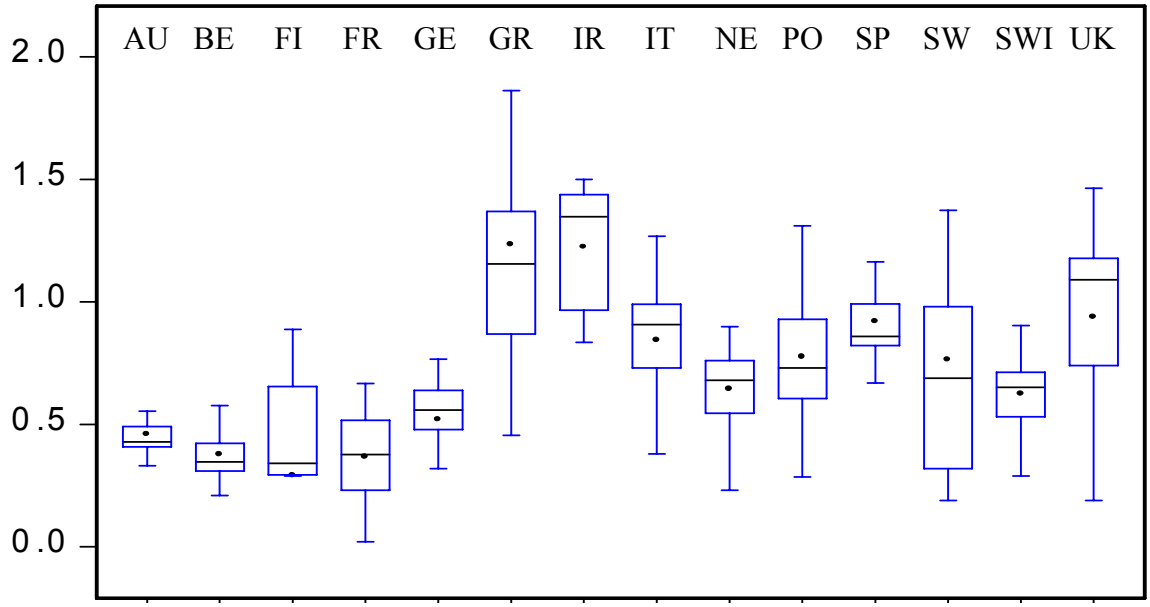


At the beginning of the nineties, the dispersion in ROA across countries widened enormously, partly due to the banking crises in the Scandinavian countries. Surprisingly though, despite of the ongoing process of European economic integration, e.g. through the implementation of the Second EU Banking Directive until 1992, ROA dispersion on average turned out to roughly sustain the level of before the crisis. The boxplot diagram (Figure 2) provides information on the ROA distribution by country. For example, the banking sector of the United Kingdom (UK) shows a relatively high ROA mean of above 1.0 while at the same time revealing a dispersion of profits over time that is much higher compared to the sample average. Yet, in both Figures, the particularly striking observation regarding the potential role of financial structure is that the variation between the respective countries shows up to be quite large.

The latter conjecture is also numerically traceable by decomposing the overall standard deviations of the panel series into their between components (i.e. between cross-section units) and their within components (i.e. within time periods). The proportion of the between variation to the within variation of the ROA measure is persistently higher than for macroeconomic variables (GDP growth, real interest rate, yield curve; see Table A2). Furthermore, we observe that the overall standard deviation of the ROA series on the country level amounts to 0.56 while in the disaggregated representation of the country data, i.e. the banking group level, it amounts to 0.81 (see Tables A2 and A3 in the Annex). This shows that ROA variability on the banking group level is 45 % higher compared to the variability on the country level. When looking at Figure 2, it also becomes clear that the cross-country variation can not be explained by resorting to a simple model of mean-variance tradeoff. Based on these stylized facts, we

expect idiosyncratic structural determinants to play an important role in explaining bank profits beyond a pure fixed effects approach.

Figure 2: ROA boxplots by country, 1979-2003 (in %)



Notes: AU:Austria, BE:Belgium, FI:Finland, FR:France, GE:Germany, GR:Greece, IR:Ireland, IT:Italy, NE:Netherlands, PO:Portugal, SP:Spain, SW:Sweden, SWI:Switzerland, UK:United Kingdom. The median is depicted using a line through the center of each box, while the mean is drawn using a dot; the box portion represents the first and third quartiles; the difference between them represents the interquartile range (IQR); the staple is a line drawn at the last data point within 1.5*IQR. Denmark and Norway are excluded from Figure 2 since otherwise several extreme values would dominate the illustration. Source: OECD, Bank Profitability and own calculations.

2.2 Theoretical approaches

With respect to the variables used in our empirical framework, three theoretical strands of the literature on the profitability of banks and banking sectors are relevant. First, the microeconomic dealership model of Ho and Saunders (1981) and its extension of Carbo-Valverde and Rodriguez-Fernandez (2007) affect our paper. Ho and Saunders show that profit margins of banks depend on market structure and the variance of interest rates, amongst other variables. Carbo-Valverde et al. generalize the pure intermediation model of Ho and Saunders by incorporating fee and trading based activities of banks. We especially make use of this latter aspect since it applies to our analysis of a broader profitability measure (ROA). At the same time, the allowance for non-traditional activities enables us to address the impact of diversification of bank revenues on profits.[4]

Second, the industrial organization literature is taken up as a reference point. Traditionally, the relationship between profits and market structure is being analysed from a market power

[4] The paper of Maudos and de Guevara (2004) is another example for an extension of the original dealership model. They allow for bank operating costs and credit risk as spread determinants.

perspective. With respect to the corresponding structure-conduct-performance hypothesis, industry concentration, in our case measured as the market share of the five biggest banks (CR5) in the respective country, acts as a proxy for market power. In this view, it is supposed that firms in more concentrated markets should be able to collude and thus to set prices above marginal costs. In contrast to that, the efficient-structure hypothesis attributes the often detected positive relation between profits and industry concentration to efficiency as the driver of both variables.[5] Third, the macroeconomic perspective on bank profitability is considered. Laeven and Majnoni (2003) target the potentially income smoothing properties and the cyclical dependence of loan loss provisions. Since loan loss provisions are a substantial cyclical component of our ROA measure their findings regarding the strong impact of GDP growth are taken into account.

2.3 Empirical evidence

Adopting an approach closely related to our own, Bikker (2004) analyses ROA, loan loss provisions and lending in 26 OECD countries at an aggregated level. Against the background of the ongoing implementation of the new Basel capital accord, his main interest is to enhance the debate on procyclicality patterns in banking. Bikker analyses whether banks behave procyclically already during the Basel I regime. If this should be the case he expects the Basel II regime to amplify this effect due to its stronger sensitivity to risk. By covering a sufficient number of business cycles, Bikker emphasises the time dimension of the data (1979-1999). Using a fixed effects panel model with an unbalanced data set, he indeed finds strong evidence that profitability moves up and down with the business cycle. The most noticeable partial result is that the contemporaneous and the lagged coefficient of GDP growth are both significant and positive. Moreover, some further macroeconomic variables strengthen this procyclical impact.

Yet, contrasting with the broad coverage of cyclical factors, Bikker models structural factors rather sparsely. “Differences between countries in financial structure, taxation regime, market structure, institutional conditions or management culture” (Bikker, 2004, p. 246) are intended to be picked up by country dummies, i.e. using a one-way unit fixed effects panel model. The country dummies show up to be jointly significant in all estimations. Furthermore, banking sector specific determinants are added to the model in terms of balance sheet ratios. The ratio of total loans to total assets is negatively related to ROA while the ratio of capital and reserves to total assets shows a positive impact on ROA. The funding structure, measured as the share of non-bank deposits to total assets, appears to be non-significant.

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[5] Yet, since our results clearly show that industry concentration is not significant in any regression, we do not develop a strategy how to differentiate between the two lines of arguments. See Bikker/Bos (2004) for a survey of the “collusion vs. efficiency debate”.

Regarding financial structure studies, Demirgüc-Kunt and Huizinga (1999, 2001) complement the well established discussion on the finance-growth nexus (e.g. King and Levine, 1993) by analysing financial systems' profitability and efficiency. In the first study, they use bank level data in a sample of 80 industrial and developing countries to analyse returns on assets and net interest margins. Covering the period 1988 to 1995, the impact of financial structure is assessed by adding key indicators of both national banking sectors and national stock markets to their ROA model. The banking sector is represented by the market concentration ratio, the number of banks and the ratio of bank assets to GDP. Bank characteristics and national macroeconomic indicators are also included as control variables. The authors find a significant and positive impact of bank concentration, measured as the ratio of the assets of the largest three banks to total banking assets (CR3) in a given year.

Concerning bank characteristics, Demirgüc-Kunt and Huizinga (1999) show that the capital ratio, measured as the book value of equity divided by lagged total assets, has a positive impact on ROA. This is in line with evidence from other microeconomic studies (e.g. Davis and Zhu, 2005, and Goddard et al., 2004). The reasoning behind this positive relationship is developed by Berger (1995). He argues that well-capitalized banks face lower expected bankruptcy costs and thereby reduce their costs of funding. Opposed to most macro-oriented studies, Demirgüc-Kunt and Huizinga find no significant effect of GDP growth while inflation enters the regression with a significantly positive sign.

Demirgüc-Kunt and Huizinga (2001) extend their framework to explicitly consider the impact of bank-based versus market-based financial systems on bank performance while controlling for the level of financial development. By averaging the data over the 1990-1997 period, the authors switch from a panel framework to a pure cross-bank respective cross-country framework. As a major result regarding the subsample of financially developed countries, the performance of banks is not affected by the degree of capital market orientation. A further result is that profits are negatively affected by the level of financial development. The authors attribute this to stronger banking sector competition in financially more advanced countries. Regarding our own framework, we concentrate on the capital market orientation of financial systems to effectively discriminate between financial systems.[6] This is due to the fact that the country sample used is much more homogeneous in our case. Differences in financial development are thus rather small.

A related area of research is concerned with the performance effect of diverging supervisory and regulatory regimes on the efficiency, stability and lending of banks. Based on cross section analyses on both the country and the single bank level, one major result in Barth et al. (2006) is that "Official Supervisory Power" neither impacts the income side nor the cost side

[6] Demirgüc-Kunt and Levine (1999) propose an applicable way to approximate the capital market orientation. In section 3, we briefly describe their approach.

of banks. As a consequence for the subsequent set-up of our model, we abstain from retesting this relationship.

3 Empirical framework

3.1 Set-up of profitability models

3.1.1 Country model

The theoretical and empirical considerations mentioned in chapter 2 are reflected in the design of our empirical work. Since a generally accepted structural profitability model has not yet been developed, we take a single equation reduced-form regression framework. At first, we set up the linear country model. The variables are grouped into five classes as follows:

(1) country-specific banking sector structure (BANK_SEC),

(2) country-specific financial system structure (FIN_SYS),

(3) country-specific macroeconomic environment (MACRO),

(4) country-specific bank balance sheet structure (BALANCE) and

(5) country-specific interaction of FIN_SYS and MACRO variables (INTERACT).

Accordingly, the basic regression equation on the country level is:

$$ROA_{i,t} = \alpha_i + \beta_1 BANK\_SEC_{i,t} + \beta_2 FIN\_SYS_{i,t} + \beta_3 MACRO_{i,t,\,(t-1)} + \beta_4 BALANCE_{i,t,\,(t-1)} + \beta_5 INTERACT_{i,t,\,(t-1)} + \varepsilon_{i,t} \quad \text{(I.)}$$

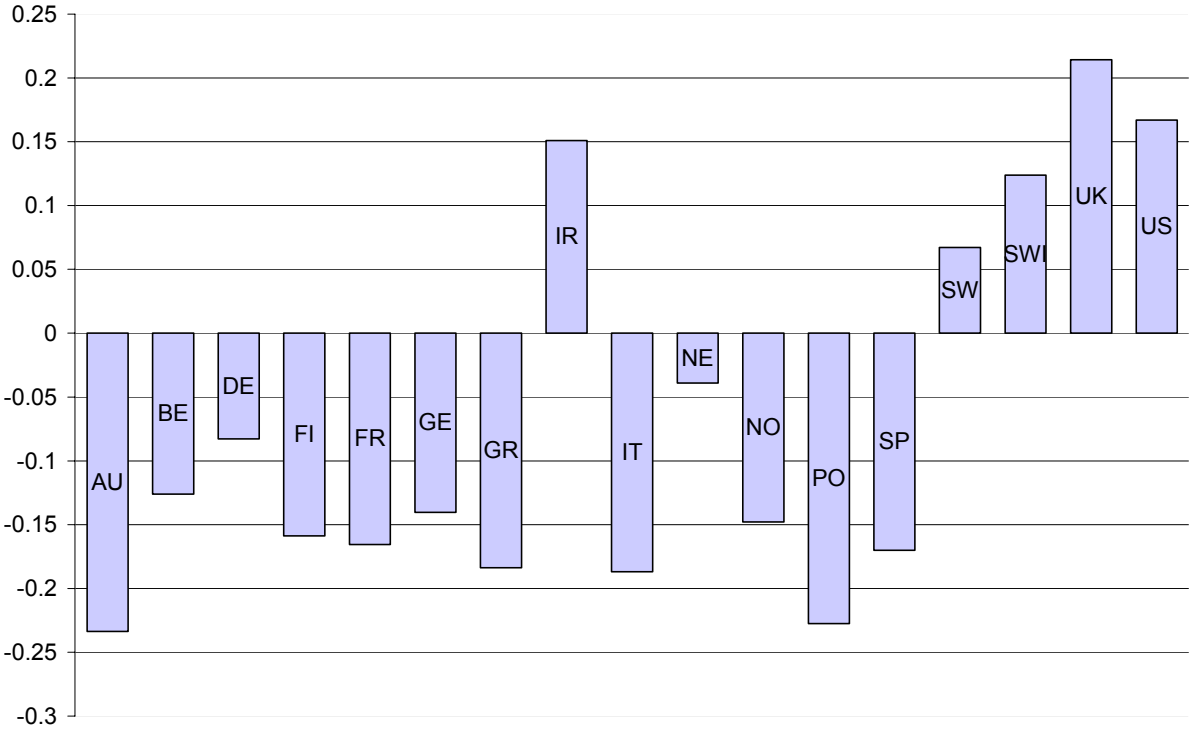
$ROA_{i,t}$ represents the aggregate return on assets before taxes of country i at time t. The country-specific constants α_i capture (unobserved) idiosyncratic effects. The idiosyncratic errors $\varepsilon_{i,t}$ are assumed to be independently and identically distributed (i.i.d.) with zero mean and finite variance.[7] By explicitly taking the structure of national banking sectors and national financial systems (BANK_SEC and FIN_SYS) into account, we augment the framework that is for example chosen by Bikker (2004) and Davis and Zhu (2005). In their empirical ROA models, the cross-country heterogeneity of banking and financial structure is covered solely by country-specific constants. In both papers, the independent variables are grouped into macroeconomic factors (MACRO) on the one hand and balance sheet structures (BALANCE) on the other hand. In the following, the variables and their expected impact are discussed.

We denote banking sector structure (BANK_SEC) as *structure in a narrower sense*. It is proxied by the concentration ratio of a national banking sector and is measured as the combined market share of the five biggest banks (CR5) in terms of total assets. Alternatively, the

[7] The robustness of our empirical results in the case of violations of the i.i.d. assumption is discussed in section 4.3.

Herfindahl index is used. According to the industrial organisation literature, a positive impact is expected under both competing views, i.e. the collusion versus the efficiency view (Goddard et al., 2001).

Figure 3: Degree of market-based vs. bank-based financial systems, averages over 1980-1995



Notes: Higher index values indicate a more market-based financial system. The country codes are as follows: AU:Austria, BE:Belgium, DE:Denmark, FI:Finland, FR:France, GE:Germany, GR:Greece, IR:Ireland, IT:Italy, NE:Netherlands, NO:Norway, PO:Portugal, SP:Spain, SW:Sweden, SWI:Switzerland, UK:United Kingdom, US:United States. Source: Beck et al. (2000) and World Bank.

We denote financial system structure (FIN_SYS) as *structure in a broader sense*. Instead of a pure dummy variable approach, i.e. to perceive a national financial system as either market-based or bank-based, we use an index variable that captures the range between both extremes. The index has been developed by Demirgüc-Kunt and Levine (1999). It gives an overall assessment of the relative importance of national capital markets compared to national banking markets by means of size, activity and efficiency characteristics. In the first step, the subindices "relative size", "relative activity" and "relative efficiency" are constructed. For example, the subindex "relative size" is calculated as the ratio of the national stock market capitalization to total assets of national deposit money banks, in each case as averages over 1980 to 1995. The single value of the overall structure index for one country is then computed as the average of the three means-removed subindices.[8] Generally, capital market orientation is con-

[8] A more detailed description of the index construction is given in Demirgüc-Kunt and Levine (1999); an empirical application is e.g. given in Demirgüc-Kunt and Huizinga (2001).

ceived as a key characteristic that still distinguishes different national banking systems in Western Europe.[9]

In Figure 3 the values of the financial structure index are displayed for the sample countries and additionally for the USA. As expected, United Kingdom, Ireland and Switzerland show the highest values among the European countries, since capital market financing has played a powerful role compared to bank financing in these countries. The lowest index values have been recorded for Austria and Portugal indicating a relatively strong weight for banking activities. We associate a higher index value with stronger capital market pressures that are expected to have a positive impact on banking profitability. In line with the reasoning in Llewellyn (2005), we attribute this to the observation that banks' focus on profitability as their key business objective is stronger if its financial system is to a greater extent leaned towards capital market financing. A higher capital market orientation thus forces banks to align to a more profit-oriented shareholder value strategy that on average should result in higher returns on assets.

As a different way of modelling financial structure, we also consider the composition of banks' income sources. Closely related to the approach in Stiroh (2004), we use a Herfindahl-Hirschmann index for the income diversification of banks (see Table A1 for the calculation); index values are therefore lower if a system is more diversified. There are two arguments that suggest a negative relation between diversification and ROA. First, the Herfindahl-Hirschmann index can be taken as a proxy for economies of scope. Second, market power might play a role since market conditions in the traditional banking business are sometimes supposed to be highly competitive compared to the fee-oriented business.[10]

The third class of variables (MACRO) corresponds to the macroeconomic environment and contains the real GDP growth rate, the real long term interest rate, the term structure, the volatility of interest rates and a banking crisis dummy variable. With respect to GDP growth there is an extensive debate on the linkages between the business cycle and banking sector performance. The quality of the credit portfolio is commonly seen as a fundamental element in the transmission of a business cycle stimulus to banks' performance. The procyclical effect emerges because the debt-servicing capacity of borrowers generally weakens in times of declining aggregate growth rates.[11] We therefore expect GDP growth to exert a positive impact on ROA. The real interest rate effect on profitability is more ambiguous. Yet, the dampening effect of a rise in real interest rates on credit demand and the accompanying deterioration in the credit quality are reasons in favour of a negative impact. The yield curve is expected to

[9] See Llewellyn (2006) for a broader discussion of this issue.

[10] Carbo-Valverde and Rodriguez-Fernandez (2007) comment further on this market power argument.

[11] See Laeven/Majnoni (2003) for a discussion of the behaviour of loan loss provisioning during the business cycle.

positively influence bank performance because of the positive maturity transformation effect in times of a normal term structure. To take transmission lags into account we also include lagged MACRO variables. The banking crisis dummy equals one if a systemic crisis is discovered and zero otherwise (Caprio et al., 2003). Interest rate risk is proxied by the volatility of interest rates. It is calculated as the annual standard deviation of monthly nominal long term interest rates.

The fourth class of variables (BALANCE) considers bank balance sheet structures and risks that correspond to that structure. Default risk in credit portfolios is ideally proxied by the ratio of non performing loans to total loans. Yet, since this variable is not available, we follow on the one hand Maudos et al. (2004) and use a loan-to-assets ratio as a credit risk proxy. On the other hand, we pick up the discussion on the relation between the capital ratio (total equity/total assets) and bank profitability. For instance, Goddard et al. (2004) theoretically favour the idea that a high capital ratio should be a signal of low risk because the respective bank is supposed to operate overcautiously and thereby ignores potential investment opportunities. This should result in a negative capital-earnings relation because investors demand a lower return on their capital in exchange for lower risk.

Yet, the overwhelming evidence points to the opposite direction.[12] For the period 1983-1989, Berger (1995) finds that US banks with a higher capital ratio have robustly higher returns. To back his empirical findings, Berger theoretically explains this relation by lower expected bankruptcy insurance costs for highly capitalized banks.[13] This means that a superior capital base is rewarded by lower interest rate payments especially on uninsured debt and interbank liabilities. In his study on US banks, Berger (1995) finds empirical support for the expected bankruptcy costs hypothesis. Another interpretation of a positive relation between capital and profits is that higher levels of capital simply reflect a higher level of riskier assets and this corresponds on average to higher expected profits.

Potential endogeneity of capital with respect to pre-tax returns has to be taken into account. Bank profits that are not distributed to shareholders, but retained to finance future investments, show a simultaneous movement with capital by definition. To reduce this effect, the capital ratio is lagged by one year.

As additional balance sheet structure variables, we use the interbank ratio, defined as the interbank fraction of the balance sheet total, and the funding gap, defined as the balance of loans to non-banks and deposits from non-banks as a share of the balance sheet total. Especially the consolidated country perspective should discover a negative relation between the

[12] See e.g. Bikker (2004) and Demirgüc-Kunt/Huizinga (1999).

[13] Alternatively, he resorts to the "signalling hypothesis". It says that sound banks can afford to signal high quality, i.e. creditworthiness on the part of the bank, by increased capital. Though, this hypothesis is empirically rejected.

interbank ratio and returns on assets. This is because country consolidation broadly cancels out interest expenditures and interest expenses while the balance sheet is extended by the interbank business. Countries with a higher interbank ratio thus should show structurally lower ROA figures. Regarding the funding gap, a positive value means that funding other than customer funding - either in the market or by interbank credit - is required. We expect a larger gap between customer loans and customer deposits to be associated with lower returns because alternative funding on markets or by interbank credit is considered to be more expensive.

Finally, by allowing for interaction between the business cycle (GDP growth) and the capital market orientation, we test whether procyclical forces work differently in market-based systems compared to bank-based systems.

3.1.2 Banking group model

We further extend the approach in Bikker (2004) by adding a disaggregated representation of the model. Instead of country aggregates, the analysis runs on the level of banking groups within countries. By this means, we account for heterogeneity in banks' business models to some extent. The grouping of the variables is therefore slightly different:

(1) country-specific banking sector structures (BANK_SEC),

(2) country-specific or banking group-specific financial system structures (FIN_SYS),

(3) country-specific macroeconomic factors (MACRO),

(4) banking group-specific balance sheet structures (BALANCE),

(5) country-specific or banking group-specific interaction of FIN_SYS and MACRO variables (INTERACT) and

(6) business model dummy variables (GROUP).

Regarding our baseline regression equation, the denotation has to be adapted to

$$ROA_{i,j,t} = \alpha_i + \beta_1 BANK\_SEC_{j,t} + \beta_2 FIN\_SYS_{i,j,t} + \beta_3 MACRO_{j,t} + \beta_4 BALANCE_{i,t(t-1)} + \beta_5 INTERACT_{i,j,t(t-1)} + \beta_5 GROUP + \varepsilon_{i,j,t} \quad \text{(II.)},$$

where $ROA_{i,j,t}$ represents the return on assets before taxes of banking group i in country j at time t. The banking group-specific constants α_i capture (unobserved) idiosyncratic effects and $\varepsilon_{i,j,t}$ is the idiosyncratic i.i.d. error term.

Compared to model (I.), the primary cross section unit changes from the country to the banking group level. Regarding the error components, we now have to take the clustering of the data into account, especially the correlation within countries. The variable classes broadly remain the same. Our main interest still is how the structural variables (BANK_SEC and FIN_SYS) are related to profitability. The improvement compared to model (I.) is that we can

now adequately control for banking group-specific balance sheet structures, i.e. the capital ratio and the interbank ratio. Also, the diversification of banks' income sources - our alternative measure of the structure of the financial system - can now be captured in a better way because the between variation is much higher compared to the country view (see Tables A2 and A3). Furthermore, the GROUP dummy variables correspond to the three banking groups in our sample (commercial bank sector, savings bank sector). The cooperative sector acts as the reference group.

3.2 Panel methodology

Our econometric strategy basically draws on the work of Hausman/Taylor (1981), Beck/Katz (1995) and Plümper/Tröger (2007). In our case, the problem of employing a standard fixed effects panel model is as follows. A few institutional variables that are of special interest for our empirical objective are observable, e.g. the industry concentration and the capital market orientation. Yet, the fixed effects estimator eliminates the time-invariant observable variables by its within transformation of the data. Estimated fixed effects therefore encompass the effects of all relevant institutional variables, be they observable or unobservable. An assignment to financial structure variables is impossible.

The instrument variable approach proposed by Hausman and Taylor (1981, hereafter HT) largely resolves this problem. The HT estimator qualifies if time-invariant regressors are considered and if any of the regressors, independent of being time-invariant or not, is correlated with the individual effect α_i. The key idea of the HT procedure is that the between variation and the within variation of the time-varying and the time-invariant exogenous variables are used to instrument the endogenous, potentially time-invariant, variables.[14] The HT estimator enables us to consistently estimate the coefficients of time-invariant variables, i.e. the banking industry concentration and the capital market orientation.

In our case, a correlation of the individual effect with some regressors cannot be ruled out; this results from the respective Hausman specification test. In addition, there is also an economic reasoning for assuming a correlation with the individual effect because the individual effect also contains the hardly observable degree of competition in banking. According to the industrial organization literature, we should expect that competition is not independent of the (observable) industry concentration (measured e.g. as CR5 or the Herfindahl index). So, a random effects estimator is suspected to yield inconsistent estimates for time-invariant respective almost time-invariant variables.

As a potential shortcoming of the HT procedure it has to be considered that the estimator does not allow for non-spherical residuals, which e.g. emerge from panel heteroskedasticity and

[14] The assignment of variables to exogenous and endogenous variables is explained in section 4.1.

contemporaneous correlation of the panel units. Therefore, our robustness checks employ firstly the panel estimator with "panel corrected standard errors" (PCSE) proposed by Beck and Katz (1995) to control for the robustness of the coefficients of the time-varying variables.[15] Secondly, regarding the time-invariant regressors, we cross-check our results by a novel approach called "fixed effects vector decomposition" (hereafter FEVD).[16]

3.3 Data

Our main data source is "Bank Profitability - Financial Statements of Banks" (OECD, 2005). Starting in 1979, the data base entails an annual reclassification of national income statements and national balance sheet information according to a standard framework. Countries report consolidated accounting data for the category "all banks" and – in some cases – also for several banking group subcategories. In our first model (country analysis), we use the category "all banks". Regarding the subcategories, we make use of "commercial banks", "savings banks" and "cooperative banks" data in the second model (banking group analysis). Macroeconomic data is taken from the annual macroeconomic database of the European Commission (AMECO) and the Main Economic Indicators database of the OECD. The crisis dummy variable is taken from the "Banking Crises Database" (Caprio et al., 2003). Indicators for financial structure are taken from World Bank studies (Demirgüc-Kunt and Huizinga, 2001), the World Bank Financial Structure Database 2005 and the EU Banking Structures Database (ECB, 2005). Some series, e.g. the concentration ratio and the capital market orientation, are not available over the entire period. Yet, since we are particularly interested in the considerable between variation and since the variation of these variables over time is relatively low, we use the respective average sample values as a proxy for the entire period.

The country sample consists of 16 Western European countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom). Regarding the banking group sample, disaggregated data is available only for a subset of 10 countries. Yet, the complete structure, i.e. including the three mentioned banking groups, is available only for Spain, Switzerland, Finland, France and Germany. Beyond that, Norway and Sweden provide data for the commercial and the savings bank sector while United Kingdom, Greece and Portugal provide data only for the commercial bank sector. As a result, the banking group sample consists of 22 banking groups

[15] If the time dimension T is approximately of the same order as the cross dimension N, this procedure is widely accepted. The alternative, a feasible generalized least square estimator (FGLS), is appropriate only for large N.

[16] The three stage FEVD procedure advances the two stage approach proposed by Hsiao (2003). Plümper and Tröger (2007) offer a broader discussion of this issue. We thank the authors for access to their STATA code called xtfevd. In empirical work, applications of the FEVD estimator are recently entering the literature; see e.g. Lago-Penas/Ventelou (2006) and Amable et al. (2006). Plümper/Tröger (2007) and Alfaro (2005) confirm the favourable small sample properties, especially regarding the estimation of time-invariant variables.

in 10 countries. Both, the country sample and the banking group sample, have an unbalanced structure and range from 1979 to 2003.

Variable definitions, summary statistics and pairwise correlations for the variables are shown in the annex (see Tables A1-A5). A test for stochastic trends is required because the panel data set is to a large extent dominated by its times series characteristics.[17] Panel unit root tests (see annex, Table A4) show that most of the variables of interest are stationary.[18] Yet, regarding "funding gap" and "credit risk", a unit root cannot be rejected. Yet, in order to stress our focus on financial structure, we circumvent the problem of unit roots for those variables that show a high fraction of between group variation (see Table A2). This is done by taking the respective group means. So, the "funding gap" is retained in the regression while the "credit risk" variable is excluded. As a consequence, the lagged capital ratio is assumed to pick up credit risk effects.

4 Empirical results

4.1 Country level

The principal results regarding the country model (see equation (I.) above) are shown in Table 1. Robustness checks are shown in Table A6 in the annex. Column (1) of Table 1 shows the specification that covers our basic structural variables, i.e. the banking industry concentration ("CR5") and the capital market orientation ("capital market"). In column (2) we add "diversification" as an alternative financial structure variable and in column (3) we include an interaction term of the capital market orientation and GDP growth ("market*gdp growth").

The coverage of the macroeconomic variables and the bank balance sheet variables is kept constant in each regression. Due to the comprehensive scope of cyclical regressors, time dummies are jointly insignificant and thus omitted. Country dummies are also omitted since otherwise the time-invariant regressors are dropped from the regressions due to collinearity.

According to the Hausman-Taylor procedure, a classification has to be made between exogenous and endogenous variables. As discussed in section 3.2, the industry concentration variable (CR5) could be correlated with the country specific effect. Also the bank balance sheet variables (interbank ratio, funding gap and diversification) are suspected to be correlated with

[17] In the case of non-stationary series, the spurious regression problem could result in biased estimates (Verbeek, 2004).

[18] Hsiao (2003) gives an overview of standard panel unit root tests. Regarding the net interest margin (see table A4 in the annex), we find that the null hypothesis of a unit root cannot be rejected. This result is noteworthy because empirical banking profitability studies bear the risk of spurious regressions unless a cointegrating relation is identified. A panel cointegration test based on the Johansen methodology - a modified trace statistic proposed by Breitung (2005) - actually provides evidence in favour of a panel cointegration relation of the net interest margin, a short-run and a long-run interest rate. This analysis, though, is beyond the scope of this paper.

the individual effect. Therefore, these four variables are regarded as endogenous variables. The macroeconomic variables (lagged gdp growth, real interest rate, yield curve, interest rate risk, crisis dummy), the capital market orientation, the interaction variable and the lagged capital ratio are assumed to be exogenous. The validity regarding this assignment of the instrument variables is confirmed by the robust Sargan-Hansen test of overidentifying restrictions (Baum, Schaffer and Stillman, 2003).[19]

Table 1: ROA country model

	(1)	(2)	(3)
gdp growth, t-1	0.09***	0.09***	0.07***
	[0.02]	[0.02]	[0.02]
real interest rate	-0.05***	-0.04***	-0.04***
	[0.02]	[0.02]	[0.02]
yield curve	0.01	-0.002	-0.002
	[0.02]	[0.02]	[0.02]
interest rate risk	0.09	0.13	0.15
	[0.12]	[0.12]	[0.12]
crisis dummy	-0.47***	-0.43***	-0.39***
	[0.13]	[0.13]	[0.13]
interbank ratio	-1.28*	-0.85	-1.01*
	[0.68]	[0.74]	[0.60]
capital ratio, t-1	0.01	0.02	0.03
	[0.03]	[0.03]	[0.02]
funding gap[a)]	-1.32*	-1.43*	-0.75
	[0.71]	[0.81]	[0.59]
capital market	0.64	0.51	1.56***
	[0.45]	[0.53]	[0.55]
CR5	0.07	0.29	-0.29
	[0.47]	[0.57]	[0.33]
diversification		-1.14***	-0.95**
		[0.38]	[0.37]
market*gdp growth			-0.30**
			[0.13]
Observations	241	241	241
Number of units	16	16	16
Sargan-Hansen stat.[b)]	1.65	1.49	6.62
Sargan-Hansen P-value	0.80	0.83	0.25

Notes: Regressions of country-specific return on assets by means of the Hausman-Taylor instrument variable estimator; standard errors in brackets; *,**,*** denotes significance at 10 %, 5 % and 1 %, respectively; no country dummies and no time dummies included. R-squared values are not computed in the applied STATA procedure (xthtaylor). Yet, an R-squared of 0.39 can be inferred from our robustness checks (see PCSE estimation in Table A6, column (2)). a) Country means. b) Test of overidentifying restrictions.

First of all, it is striking that the macroeconomic impact is very strong. Lagged GDP growth, the real interest rate and the crisis dummy variable display a highly significant impact on ROA throughout the three specifications. The magnitude of the coefficient on lagged GDP

[19] De Haas and Lelyveld (2006) undertake a comparable assignment of variables to exogenous and endogenous variables in their Hausman-Taylor estimation. Further robustness test are shown in Table 4 in section 4.3.

growth is comparable to that in Bikker's study (2004) where a broader sample of 26 OECD countries is used. The negative impact of the real interest rate further strengthens the procyclical profitability pattern. This finding is consistent with results of Arpa et al. (2001) for Austrian banks. As expected, the crisis dummy variable shows a negative impact. Unexpectedly, the yield curve is without statistical meaning. This result is potentially driven by the prevalence of large banks since they can more effectively hedge themselves against fluctuations of the term structure.[20] Also, the volatility of interest rates is not statistically significant.

Among the banking sector balance sheet variables (BALANCE), the lagged capital ratio is without statistical significance at this stage of analysis. The funding gap shows the expected negative impact, i.e. relatively low funding expenditure for non-bank depositors translate into higher profits. However, this effect is only weakly significant. As argued in section two, a higher interbank ratio, i.e. a stronger participation in the interbank business, weakens returns on assets.

The capital market orientation and the concentration ratio CR5 do not play a major role in the first two specifications. Regarding the CR5, this finding is pervasive throughout our regressions.[21] Yet, the effect of the capital market orientation is less univocal. In column (3), the inclusion of an interaction term between GDP growth and the capital market orientation brings about a positive capital market impact while the interaction term is negatively significant. The latter implies that the procyclical effect of GDP growth is higher in a bank-based than in a market-based environment.

The diversification variable has a negative and statistically highly significant impact on ROA. A high degree of diversification thus has a favourable effect on overall profits. We regard the diversification effect and the effect of capital market orientation as complementary because in market-based systems banks have a higher potential to participate in financial markets and thereby benefit from additional, i.e. fee-based and trading-based, business areas. The fact that the measure of income diversification in national banking sectors is significantly negative correlated with the index of capital market orientation (see Table A5, annex) underpins this argument. We therefore suggest that income diversification can be regarded as an alternative way to proxy the capital market orientation of a financial system. Recent microeconomic evidence on the impact of income diversification on bank profits (Carbo-Valverde et al., 2007 and Elsas et al., 2006) is in line with our results. These studies identify a "diversification premium", i.e. banks are more successful if their income streams are widely spread over the various income sources.

[20] Flannery (1981) finds for the US banking system that asset and liability portfolios of large banks have similar average maturities to evade interest rate risk.

[21] Results are unchanged if the Herfindahl index is used instead of CR5.

4.2 Banking group level

The principal results regarding the banking group model (see equation (II.) above) are shown in Table 2. The four specifications differ regarding the choice of financial structure variables. The method of estimation and the robustness tests are the same as on the country level (see section 4.1). The MACRO variables, the capital market orientation and the banking sector concentration are still defined on the country level. The BALANCE variables, the diversification measure and the business model dummy variables, however, are defined on the banking group level.

Regarding the impact of the MACRO variables, the results on the banking group level largely confirm the country level results. The estimated coefficients for lagged GDP growth and for the real interest rate are in fact somewhat larger. Contrasting to the country results, interest rate risk now brings about the expected positive risk premium effect.

The impact of the balance sheet structure variables and the national banking sector and national financial system structure is slightly different from the country regressions. The lagged capital ratio turns out to be weakly significant only in one regression. The inclusion of the concurrent capital ratio would result in a statistically highly significant effect. Yet, due to simultaneity bias, this result would be misleading; a rise in profits simultaneously raises capital for those fraction of profits that is not distributed to shareholders.[22] The funding gap is insignificant in the main regressions; merely in two robustness regressions (Table A7) it is negatively significant. Regarding the business model dummy variables, cooperative banks act as the reference group. They reveal the highest profitability compared to both competing groups, i.e. savings banks and commercial banks. But this effect is not significant in our principal regressions. We therefore infer that belonging to one of our main banking groups per se has no effect on profitability.

The most striking result is again the diversification effect. In all regressions, this banking group specific variable is highly significant and negative. If the business model of banks, proxied as an average over their respective banking group, is narrowed to one source of income – in our sample this is the traditional banking business of taking deposits and granting loans – return on assets is negatively affected. Economies of scope that are generated among different lines of the banking business can be regarded as one explanation. Another reasoning behind this finding is that market power is often supposed to be particularly higher in the non-traditional compared to the traditional banking business. Profit margins in fee-producing activities have thus been higher and a strategy of compensating lower margins in the traditional intermediation-oriented business by expanding fee-oriented business emerged to be successful.

[22] Unfortunately, a better risk proxy, e.g. a non performing loans ratio, is not available.

Table 2: ROA banking group model

	(1)	(2)	(3)	(4)
gdp growth, t-1	0.16***	0.16***	0.15***	0.15***
	[0.02]	[0.02]	[0.02]	[0.02]
real interest rate	-0.08***	-0.08***	-0.07***	-0.08***
	[0.02]	[0.02]	[0.02]	[0.02]
interest rate risk	0.39**	0.39**	0.43***	0.43***
	[0.16]	[0.16]	[0.16]	[0.16]
crisis dummy	-0.18	-0.18	-0.26	-0.25
	[0.22]	[0.22]	[0.21]	[0.21]
capital ratio, t-1	0.04	0.05*	0.03	0.03
	[0.03]	[0.03]	[0.03]	[0.03]
funding gap[a)]	-0.99	-0.67	-1.29	-1.24
	[1.32]	[1.19]	[1.70]	[1.74]
capital market	1.39	1.30	1.11	6.66
	[0.94]	[0.92]	[1.37]	[5.58]
CR5	-0.05	-0.06	-0.08	0.04
	[0.53]	[0.54]	[0.78]	[0.85]
commercial banks		-0.08	-0.28	-0.36
		[0.26]	[0.40]	[0.44]
savings banks		-0.05	-0.05	-0.07
		[0.28]	[0.42]	[0.46]
diversification			-2.08***	-3.69**
			[0.57]	[1.63]
market*diversification				-10.11
				[9.79]
Observations	338	338	338	338
Number of units	22	22	22	22
Sargan-Hansen stat.[b)]	1.51	1.55	3.10	2.94
Sargan-Hansen P-value	0.82	0.82	0.54	0.71

Notes: Regressions of banking group-specific return on assets by means of the Hausman-Taylor instrument variable estimator; standard errors in brackets; *,**,*** denotes significance at 10 %, 5 % and 1 %, respectively; no country dummies and no time dummies included. R-squared values are not computed in the applied STATA procedure (xthtaylor). Yet, an R-squared of 0.42 can be inferred from our robustness checks (see PCSE estimation in Table A7, column (2)). a) Banking group means. b) Test of overidentifying restrictions.

The finding of a significant and positive correlation between the index of financial structure and the measure of income diversification proves also to be true when diversification is measured on the banking group level (see Table A5 in the annex). Finally, we find that it makes no difference if banking groups' income sources are more diversified in bank-based compared to market-based systems. Column (4) shows that the corresponding interaction variable ("market*diversification") is not significant.

Table 3 shows the effective relevance of key independent variables. The economic significance is measured as the impact of a 1/2 standard deviation decrease in independent variables (from the sample means) on ROA. The strong macroeconomic influence is striking. For example, a decrease in GDP growth of one percentage point would result in a decrease of ROA amounting to 22.4 %.

Table 3: Economic significance of the banking group results

	decrease of ½ s.d. in independent variables (from sample means)	corresponding ROA impact: absolute ROA change (% change in brackets)
gdp growth, t-1	1.0	-0.15 (-22.4 %)
real interest rate	1.3	+0.10 (+13.4 %)
interest rate risk	0.15	-0.06 (-9.0 %)
capital ratio, t-1	1.0	-0.03* (-4.5 %)
CR5*	0.12	+0.01* (+1.5 %)
diversification	0.07	+0.15 (+20,9 %)

Notes: The reference estimation is displayed in Table 2, column 3. * denotes that this effect is not significant (10 %) in the baseline HT regression.

4.3 Robustness checks

Corresponding to the methodological set-up outlined in section 3.2, the robustness of the Hausman-Taylor estimations is tested by alternative panel estimators. We present these tests for both the country model (Table A6) and the banking group model (Table A7). However, we first reconfirm the need to employ the HT procedure. Hausman specification tests between the fixed effects and the random effects models show that the null hypothesis is rejected in the banking group model but cannot be rejected in the country model (see the respective Hausman statistics in column (3) in Tables A6 and A7). In the former case, the fixed effects model is to be preferred due to the inconsistency of the random effects estimator. To warrant consistency of our results, especially in the light of the non-robustness of the Hausman test to non-spherical errors, we stick to the fixed effects model in the country case as well.

As an initial consistent estimation, we can thus refer to the results of the fixed effects model (columns (1): FE). The problem of the fixed effects estimator gets evident when looking at the coefficients: structural variables are dropped from the regressions and estimation of their coefficients is therefore not possible. To ensure that the HT estimator is indeed a viable solution to this problem, besides the Sargan-Hansen test (see Tables 1 and 2) we further test the validity of the benchmark HT model. This second test follows the idea of the Hausman specification test.[23] These Hausman tests cannot be rejected (see columns (4) of Tables A6 and A7) and thus confirm the validity of the instruments.

Another problem of the HT estimator is that potential violations in the classical i.i.d. assumptions about the error process are not allowed for. Our data set indeed shows the presence of serial correlation, heteroskedasticity and spatial correlation; the respective null hypotheses (i.e. non-violation of perfect assumption about the error process) are largely rejected (see Ta-

[23] In this test, one estimator that is consistent and efficient under the null hypothesis but inconsistent if the null is rejected is compared with an estimator that is consistent under both outcomes. Here, the HT estimation is tested by using the within estimation as benchmark. If the null hypothesis cannot be rejected, the exogeneity restrictions imposed by the choice between exogenous and endogenous variables are not too restrictive and the HT estimator fits the statistical requirements. This testing procedure has been proposed by Baltagi et al. (2003) and has been applied e.g. by Carrére (2006).

bles A6 and A7 and the respective notes). Thus, we consider alternative estimators that are robust to the mentioned violations. On the one hand, regarding the time-varying variables, we follow the strategy developed by Beck and Katz (1995), i.e. "panel corrected standard errors" (PCSE). As the standard errors remain broadly unchanged, PCSE regressions in columns (2) confirm the HT results. On the other hand, to test the robustness of the time-invariant variables, we control the results by a panel estimator that has recently been developed to deal exactly with the problem of time-invariant variables in fixed effects panel models (see section 3.2 and Plümper/Tröger (2007) for further details). The results are also broadly confirmed.

To show that financial structure effects on profits are not due to the country sample selection, we also estimated the country model for the sample of those ten countries where disaggregated banking group data is available. The main results for the full country sample (see Table 1) are confirmed for the smaller sample (see Table A8 in the annex).

5 Conclusion

In this study, we provide evidence on structural and cyclical determinants of banking profitability - as measured by the return on assets before tax - in 16 Western European countries. We use annual data over the period 1979-2003 and estimate panel models on two different levels of aggregation, the country level and the banking group level. The main idea is to take structural characteristics of national banking sectors and national financial systems explicitly into account and in parallel not to forgo the business cycle dynamics of the data. The extension of the country perspective by a banking group perspective enables us to control for specific banking groups (commercial banks, savings banks and cooperative banks) and to incorporate group specific variables, e.g. the capital ratio, into the model.

We find that financial structure matters to some extent while business cycle effects display a substantial impact on banking profitability. The main results are as follows. First, a market-based financial system is more beneficial to the profitability of a national banking sector than a bank-based system. Second, the industry concentration in national banking markets does not have a significant effect. Third, the income structure of a banking system matters since a higher degree of diversification is related to higher profitability. Fourth, business cycle effects can especially be attributed to the effect of lagged GDP growth and the real interest rate. Compared to the results of Bikker (2004), we find even larger effects of lagged GDP growth on ROA. Furthermore, these results show that estimation efficiency is enhanced if key characteristics of financial structures are explicitly considered instead of assuming pure country and banking group specific fixed effects. Even so, we confirm results of existing studies on the cycle-profit relation where financial structure is subsumed under fixed country effects (Bikker, 2004). Finally, we find that the procyclical effect of GDP growth is higher in a bank-based than in a market-based environment.

One has to bear in mind, however, that our results correspond only to the period up to 2003. The strong dynamics in markets for financial innovations, e.g. on the credit derivatives segment, that in Western-Europe unfolded especially within the last couple of years, therefore play only a marginal role regarding the entire period of investigation (1979-2003). Thus, our results should not mechanically be carried forward towards the future without considering the possible adverse secondary effects of strongly growing capital markets.

Regarding the effect of income diversification, our results corroborate recent evidence on the "diversification premium" (Carbo-Valverde et al., 2007 and Elsas et al., 2006). These studies observe that banks are more profitable when their income streams are widely spread over the income sources of banks. This income diversification effect and the effect of the capital market orientation can be considered as complementary since in market-based systems banks are usually strongly involved in capital market activities. Thereby it is easier for them to tap into additional market related business areas. Further research on the individual bank level is however required to clarify this relation.

Furthermore, our results are for the most part in line with Llewellyn's "holistic approach to the analysis of bank profitability" (2005). Llewellyn states that the strong performance of the banking sector in the United Kingdom compared to continental European banking is the result of the business cycle and structural factors on the one hand and the mix, the practice and the strategy of the business of banking firms on the other hand. Especially the fact that British banks have strongly been governed by capital market forces in the past corresponds to our result regarding the beneficial impact of a market-based financial system. Even though the relative weight of capital markets compared to banking activities in Western European countries is on the rise, adjustments in this field go on rather slowly. Therefore, we agree with Bikker and Bos (2006) that national differences in terms of structure and performance in European banking remain substantial in spite of strong efforts to liberalize and integrate European banking markets.

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Annex

Table A1: Data sources

Variable	Description/Calculation	Source
Return on assets (ROA)	Profit before tax/balance sheet total (year average); in %.	OECD, Bank Profitability
CR5	Percentage share of the five largest credit institutions; in %.	ECB, EU Banking Structures (2005)
Herfindahl-Index	Sum of the squares of all the credit institutions' market shares, according to total assets.	ECB, EU Banking Structures (2005)
Capital market	Index that merges the subindices "relative bank size", "relative bank activity" and "relative market efficiency".	Demirgüc-Kunt/Levine (2001)
GDP growth	Real GDP growth rate; in %.	AMECO Database
Crisis dummy	Dummy variable that equals one if a systemic crisis is discovered and zero otherwise.	Caprio et al. (2003): Banking Crises Database
Interest rate	Real long term interest rate: difference of nominal long-term interest rate and contemporary inflation rate, in %.	AMECO Database
Yield curve	Difference of nominal long-term and nominal short-term interest rates, in %.	AMECO Database
Interest rate risk	Annual standard deviation of monthly nominal long term interest rates.	OECD Main Economic Indicators
Capital ratio	ratio of capital and reserves to total assets; in %; in %.	OECD, Bank Profitability
Interbank ratio	(interbank assets + interbank liabilities)/2*balance sheet total; in %.	OECD, Bank Profitability
Credit risk	ratio of total loans to total securities; in %	OECD, Bank Profitability
Diversification	(non interest income/gross income)^2+(net interest income/gross income)^2.	OECD, Bank Profitability
Funding gap	(loans to non-banks - deposits from non-banks)/balance sheet total; in %.	OECD, Bank Profitability
Commercial banks	Dummy (1/0) variable that equals one if the group is composed of commercial banks.	OECD, Bank Profitability
Savings banks	Dummy (1/0) variable that equals one if the group is composed of savings banks.	OECD, Bank Profitability

Notes: OECD, Bank Profitability - Financial Statements of Banks (2005); AMECO is the annual macroeconomic database of the European Commission.

Table A2: Descriptive statistics for country level variables

Variable	Mean	Standard Deviation (s.d.)		between s.d./ within s.d.	Observations
ROA	0.67	overall s.d.	0.56		N = 341
		between s.d.	0.28	0.56	n = 16
		within s.d.	0.50		T* = 21.3
GDP growth	2.44	overall s.d.	2.10		N = 400
		between s.d.	0.84	0.44	n = 16
		within s.d.	1.93		T = 25
Interest rate	4.12	overall s.d.	2.81		N = 372
		between s.d.	1.25	0.49	n = 16
		within s.d.	2.55		T* = 23.3
Yield curve	0.54	overall s.d.	1.60		N = 368
		between s.d.	0.55	0.36	n = 16
		within s.d.	1.51		T* = 23
Interest rate risk	0.47	overall s.d.	0.33		N = 301
		between s.d.	0.13	0.43	n = 16
		within s.d.	0.30		T* = 18.8
Crisis dummy	0.08	overall s.d.	0.26		N = 385
		between s.d.	0.11	0.45	n = 16
		within s.d.	0.24		T* = 24.1
CR5	0.53	overall s.d.	0.22		N = 416
		between s.d.	0.23	4.6	n = 16
		within s.d.	0.05		T = 26
Herfindahl	817	overall s.d.	619		N = 143
		between s.d.	616	3.5	n = 13
		within s.d.	176		T = 11
Capital market	-0.08	overall s.d.	0.14		N = 416
		between s.d.	0.14	-	n = 16
		within s.d.	0.00		T = 26
Diversification	0.59	overall s.d.	0.11		N = 343
		between s.d.	0.06	0.67	n = 16
		within s.d.	0.09		T* = 21.4
Credit risk	3.57	overall s.d.	2.43		N = 344
		between s.d.	1.50	0.77	n = 16
		within s.d.	1.95		T* = 21.5
Interbank ratio	0.20	overall s.d.	0.11		N = 330
		between s.d.	0.10	2.5	n = 16
		within s.d.	0.04		T* = 20.6
Capital ratio	5.86	overall s.d.	2.04		N = 340
		between s.d.	1.72	1.53	n = 16
		within s.d.	1.12		T* = 21.3
Funding gap	-0.01	overall s.d.	0.15		N = 340
		between s.d.	0.14	1.56	n = 16
		within s.d.	0.09		T* = 21.3

Notes: T* denotes the average number of available values per cross section unit.

Table A3: Descriptive statistics for the variables on the banking group level

Variable	Mean	Standard Deviation (s.d.)		between s.d./ within s.d.	Observations
ROA	0.67	overall s.d.	0.81		N = 495
		between s.d.	0.37	0.51	n = 22
		within s.d.	0.73		T* = 22.5
Diversification	0.62	overall s.d.	0.12		N = 499
		between s.d.	0.09	1.29	n = 22
		within s.d.	0.07		T* = 22.7
Credit risk	5.98	overall s.d.	6.37		N = 500
		between s.d.	4.72	1.03	n = 22
		within s.d.	4.57		T* = 22.7
Interbank ratio	14.28	overall s.d.	10.78		N = 490
		between s.d.	11.26	2.84	n = 22
		within s.d.	3.97		T* = 22.3
Capital ratio	6.11	overall s.d.	2.63		N = 500
		between s.d.	2.07	1.23	n = 22
		within s.d.	1.68		T* = 22.7
Funding gap	-0.04	overall s.d.	0.19		N = 500
		between s.d.	0.18	1.8	n = 22
		within s.d.	0.10		T* = 22.7

Notes: T* denotes the average number of available values per cross section unit.

Table A4: Panel unit root tests for unbalanced panels

Country variables (N=16, T=25)

Null hypothesis: Unit root	Levin, Lin & Chu t*Statistic / Prob.		Im, Pesaran and Shin W-stat / Prob.	
ROA	-2.15	0.016	-2.94	0.002
GDP growth	-4.17	0.000	-5.99	0.000
Interest rate	-3.27	0.001	-4.45	0.000
Yield curve	-4.39	0.000	-4.67	0.000
Interest rate risk	-7.83	0.000	-4.91	0.000
Interbank ratio	-1.80	0.036	-1.75	0.039
Capital ratio	-2.79	0.003	-1.91	0.028
Diversification	-2.77	0.003	-1.80	0.036
Funding gap*	1.79	0.964	2.93	0.998
Credit risk*	-0.98	0.164	1.79	0.963
Net interest margin*	0.74	0.771	3.06	0.999

Banking group variables (N=22, T=25)

Null hypothesis: Unit root	Levin, Lin & Chu t*Statistic / Prob.		Im, Pesaran and Shin W-stat / Prob.	
ROA	-1.88	0.030	-3.81	0.000

Notes: Test equations include individual intercepts; the selection of lags is based on Akaike's information criterion. * denotes that the null hypothesis of a unit root cannot be rejected.

Table A5: Correlation matrices for the country data and the banking group data

countries	ROA	GDP growth	Interest rate	Yield curve	Interest rate risk	Crisis	CR5	Herfindahl	Capital Market	Diversifi-cation.	Credit risk	Interbank ratio	Capital ratio	Funding gap
ROA	1													
GDP growth	0.30*	1												
Interest rate	-0.29*	0.03	1											
Yield curve	-0.07	0.14*	0.06	1										
Interest rate risk	-0.06	-0.06	0.21*	-0.12*	1									
Crisis Dummy	-0.26*	-0.14*	0.16*	-0.12*	0.19*	1								
CR5	-0.15*	-0.01	0.05	0.08	-0.20*	0.07	1							
Herfindahl	-0.02	0.03	-0.04	0.12	-0.06	0.05	0.97*	1						
Capital market	0.12*	0.09	-0.06	-0.07	0.05	-0.12*	-0.04	-0.11	1					
Diversification	-0.24*	-0.02	-0.24*	-0.03*	0.21*	0.15*	-0.09*	-0.13*	-0.23*	1				
Credit risk	-0.1	-0.01	-0.07	-0.19*	-0.14*	0.05	0.15*	-0.05	0.06	-0.07	1			
Interbank ratio	-0.11*	-0.04	0.02	0.19*	-0.21*	-0.30*	-0.21*	-0.28*	0.14*	0.03	-0.25*	1		
Capital ratio	0.32*	0.14*	-0.22*	-0.08	0.17*	0.08	-0.01	-0.06	-0.16*	0.05	-0.02	-0.36*	1	
Funding gap	-0.21*	-0.07	-0.12*	0.17*	-0.34*	0.00	0.16*	-0.08	0.08	-0.07	0.25*	0.29*	-0.20*	1
banking groups														
ROA	1													
GDP growth	0.19*	1												
Interest rate	-0.23*	0.03	1											
Yield curve	0.00	0.19*	-0.05	1										
Interest rate risk	0.00	-0.07	0.26*	-0.08	1									
Crisis Dummy	-0.21*	-0.24*	0.31*	-0.09	0.39*	1								
CR5	-0.18*	0.08*	0.04	0.00	-0.14*	0.24*	1							
Herfindahl	0.40*	0.32*	-0.05	0.10	-0.06	0.00	0.95*	1						
Capital market	0.01	-0.12*	-0.07	0.00	-0.15*	-0.01	0.08	-0.18	1					
Diversification	0.03*	0.02	0.07*	-0.17*	0.19	-0.04*	-0.29*	-0.22*	-0.27*	1				
Credit risk	-0.20*	0.04	-0.01	-0.11*	-0.17*	0.00	0.31*	0.47*	0.09*	-0.07	1			
Interbank ratio	-0.06	-0.08	0.02	0.05	-0.08	-0.13*	-0.41*	-0.45*	-0.01	-0.05	-0.11*	1		
Capital ratio	0.40*	0.10*	-0.15*	0.03	0.20*	-0.03	0.04	0.26*	-0.14*	0.12*	-0.14*	-0.22*	1	
Funding gap	-0.23*	-0.12*	-0.10*	0.08	-0.34*	0.11*	0.38*	0.01	0.32*	0.15*	0.21*	-0.03	-0.16*	1

Notes: A star denotes that correlation coefficients are significant at the 5% level.

Table A6: Robustness checks of the baseline ROA country model

	(1) FE	(2) PCSE(AR)	(3) RE(AR)	(4) HT	(5) FEVD(AR)
gdp growth, t-1	0.07**	0.05*	0.06***	0.07***	0.05***
	[0.03]	[0.03]	[0.02]	[0.02]	[0.02]
real interest rate	-0.05***	-0.05**	-0.04***	-0.04***	-0.04***
	[0.02]	[0.02]	[0.01]	[0.02]	[0.01]
interest rate risk	0.16	0.13	0.05	0.15	0.03
	[0.12]	[0.11]	[0.11]	[0.12]	[0.11]
crisis dummy	-0.37***	-0.28*	-0.29**	-0.39***	-0.39***
	[0.14]	[0.16]	[0.15]	[0.13]	[0.13]
interbank ratio	-0.27	-0.81	-0.55	-1.01*	0.30
	[0.99]	[0.88]	[0.51]	[0.60]	[0.77]
capital ratio, t-1	0.04	0.05	0.04	0.03	0.03
	[0.04]	[0.06]	[0.03]	[0.02]	[0.03]
funding gap[a)]	n.f.	n.f.	-0.90*	-0.75	-1.15***
			[0.50]	[0.59]	[0.29]
capital market	n.f.	n.f.	1.28**	1.56***	1.23***
			[0.55]	[0.55]	[0.23]
CR5	n.f.	n.f.	-0.27	-0.29	-0.15
			[0.22]	[0.33]	[0.13]
diversification	-1.15***	-1.00***	-1.29***	-0.95**	-1.49***
	[0.39]	[0.23]	[0.33]	[0.37]	[0.35]
capital market*gdp growth	-0.34**	-0.31**	-0.22*	-0.30**	-0.30**
	[0.17]	[0.15]	[0.13]	[0.13]	[0.12]
Observations	241	241	241	241	235
Number of units	16	16	16	16	
R-squared	0.34	0.39	0.41		0.46
Serial correlation	38.53***				
Heteroskedasticity	2224.68***				
Spatial correlation	2.63***				
Hausman test			3.21	4.52	

Notes: The reference specification is presented in Table 1, column (3). Standard errors in brackets; *,**,*** denotes significance at 10%, 5% and 1%, respectively; n.f. means estimation not feasible due to time-invariance; FE: Fixed effects estimator; PCSE(AR): Panel corrected standard errors with AR(1) autocorrelation structure, country dummies included; RE(AR): Random effects estimator with AR(1) autocorrelation structure; HT: Hausman-Taylor estimator; FEVD(AR): Fixed effects vector decomposition estimator with AR(1) Prais-Winsten transformation; Serial correlation: Wooldridge test for autocorrelation in panel data (Wooldridge, 2002); Heteroskedasticity: Modified Wald test for groupwise heteroskedasticity in fixed effect regression model (Greene, 2000, p. 598); Spatial correlation: Pesaran's test (2004) of cross sectional independence; Hausman test: FE vs. RE in column (3) and FE vs. HT in column (4). a) Country means.

Table A7: Robustness checks of the baseline ROA banking group model

	(1) FE	(2) PCSE	(3) RE	(4) HT	(5) FEVD
gdp growth, t-1	0.14***	0.14***	0.17***	0.15***	0.14***
	[0.02]	[0.03]	[0.02]	[0.02]	[0.02]
real interest rate	-0.07***	-0.07***	-0.07***	-0.07***	-0.07***
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]
interest rate risk	0.42***	0.42***	0.40**	0.43***	0.42***
	[0.16]	[0.15]	[0.16]	[0.16]	[0.15]
crisis dummy	-0.29	-0.22	-0.04	-0.26	-0.29
	[0.22]	[0.25]	[0.21]	[0.21]	[0.21]
capital ratio, t-1	0.02	0.02	0.08***	0.03	0.02
	[0.03]	[0.04]	[0.02]	[0.03]	[0.02]
funding gap[a)]	n.f.	n.f.	-0.68*	-1.29	-1.32***
			[0.40]	[1.70]	[0.37]
capital market	n.f.	n.f.	1.27***	1.11	1.06***
			[0.45]	[1.37]	[0.39]
CR5	n.f.	n.f.	-0.52**	-0.08	-0.25
			[0.25]	[0.78]	[0.22]
commercial banks	n.f.	n.f.	-0.20	-0.28	-0.34***
			[0.14]	[0.40]	[0.12]
savings banks	n.f.	n.f.	-0.02	-0.05	-0.03
			[0.14]	[0.42]	[0.12]
diversification	-2.28***	-2.28***	-1.26***	-2.08***	-2.28***
	[0.59]	[0.60]	[0.48]	[0.57]	[0.48]
Observations	338	338	338	338	338
Number of units	22	22	22	22	
R-squared	0.26	0.42	0.34	--	0.42
Serial correlation	1.93				
Heteroskedasticity	5802.66***				
Spatial correlation	3.07***				
Hausman test			15.63**	2.35	

Notes: The reference specification is presented in Table 2, column (3). Standard errors in brackets; *,**,*** denotes significance at 10%, 5% and 1%, respectively; n.f. means estimation not feasible due to time-invariance; FE: Fixed effects estimator; PCSE: Panel corrected standard errors; banking group dummies included; RE: Random effects estimator; HT: Hausman-Taylor estimator; FEVD: Fixed effects vector decomposition estimator; Serial correlation: Wooldridge test for autocorrelation in panel data (See Wooldridge, 2002); Heteroskedasticity: Modified Wald test for groupwise heteroskedasticity in fixed effect regression model (See Greene, 2000, p. 598); Spatial correlation: Pesaran's test (2004) of cross sectional independence; Hausman test: FE vs. RE in column (3) and FE vs. HT in column (4) (See Hausman, 1978). a) Since the unit root test for the funding gap cannot be rejected (see Table A4, annex), the respective banking group mean is inserted.

Table A8: ROA country panel model for a subgroup of countries

	(1) HT	(2) HT
gdp growth, t-1	0.11***	0.07*
	[0.03]	[0.04]
interest rate	-0.07***	-0.07***
	[0.02]	[0.02]
yield curve	-0.05	-0.05
	[0.03]	[0.03]
interest rate risk	0.11	0.15
	[0.17]	[0.17]
crisis dummy	-0.62***	-0.55***
	[0.19]	[0.19]
capital ratio, t-1	0.01	0.03
	[0.04]	[0.04]
interbank ratio	-1.90	-0.88
	[1.16]	[0.85]
funding gap	-0.61	-0.78
	[0.91]	[0.73]
CR5	-0.20	-0.26
	[0.59]	[0.41]
capital market*gdp growth		-0.42*
		[0.22]
diversification		0.42
		[0.92]
capital market		2.11***
		[0.80]
Observations	145	145
Number of units	10	10

Notes: Regressions (HT estimation) correspond to results shown in Table 1. They check the robustness of the country results for an alternative country sample.

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