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# Bank income and profits over the business and interest rate cycle

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**Abstract:** If and how the conduct of the banking sector contributes to the propagation of aggregate shocks has become a prominent empirical research question. This study explores what a cyclicity analysis of net interest margins and spreads, as well as profitability figures, can contribute to the discussion. By using time series data for the Austrian banking sector from 1987 to 2005, it is found that many of these measures fall in economic upturns. Net interest income from granting loans and taking deposits from non-banks, however, evolves procyclically and increases with rising interest rates. Combined with the observation that the margins' countercyclical variations are rather small, it can be concluded that there is no striking evidence for a financial accelerator caused by the Austrian banking sector.

**Keywords:** Bank interest margins, business cycles, financial accelerator, impulse response analysis.

**JEL classification:** E 32, G 21.

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# 1 Introduction

Financial propagation mechanisms for real and monetary aggregate shocks have been extensively studied in recent years. It has become common sense that financial institutions and contracts play a prominent role in macroeconomic dynamics. For example, the literature on the credit channel (Bernanke and Gertler 1995) argues that informational frictions and costly enforcement of contracts create agency problems in financial markets which affect the way monetary policy signals are transmitted.

An important part of this literature stresses the “financial accelerator” (proposed by Bernanke, Gertler and Gilchrist 1996), the amplification of shocks through endogenous developments in credit markets. Besides cyclical variations in the availability of (bank) finance (Hubbard 1995, Bernanke et al. 1996), endogenous effects on external financing conditions are studied. The main factor examined in this respect is the “external finance premium” (EFP), the wedge between the cost of funds raised externally (by issuing equity or debt) and the opportunity cost of funds raised internally (by retained earnings). As borrowers’ financial positions (e.g. balance sheet strength is the key signal through which the creditworthiness of firms is evaluated) are procyclical, movements in the premium for external funds are countercyclical (Mody and Taylor 2004), leading to an amplification of aggregate shocks via borrowers’ spending. While, in principle, such premiums can be considered for each type of external finance, the EFP mostly is associated with financing conditions on corporate bonds markets.

From the viewpoint of the banking sector, several measures could be investigated concerning their cyclical behavior. A bulk of research is devoted to the determinants of interest rate margins and spreads, but mostly lacks a clear connection to the above-mentioned literature. Whereas the endogenous variation of price-cost margins in goods markets as a shock-propagation mechanism has received considerable attention, comparable efforts for banking markups are scarce.<sup>1</sup> This is somewhat surprising, having in mind the enormous relevance of bank finance and the fact that, for example, interest spreads *are* understood as banking markups.<sup>2</sup>

Most closely connected to the role of cyclicity in bank markups as a shock-propagation channel is the analysis of Dueker and Thornton (1997). In their model, capital market imperfections (in combination with risk aversion of the bank management) give rise to a countercyclical bank markup. Aggregate U.S. interest rate data for the 1973 to 1993 period are applied to test and confirm their proposition. Angelini and Cetorelli (2003), on the other hand, use regional panel data for Italy (1984-1997) and find that GDP growth is negatively related to the bank margin (calculated from interest and services income). Aggregate demand or other cyclically varying variables do appear in several studies of bank margins and spreads (e.g. Corvoisier and Gropp 2002). However, as these studies mostly conduct panel regressions with yearly data, a thorough analysis of bank markup cyclicity is unintended and also impractical as short-term cycles are hidden and cross-country differences have to be accounted for.

The literature is extended in this being one of the first studies that applies quarterly time series data from a single country to examine how net interest margins and spreads as well as banking profits vary over the interest and business cycle. Therefore, the above-mentioned problems with yearly panel data are precluded. Unlike the single-equation models estimated in many studies, our methodological framework addresses endogeneity, simultaneity and identification issues. Furthermore, it will be shown that the quality of the conclusions that can be drawn depends crucially on the chosen indicators for bank behavior. Besides the rather standard division into net interest income and non-interest income, the net interest income from the business with non-banks (with respect to loans and deposits) and other sources of interest income and expenses will be further differentiated.

Austria is a country with strong bank dependence in corporate financing and therefore is a perfect candidate for being examined. Braumann (2004) concludes that state influence, networks between banks, the high share of non-profit banks, and the prominent role of banking relationships led the Austrian banking sector to even contribute to a financial *decelerator* in the past. However, it is not clear a priori how ex-post bank margins (as a more general measure of bank conduct, they reflect changes prices and volumes of assets and liabilities, as well as balance sheet structure) will vary over the business cycle and whether their cyclical behavior is consistent with a financial accelerator or decelerator.<sup>3</sup> Our results show that most of the examined bank margins, spreads and profit measures, in fact, temporarily shrink after increases in GDP growth. However, after analyzing the countercyclicality of margins more deeply, it can be concluded that the evidence in favor of a financial accelerator originating in the Austrian banking sector's conduct is not strongly convincing.

The rest of the article is organized as follows: A review of the empirical literature on this topic is outlined in section 2. Section 3 presents details about the data, and section 4 describes the methods used. Our results are reported in section 5 and section 6 summarizes and concludes.

## 2 Literature review

Banks play a crucial role in the operation of most economies, and literature has shown that the efficiency with which banks intermediate capital can affect economic growth (Levine 2005). Therefore, research on the determinants of the costs of financial intermediation (the arrangement between capital demand and supply, as far as banks are involved) will naturally enter the policy dialogue (Demirgüç-Kunt, Laeven and Levine 2004). In empirical analyses, intermediation costs are commonly represented by financial ratios as the so-called net interest margin, i.e. net interest income as a share in interest-earning or total assets. Sometimes, interest rate differentials are used, or standard operating figures as the return on assets or equity.<sup>4</sup>

Bank interest margins and spreads also serve as indicators of the efficiency of the banking system (Demirgüç-Kunt and Huizinga 1999, Drakos 2003)<sup>5</sup> and, consequently, are also used for competition policy evaluation. On the other hand, however, increases in banking competition may

also weaken financial stability (Bikker and Groeneveld 2000, Weill 2004). Due to lower profits and banks taking more risks, an increase in the probability of bankruptcy may be induced. Saunders and Schumacher (2000), for example, argue that it is not clear whether high margins are good or bad from a social welfare perspective. Large margins add to the profitability and capital of banks so that they can insulate themselves from macroeconomic and other shocks. Angbazo (1997) states that banks' margins should generate sufficient income to increase the capital base as risk exposure increases. Nevertheless, there has been surprisingly little interest in examining the cyclicity of banks' markups.

## **2.1 Literature on banking markup cyclicity**

Dueker and Thornton (1997), for example, study aggregate loan markups in the U.S. banking industry (from 1973 to 1993). The difference between the prime lending rate and the rate on 180-day certificates of deposit is used to proxy the bank markup. As the data for this is weekly, common indicators of the cyclical state of the economy do not apply. With the spread (difference) between the commercial paper rate and the Treasury bill rate as an alternative measure, they find evidence for the countercyclical behavior of the loan markup. The theoretical reasoning provided by Dueker and Thornton (1997) for this to emerge consists, on the one hand, of a risk-averse and profit-smoothing bank management and, secondly, switching costs in the loan market which give banks some market power over their customers. They conclude that by mitigating these capital market imperfections it would be possible to attenuate business cycles.

A different approach is chosen by Angelini and Cetorelli (2003), who construct yearly panel data (1984-1997) from income statements and balance sheets of Italian banks for five geographical regions. The price-deposit margin they calculate, which includes interest as well as services income, is negatively related to changes in real GDP growth. Though they also do not directly relate their results to the discussion of margin cyclicity in banking, the results of Corvoisier and Gropp (2002) point to countercyclicity as well. Using yearly (1995-1999) interest rate data from 11 euro area countries, differences to money market rates for seven different banking product categories are constructed. Their results suggest that higher confidence reduces the gap between money market and deposit rates as well as the gap between lending and money market rates. There is, admittedly, additional research on bank margins having real GDP (growth) or other cyclical measures (e.g. credit risk or loan defaults) among the regressors. As the majority of this is conducted using panel data and does not draw conclusions on cyclical bank behavior, it is not seen as related work in this respect.

In studying the effects of macroeconomic fluctuations on bank margins and spreads, interest rate developments should be controlled for in order to business cycle effects not being obscured by endogenous changes in monetary policy rates. On the other hand, the variation of banking-related measures over the interest rate cycle is rewarding on its own. Our presumptions follow the observation from the interest rate transmission literature (e.g. Sander and Kleimeier 2004) that, in periods of

monetary tightening, interest rates on bank liabilities are more sluggish than those on assets and vice versa. So, as Angelini and Cetorelli (2003) argue and confirm empirically, increases in short-term interest rates should lead to rising margins.

## 2.2 Literature on other determinants of bank margins and spreads

Literature on bank margins mainly focuses on their (empirical) bank- or banking-sector-related determinants. A popular starting point is the seminal study of Ho and Saunders (1981), in which banks are seen as dynamic dealers in loans and deposits. According to this theory, the demand for loans and the supply of deposits arrive asynchronously at random time intervals. For every planning period, the representative (risk-averse) bank selects optimal loan and deposit rates which should minimize the risks of excessive demand for loans or insufficient supply of deposits (Angbazo 1997). As emerging from the theoretical model, the main determinants of the optimal differential between the loan and deposit rates are the extent of competition in the markets, the interest rate risk to which the bank is exposed, the degree of risk aversion of the bank management and the size of bank transactions. Several authors have extended the basic framework of the dealership model, including Allen (1988) who introduced different types of bank products and Angbazo (1997) who augmented the model with credit default risk. Another model for interest "spreads" is provided by the firm-theoretical approach explored in, for example, Wong (1997). In this (static) setting, loan and deposit markets are simultaneously cleared by demand and supply adjustments.<sup>6</sup> Although the model of Wong (1997) yields implications which are quite similar to those from the dealership model, some additional explanatory factors emerge, as regulation, operating costs and equity capital. The following paragraphs will elucidate how these models have been tested empirically and which dependent and explanatory variables were chosen.

Most empirical studies of interest margins and banking profits examine annual bank-level panel data (e.g. Demirgüç-Kunt and Huizinga 1999, Saunders and Schumacher 2000, Goddard, Molyneux and Wilson 2004, Maudos and de Guevara 2004).<sup>7</sup> Corvoisier and Gropp (2002), Gischer and Jüttner (2003) and Demirgüç-Kunt et al. (2004), on the other hand, use country-level banking data.<sup>8</sup> Aggregated time series are analyzed by Chirwa (2003). The preferred banking profitability measure to be explained is the net interest margin (NIM, net interest income divided by total or earning assets) as used in Angbazo (1997), Demirgüç-Kunt and Huizinga (1999), Saunders and Schumacher (2000), Gischer and Jüttner (2003) and Maudos and de Guevara (2004). Returns on assets (ROA) or equity (ROE) make up the dependent variable in Chirwa (2003), Goddard et al. (2004), but also in Demirgüç-Kunt and Huizinga (1999) and Gischer and Jüttner (2003). Interest rate differentials (i.c. gaps between contractual interest rates and money market rates) as ex-ante measures of banking profitability appear e.g. in Corvoisier and Gropp (2002).

Concentration is supposed to be one of the main determinants of interest margins and bank profits. According to the structure performance hypothesis (SPH), increased market power leads to

lower costs of collusion and to an extraction of rents, so that a positive relation between concentration and profits should be observable. On the other hand, the efficient structure hypothesis (ESH) proposes a negative relation, because the increase in concentration is due to the growth of the most efficient banks (having lower margins) or these banks taking over the less efficient ones (Corvoisier and Gropp 2002). In empirical work, concentration ratios and Herfindahl indices are used, and the results are mixed. The share of the top 3 banks in total assets is found to positively affect the ROA in Demirgüç-Kunt and Huizinga (1999), whereas the individual bank's market share and the ROE are negatively related in Goddard et al. (2004).<sup>9</sup> Herfindahl indices (the sum of squared market shares) also reflect changes in the market structure between smaller banks. A positive relation is found by Corvoisier and Gropp (2002) to the difference between contractual lending rates and money market rates, and a negative one for some differentials calculated with deposit rates (money market less deposit rates).

The generation of non-interest income, reflecting the importance of fee-based services, is supposed to occur partly at the expense of interest income (Bikker and Haaf 2002). Indeed, Demirgüç-Kunt et al. (2004) find a negative relation to net interest margins, and Bikker and Haaf (2002) observe that the interest income, relative to total assets, shrinks following increases in other income.

Operating costs (overheads) are included to investigate whether rising costs are passed on to the customers in the form of higher margins. This is confirmed, by using the operating-expense ratio (OER, the share of operating expenses in total assets), by Demirgüç-Kunt and Huizinga (1999). The quality of management in selecting highly profitable assets and low-cost liabilities is measured by the cost-income ratio (CIR, operating costs divided by total income) in Maudos and de Guevara (2004). If the quality of management in the above sense increases, lower operating costs are required in order to generate one unit of income, hence margins are supposed to be higher. Maudos and de Guevara (2004) find the CIR to be highly negatively significant for the net interest margin. Angbazo (1997) measures the quality of management by the ratio of earning assets to total assets and also observes a positive relation of management quality to the margin.

The equity ratio is usually supposed to measure the risk aversion of banks. According to this reasoning, banks want to be highly capitalized and, on account of this, lend more prudentially. Consequently, interest income could become lower, via lower-risk lending with lower interest rates because of a decreased risk premium. However, more infrequently occurring loan defaults counteract this effect. A high equity ratio might be an indication of banks operating over-cautiously, ignoring potentially profitable diversification or other opportunities (Goddard et al. 2004). Another view, also leading to propose a negative relation of the equity ratio with interest margins, is that a reduction of the equity share means that the insolvency risk increases. Shareholders therefore demand higher returns and banks increase their interest margins to compensate them accordingly. Opposed arguments highlight that high equity capital stocks increase the average cost of capital. Maudos and de Guevara (2004) accentuate the role of equity capital to insulate banks from expected and unexpected (credit) risk. As holding equity capital is relatively costly compared to debt (because of tax and dilution of

control reasons), banks with high capital ratios for regulatory or credit reasons seek to recover some of these costs in the form of higher net interest margins (Angbazo 1997, Saunders and Schumacher 2000, Drakos 2003). Some theories also suggest that well-capitalized banks face lower expected bankruptcy costs and hence may have lower funding costs. According to this view, higher bank equity ratios imply larger net interest margins when loan rates vary only slightly with bank equity (Demirgüç-Kunt et al. 2004). A positive relation of the equity ratio to interest margins and profits is found in Angbazo (1997), Demirgüç-Kunt and Huizinga (1999), Saunders and Schumacher (2000), Drakos (2003), as well as in Maudos and de Guevara (2004). The influence of the capital ratio on the ROE is negative in Goddard et al. (2004), explained by banks that take more risk having higher profits, which is in accordance with portfolio theory. However, in view of the regulations on minimum equity, results obtained using the equity ratio as a measure of risk aversion should be interpreted with caution (Maudos and de Guevara 2004).

Another variable believed to have an influence on margins and profits is the implicit taxation associated with reserve and liquidity requirements. Measures of liquidity used in the literature differ by which items they include (cash, central bank balances, interbank claims). If more assets are to be held in cash, reserves or liquid assets, interest income goes down because of the lower risk of and lower interest rates on these assets. However, banks may like to restore interest income by passing the respective losses in interest income on to their customers in the form of higher margins. The first (negative) effect is found in Demirgüç-Kunt and Huizinga (1999) for reserves divided by total deposits. Cash and due (used as a proxy for reserves) is positively related to the NIM in Maudos and de Guevara (2004).

The share of loans in total assets is often also understood as an illiquidity measure or, if data on loan loss provisions is unavailable, as a proxy for credit risk (Maudos and de Guevara 2004). Besides illiquidity and risk premiums, a higher loan ratio should be associated with higher interest margins because loans are the interest-bearing assets with the highest rates. The empirical relation to the NIM is mostly found to be positive (Demirgüç-Kunt and Huizinga 1999, Chirwa 2003, Maudos and de Guevara 2004). However, Demirgüç-Kunt and Huizinga (1999) report a negative relation to the return on assets.

The importance of the banking sector or, respectively, the structure of the financial system is a regularly used interest income or profit determinant. Demirgüç-Kunt and Huizinga (1999) find a negative relation of the ratio of bank assets to GDP with the NIM and the ROA, supposed to reflect more intense interbank competition in countries with larger markets. The same variable has a positive effect on interest rate differentials in Corvoisier and Gropp (2002). A positive effect on the NIM is found for the ratio of stock market capitalization to GDP in Demirgüç-Kunt and Huizinga (1999), supporting a complementary relation between stock market and bank finance (but they also report a negative influence of stock market capitalization to banking assets). Ex-ante interest rate differentials seem to be negatively affected by stock market capitalization to GDP (Corvoisier and Gropp 2002).



Implicit interest payments (IIP, appearing also in Ho and Saunders 1981 and Angbazo 1997) are a measure for “free” banking services that are offered instead of explicitly charging extra interest on deposits (Maudos and de Guevara 2004). For these services, however, banks could not only charge through a lower remuneration of liabilities, but also via higher lending rates or both. The effect of a rise in IIP on the NIM is found to be indeed positive in Saunders and Schumacher (2000) and Maudos and de Guevara (2004). The reason for this is (as also argued later) that the trend towards more explicit pricing of services (fees and commissions, non-interest income) has reduced the IIP and therefore reduced margins.

Some macroeconomic determinants of banks’ interest margins and profits shall also be discussed. Daily or weekly interest rates are often used to calculate measures of interest rate volatility and the associated risk. Effects on the net interest margin are typically positive (Saunders and Schumacher 2000, Maudos and de Guevara 2004). Although GDP per capita (as a measure of economic development, but also banking technology) is found to have no statistically significant relation to the NIM in Demirgüç-Kunt and Huizinga (1999), the ROA increases with GDP per capita. Using real GDP growth as a demand side indicator, Goddard et al. (2004) find a positive relation to the return on equity. GDP growth is insignificant in Demirgüç-Kunt and Huizinga (1999), but negatively associated with the net interest margin in Demirgüç-Kunt et al. (2004).

Other potential determinants (not used as often) in net interest margin and profitability regressions are, for example, the importance of off-balance-sheet business (Goddard et al. 2004), the ratio of non-interest-earning to total assets (Saunders and Schumacher 2000), the inflation rate (Demirgüç-Kunt and Huizinga 1999), the share of problem loans (Corvoisier and Gropp 2002), and the real interest rate (Demirgüç-Kunt and Huizinga 1999). Bank size is also an issue because of economies of scale, but its supposed positive effect may be partially offset by greater ability to diversify resulting in lower risk and a lower required return (Chirwa 2003). Nevertheless, a positive relation to the NIM is found by Demirgüç-Kunt and Huizinga (1999).

In cross-country studies other factors still play a role, such as whether there is a deposit insurance scheme, the explicit taxation of the banking sector, (interest rate) regulation, as well as legal and institutional factors. Across banks, it might be of significance whether a bank is state-owned or foreign.

### **3 Data issues and variable selection**

#### **3.1 Remarks on data sources and recent developments in Austrian banking**

Data on profit and loss account items for the Austrian banking sector comes from quarterly bank reports and balance sheet data from monthly balance sheet reports (almost all banks operating in Austria have to report on the legal basis of the Austrian Banking Act).<sup>10</sup> Balance sheet items are

quarterly averages of monthly (of three end-of-month) figures. In general (exceptions as indicated in appendix C), the data source is the Austrian Central Bank (the Oesterreichische Nationalbank, OeNB), and the sample period ranges from the first quarter of 1987 to the second quarter of 2005 (74 observations). See appendix C for a summary of series used and a short description of each one.

In the last 20 years, the Austrian banking sector has undergone some large structural changes (see also Ali and Gstach 2000, Braumann 2004 and Waschiczek 2005). The most important structural break from deregulation occurred in 1994, when Austria joined the European Economic Area (EEA). It is common opinion that the associated removal of entry barriers (freedom of establishment)<sup>11</sup> had substantial effects on bank profitability. Additional changes were, for example, the abolition of the anchor or central interest rate for deposit rates, the implementation of Stage III of the European Monetary Union, changes in capital requirements, financial (technological) innovations, as well as an altered ownership structure of banks (privatization of public-sector stakes in Austrian banks, associated with more foreign ownership).

Waschiczek (2005) describes the observable disintermediation trend as a process which is driven mainly by enterprises making use of expanded financing options (corporate bonds, share issues, venture capital), but not by a more restrictive corporate-sector lending of banks or changes in the investment decisions of households. While the relative importance of bank intermediation has declined, the competitive pressure of euro area banks has remained fairly low to date relating to the physical presence of these banks on the Austrian market (Waschiczek 2005). However, the *potential* increase in competition (due to entry threat) is also important. Gischer and Jüttner (2003) argue that competition in the banking sector is of an increasingly global nature, above all, in wholesale markets, the trading business, as well as in debt securities and share markets. Loans and deposits are not concerned that much because local ties between banks and their customers are more important concerning these matters.

A higher degree of competition in banking should, via lower monopoly power and an incentive for banks to reduce their costs, lead to the reduction of prices with positive effects on investment, growth and welfare (Weill 2004). Waschiczek (2005) lists increased activity in mergers and acquisitions, the cutting of resources and the increased business activities in Central and Eastern European (CEE) countries as the strategic responses of Austrian banks to these changing conditions.

For selected years, Table 1 shows the percentage division of assets and liabilities of the Austrian banking sector (domestic and foreign assets are separated) as well as the balance sheet total. On the assets side, it can be seen that the shares of cash and central bank balances, interbank claims and loans (despite rising loans to foreign non-banks) have decreased over time. On the other hand, the share of foreign securities and participations increased from 1.6 (1990) to 12.4 percent (2005). The liabilities side of the balance sheet displays a rise in the equity ratio and a sharp decrease in non-bank deposits at the expense of foreign issues of secured debt after 1995.

The first panel of Table 2 shows a similar division for income and costs (selected periods) according to the standard illustration of the bank income statement. Total operating income is calculated as the sum of the net interest income, net fees and commissions, income from securities and participations, net profit or loss from financial operations and other operating income. The share of net interest income declined steadily, whereas the contributions of net fees and commissions as well as the income from securities and participations mounted. By splitting total income into costs (only staff and administrative expenses are left as expenses like interest, fees and commissions etc. were already deducted in the calculation of total income) and profit, it can be seen that the share of operating profit has been rather constant, whereas the share of administrative expenses has risen and banks have succeeded in reducing that of staff costs. The second part of the table provides a more detailed illustration with interest and fee-based expenses shown explicitly.

In selecting our variables, adequate measures to represent the before-mentioned structural changes as well as the responses of the Austrian banking sector to these changes were also explored. Structural changes can be seen in the decreased importance of net interest income stemming from the accelerated competition in the interest business from the mid-1990s on. Additionally, it can be observed that Austrian firms increasingly seek non-bank finance (as, for example, banks also stepped up their issues of secured debt) and that households also changed their investment behavior towards a heightened use of capital market instruments. These developments show up in an increase of the income of banks from fees and commissions.

The banking sector's reactions to the changed environment may be seen from, for example, a loan ratio declining at the expense of securities and participations. This, as well as the partial replacement of (cheaper) deposits with secured debt on the liabilities side of the banking sector balance sheet, contributed to a reduced relevance of net interest income. Consequently, the effects of structural change and the banking sectors' reactions cannot be strictly separated in explaining trends in net interest margins and banking profits.

### **3.2 Bank performance measures**

In general, bank performance and behavior can be described by ex-ante or ex-post measures (Demirgüç-Kunt and Huizinga 1999). An ex-ante measure would be the difference between contractual rates charged on (or offered ones for) loans and rates paid on deposits (typically relating to new business). Ex-post measures account for the actual interest income less the actual interest expenses. The approaches of applying either one or the other differ by the ex-post margins being determined by loan and deposit volumes, loan defaults, changes in the composition of assets and liabilities, as well as changes in their maturity structure. In this paper, ex-post measures of interest margins and profitability are solely applied.

The net interest margin (NIM) is mostly analyzed in the empirical literature and is defined as the net interest income (interest income less interest expenses) relative to total or interest-earning

assets. Both will be examined here and named NIM (TA, for total assets) and NIM (IEA, for interest-earning assets). The interest-earning assets in our calculations are interbank claims, claims against non-banks and fixed-income securities.

Our third measure, often called “total spread”, is the average interest earned on assets less the average interest expense paid on liabilities, as defined in Equation (1).<sup>12</sup>

$$\text{Net interest spread} = \frac{\text{Interest income}}{\text{Interest-earning assets}} \cdot 100 - \frac{\text{Interest expenses}}{\text{Interest-bearing liabilities}} \cdot 100 \quad (1)$$

As a fourth measure for the development of interest income, a spread which only considers business with non-banks (loans to and deposits from) was calculated. The formula for the net interest spread (non-banks) is equivalent to (1), but interest income and expenses are from claims against and for liabilities to non-banks only, which are also the respective denominators.

The profitability measures considered are the return on equity (ROE) and the return on assets (ROA). Operating profit (the numerator) is observed before deductions for taxes and loan loss provisions are made because no quarterly data is available on these two items for such a long period. Equity capital in the denominator of ROE is the book value of equity from the banking sector balance sheet. This is somewhat dissatisfactory as equity capital therefore only comprises registered (nominal) capital and disclosed reserves (resulting in core or tier 1 capital), as well as some parts of supplementary (tier 2) capital.<sup>13</sup> Therefore, this measure is not compatible with the capital used in describing (the compliance with) capital adequacy rules.

Finally, a so-called non-interest margin, defined as the share of non-interest income in total assets, was calculated. Non-interest income contains the net fees and commissions income, the profit from financial operations, and the income from securities and participations.

Table 3 shows descriptive statistics for the bank performance measures<sup>14</sup> that were calculated, as well as for the explanatory variables which will be described in the next section. For the time paths of interest margins, spreads and profitability see Figures 1 to 4.

The net interest margin which is calculated by dividing through total assets could be supposed to be shrinking (excessively) over time because of the rise in non-interest-earning assets (see the structural changes above). However, net interest income also decreased relative to interest-earning assets (from about 1995 on). The spread in the business with non-banks also shows a development over time which is similar to that of the margins. Only the total spread increased after 1998. Figure 3 illustrates how banks managed to earn a relatively constant return on assets over time. The return on equity fell quite heavily and the non-interest margin shows a slow but steady increase during the sample period.

### 3.3 Explanatory and control variables

The proposed determinants of interest margins and banking profits that enter our analysis (see also appendix C)<sup>15</sup> include two measures applicable for an examination of bank performance cyclicality. GDP growth, according to Demirgüç-Kunt et al. (2004), should proxy investment opportunities in the economy (which are cyclical) and therefore also represents business opportunities for banks. As a measure of the interest cycle, the yield of fixed-interest bonds is applied (results obtained from using, for example, the 3-month interbank rate instead are qualitatively similar and will therefore not be reported). Interest rate risk (volatility) will be proxied by the standard deviation of daily bond yields.

The measure of competition used is a concentration ratio, the share of the top 10 banks in total assets.<sup>16</sup> As there is no clear relation of concentration and competition a priori (structure performance vs. efficient structure hypothesis), the literature proposes different other approaches to quantify competition and market contestability. However, these methods unfortunately are not applicable for a single-country analysis in the time series context.<sup>17</sup>

Gischer and Jüttner (2003) vehemently recommend thinking about the increasingly global nature of competition in banking and therefore searching for adequate related proxy variables. The first variable they use is the ratio of fee to interest income, which measures the (deregulation-induced) explicit pricing of services and therefore also replaces the implicit interest payments variable. Bikker and Groeneveld (2000) support the inclusion of other income parts (from trading etc.) in relating non-interest income to interest income. Being compatible with the arguments of Gischer and Jüttner (2003), these income parts are raised from business which is subject to more intense (and global) competition than the credit business. A summary measure should emerge for the degree to which banks have adjusted to the new financial deregulation environment. In the end, a rise in non-interest income is supposed to represent technological advances, product-mix changes (expansion of low-risk activities) and the banks' exposure to international competition. A negative influence on the NIM should be exerted if the shift to explicit pricing of services through fees and to other non-interest income narrowed margins in the interest business. Since the fee income business is more competitive, the ROA should also be influenced negatively. Demirgüç-Kunt et al. (2004) argue that well-developed fee income sources will produce lower interest margins due to cross-subsidization of bank activities. We use the share of non-interest income in total operating income with the non-interest income including net fees and commissions, income from securities and participations and net financial operations income.

The second global competition variable applied by Gischer and Jüttner (2003) is the openness of the financial sector which they measure by the share of foreign assets and foreign liabilities of the country in GDP. In this paper, on the other hand, a banking-sector-related measure is proposed, which is the sum of foreign assets and liabilities of the banking sector divided by its total assets. The expected sign is also negative.

The share of the book value of equity in total assets is used as the equity capital measure.<sup>18</sup> As mentioned before, there are arguments for effects of the changes in the equity ratio on margins in both directions.

Banks that hold a high fraction of liquid assets have lower net interest margins (Demirgüç-Kunt et al. 2004). A measure of liquid assets that includes cash, central bank balances and interbank claims cannot be used along with a loans ratio, because until the end of 1993, the two ratios were almost perfectly collinear (the shares of other assets in total assets were constant). Instead, we use the share of cash and central bank balances in total assets.

The share of loans in the banks' portfolios is typically a measure for credit risk. Maudos and de Guevara (2004) also include the level of loans to represent the level of operations. The larger the latter, the larger the potential loss, and therefore the larger the margins shall be. The stock of loans divided by total assets, as it is also calculated in this paper, might also be seen as a reverse liquidity measure. If a high share of total assets is loaned out, the bank might become illiquid.

According to Gischer and Jüttner (2003), the operating-expense ratio that should be used is operating expenses related to gross income, which in fact is the cost-income ratio (CIR). Following common calculation rules, expenses include staff, general administration and some other expenses, but no interest and fee-based expenses. The latter are usually deducted from the respective income figures (so that net interest and net fee-based income are added up along with other income). Overhead costs also measure cost inefficiency and market competition (Demirgüç-Kunt et al. 2004), and Maudos and de Guevara (2004) use the CIR as a proxy for the quality of management in explaining the net interest margin.

## 4 Methodology

In analyzing time series data for the Austrian banking sector we use vector autoregressive (VAR) models and therefore treat each variable as potentially endogenous.<sup>19</sup> Unsurprisingly, the Schwarz information criterion leads us to chose one lag in each case (see section 5) as a consequence of the rather large number of variables. In the end, results from impulse response analysis from VAR models where the variables are in levels with a time trend also included (following the recommendations of Ashley and Verbrugge 2004, for the estimation of impulse response functions and confidence intervals for same) are presented. Seasonal dummies are in the model as well, and we will report responses to unit shocks for a maximum time horizon of eight quarters. In obtaining structural responses, the underidentification problem is solved by applying a recursive structure (causal chain) to the contemporaneous relations between our variables. Technically, this amounts to using the so-called Cholesky decomposition of the variance-covariance matrix of the reduced-form VAR residuals to recover the structural shocks.

Impulse response functions and corresponding error bands are obtained (simulated) via Monte Carlo Integration using adaptations of the RATS example programs *monteva2* and *montesur* (obtained from [estima.com](http://estima.com)). Following Sims and Zha (1999), among other things, fractiles are used instead of standard deviations in computing error bands (the two-standard-deviation band is replaced by the 0.025 and 0.975 fractiles to approximate a 95% confidence interval). Generalized impulse response functions (see Koop, Pesaran and Potter 1996 and Pesaran and Shin 1998), which are to be preferred in nonlinear models, were also calculated. In general, qualitative results from these responses are similar to the reported ones.

For investigating asymmetry in the adjustment to cycles-related shocks, we quote responses from a VAR where the equation for the bank performance variable is specified as (example for the NIM equation in a VAR with lag order of one including the growth rate of real GDP, GROWTH)

$$NIM_t = \mu + \sum_{i=1}^j \alpha_j RHS_{j,t-1} + \beta GROWTH_{t-1} + \gamma GROWTH_{t-1} I_{t-1} + \delta I_{t-1} + \phi Z + \epsilon_t \quad (2)$$

where  $RHS_j$  stands for  $j$  explanatory variables apart from GDP growth. The indicator function (dummy)  $I_{t-1}$  represents cases of rising (falling) growth rates of real GDP so that the  $\beta$  coefficients measure the effects of falling (rising) growth.<sup>20</sup>  $Z$  is for additional deterministic terms (trend, seasonal dummies).

## 5 Results

### 5.1 Preliminary remarks

First, how (non-)interest margins and profit variables vary with the business and interest cycle will be examined. Table 4 reports their responses to unit shocks in the bond yield and GDP growth in *bivariate* vector autoregressions. It can be seen that, in the end (after 8 quarters), interest margins and spreads rise after a shock in the interest rate, but also that it takes some time for this to emerge. For several quarters, the levels of the return on equity and assets are significantly lower than they would have been without the shock. Both the ROE and the ROA rise over time and approximately reach the before-shock level after 8 quarters again. The non-interest margin shows a similar behaviour, but is never significantly below its baseline time path.

From the responses to unit shocks in the growth rate of real GDP we see that all interest margins and profitability measures are countercyclical.<sup>21</sup> Margins and spreads are lower than without the shock, above all, after one quarter, and the ROE and ROA remain significantly below the level they would have been at without the shock for a longer period. The non-interest margin is temporarily above its baseline level.

Although many of the “effects” in Table 4 appear to be significant in terms of the error bands, they appear to be quite unimportant if one bears in mind that we examine the reactions to unit (one percentage point) shocks in the interest rate or GDP growth. A naive calculation based on the variable values for the second quarter of 2005 (and therefore holding the balance sheet total fixed) would yield that a reduction in the net interest margin (TA) of 0.01 percentage points amounts to banks losing a net interest income of about 70 million euro. Representing approximately 4 percent of the respective quarter’s net interest income and 5 percent of before-tax profit, this amount appears to be non-trivial. However, a reduction in the net interest margin does not necessarily need to be associated with a reduction in net interest income. As bank assets and liabilities have increased tremendously during the sample period, responses of incomes (profits) are examined in section 5.4.

Table 5 gives a short insight into results from our asymmetric specification in Equation (2). It is evident (results not reported) that there is practically no difference in the responses of all variables to shocks in the bond yield depending on the case specified (rising or falling interest rate). The countercyclicality of margins, spreads and profitability measures (the table exemplarily shows responses of the return on assets) appears to emerge mainly from bank behavior in cyclical upturns.

Our basic VAR specification consists of the standard deviation of interest rates, openness, the concentration, equity, loans and cash ratios, the non-interest income share in total income and the cost-income ratio.<sup>22</sup> This mix of variables that are either banking-specific or describe the macroeconomic environment shall explain the development of each of the margins and profitability measures. The basic vector autoregressions are then augmented with the bond yield and the growth rate of GDP to see whether the cyclical patterns from the bivariate regressions remain or are explained by the cyclical behavior of the remaining included variables. As we do not have a full structural model for such a large number of variables, the Cholesky decomposition method is applied in the following form. The standard deviation of the bond yield is seen as determined at the macroeconomic level (monetary policy, inflation uncertainty, etc.) and therefore treated as contemporaneously exogenous (and therefore comes first in the variable sequence). On the other hand, the respective banking sector performance measure is the endogenous variable of interest and is therefore always placed at the end. In between, we position balance sheet variables before items from the income statement. Openness is put right after interest rate risk because it is preferably interpreted as a strategic variable (one of the reactions of the banking sector to deregulation and liberalization).<sup>23</sup> Concentration appears before the three balance sheet ratios (equity, loans and cash ratio) because it is seen as being partly driven by longer-term decisions as, for example, the acquisition of participations. The first income statement variable in the order is the share of non-interest income in total income (the argument is similar to that used with balance sheet items for openness) followed by the cost-income ratio. Results for our seven margins, spreads and profitability variables can be found in Tables 6 to 12.



## 5.2 Basic results

### Interest rate volatility

Shocks in the standard deviation of the bond yield have, in no case, significant effects on the dynamic paths of the margins, spreads and profit ratios. As a unit increase in our interest rate volatility measure is unrealistically high, the effects reported in the tables are also practically small.

### Concentration

There also are no significant responses of any dependent measure of banking profitability to shocks in the concentration ratio. However, the signs of the responses to changes in the concentration ratio are negative for the net interest margins and the total spread, but mostly positive for the return on equity and the non-interest margin. For the other two measures (the net interest spread in the non-bank business and the return on assets), the responses are apparently zero.

In explaining a negative relation between concentration and margins, the (empirical) literature offers several possibilities. As Demirgüç-Kunt and Huizinga (1999) argue, larger banks tend to have lower margins and profits and smaller overheads, which is consistent with the efficient structure hypothesis. Or these large banks simply have a different structure in their interest-earning assets and interest-bearing liabilities. It could be the case that larger banks are more capable of diversifying (and have better risk-management skills) resulting in lower risk and required returns (Chirwa 2003). Another argument, that the threat of potential entry also forces banks with high market shares, under certain conditions, to price their products competitively (the contestability theory in Bikker and Groeneveld 2000), is potentially captured by the inclusion of the openness variable.

Apart from the fact that the concentration-induced changes in margins and profits are economically small, we tend to confirm that the concentration ratio, in this form and in such a model constellation, is not an adequate measure of competition. As the openness variable is interpreted as a (global) competition measure, and the cost-income ratio, on the other hand, changes with the banks' efficiency, showing what concentration really measures is not that straightforward.

Based on these results, one cannot detect a channel through which the competition policy of the European Union could have succeeded in bringing bank margins down via deregulation (Second Banking Directive, the Commission's Financial Services Action Plan, etc.) and a subsequent decrease of concentration in the banking sector. Although there is no significant relation between the concentration ratio and the net interest margins, spreads and bank returns, this does not necessarily mean that the EU policies did not contribute to the observed reduction in, for example, margins over time. What can indeed be observed in the data are the reactions of the banking sector to the changing environment. Besides increased consolidation efforts in the banking industry, especially large Austrian banks widened their assets by expanding abroad, leading to relatively high concentration ratios from

the later 1990s to 2002, a time of shrinking margins not only in Austria. However, it seems that also the mergers of the 1990s did not have the effect of significantly increasing margins in the banking sector.<sup>24</sup>

### **Openness and the share of non-interest income in total income**

Openness (the share of the sum of foreign assets and liabilities in the balance sheet total) and the ratio of non-interest income to total income are intended to represent two main structural changes in banking - the increase in (global) competition and the strengthened importance of fee-based (and other) income at the expense of interest income. Openness decreased from 52 to 43 percent between 1989 and 1995, and rose rather continuously (with two intermissions) up to 64 % again thereafter. The share of non-interest income in total income, on the other hand, increased very steadily from below 30 percent in the late eighties to over 50 % in recent years.

Shocks in our openness variable, in fact, significantly alter the dynamic paths of net interest margins, as well as that of the more comprehensive interest spread. The effects on these variables are, as presumed, negative. Taking its development over time into account, openness can explain a large fraction of the fall in the mentioned margins and spreads. Although openness shocks do not lead the net interest spread in the non-bank business to significantly deviate from its baseline path, its responses are of equal magnitude like those of the other interest margins and spreads. This is against the presumption that openness exerts its influence on the net interest margin (TA), above all, through an expansion of the balance sheet.

Responses of the non-interest margin to shocks in openness are positive (but not significantly), indicating that banks increasingly sought to find other (not interest-related) sources of income following deregulation and liberalization. General profitability, when measured by the return on assets, is nevertheless negatively (also not significantly) affected by shocks in openness. The return on equity, on the other hand, seems to, at least temporarily, increase subsequent to such changes.

In general, changes in the non-interest income share in total operating income of the banking sector have a negligible and insignificant impact on margins, spreads and profitability. It might be the case that both structural change variables (openness and non-interest income) explain quite the same variation in banking performance.

### **The loan ratio**

The loan ratio is also supposed to capture some of the reactions of Austrian banks to the altered business conditions from 1994 on. The share of loans to non-banks in total assets had risen from 45 to about 52 percent by the end of 1992, but decreased subsequently (with periods of interim increases) to 46 % again by the end of the sample period. Especially after 1997, fixed-interest securities and participations gained in importance (their shares in total assets increased) relative to loans to non-

banks. However, the results from our analysis of impulse response functions do not indicate that shocks in the loan ratio had a significant effect on the development of net interest margins, interest spreads and profitability measures. After some time, the responses are mostly positive (the main exception is the return on equity) and not too small. For example, from 1998 to 2005, the loans ratio decreased by about 5 percentage points, and the net interest margin (TA) by approximately 0.09 percentage points. So, based on the estimated response paths, changes in the loan ratio could (if significant) explain a large fraction of margin and profitability changes. However, there were also longer time periods with practically no change in the loans ratio and decreasing margins (1994-1997).

### **The equity ratio**

The share of (the book value of) equity capital in the balance sheet total rather steadily increased over the sample period (from about 3.2 percent in 1987 to 5.2 in 2005). An exception occurred in (the second half of) 1999 and 2000, where the equity ratio temporarily dropped by 0.4 percentage points. At the same time (one or two quarters thereafter), the prior decrease in net interest margins and spreads intermittently stopped. By evaluating the time series paths of the equity share and margins, it can be seen that both measures are moving in opposite directions most of the time. However, by calculating correlation coefficients between detrended series, it can be observed that the relation between the deviations from the time trend is positive. Therefore, if the remaining control variables can adequately explain the downward trend in margins, the effect of a rise in the equity share could emerge to be positive.

Results related to interest margins and spreads pretty much follow our above observations. Following a shock in the equity ratio, interest margins and spreads (often significantly) fall in the short run. However, after reaching the maximum negative deviation from their baseline paths (typically in the quarter following the equity ratio shock), interest margins and spreads rise over time. After five or six quarters, responses become positive in these cases. The opposite path emerges for the non-interest margin, as it rises in the short run and the equity ratio effect diminishes subsequently.

In the end, a positive relation between the equity ratio and net interest margins emerges (as in the discussed empirical literature), although banks do not immediately react in this way after the shock in the equity ratio. Finding explanations for the negative short-run effect is more difficult, and some of them might also be data-driven. Changes in the structure of the liabilities side of the balance sheet (we have not accounted for) may produce this short-term negative correlation. Periods of surging interbank liabilities (1999-2000) and the trend to replace non-bank deposits with own issues of secured debt (reduced margins via increases in funding costs), especially since the late 1990s, might be candidates for these neglected factors. However, it can be observed (see also section 5.3) that the negative reaction becomes smaller (shrinks to about -0.7 for the net interest margins, for example) and statistically insignificant if GDP growth is added as an explanatory variable.

## **The cash ratio**

Until the third quarter of 1995, the cash ratio lay between 1.6 and 1.8 percent. Afterwards, it decreased steadily to about 0.8 %. As the development of the cash ratio over time seems very similar to those of the net interest margins and spreads, the question is whether any (positive) relation remains after controlling for the other factors.

It turns out that the net interest margins and spreads increase after shocks in the cash ratio. However, the contemporaneous response of the net interest spread, which is also fairly large in magnitude, is the only statistically significant one. Responses of the non-interest margin are mostly negative, and those of the profitability measures are rather small. Altogether, it appears that changes in cash and central bank balances do not play a very important role in explaining bank performance measures, although the effects do not seem to vanish completely over time.

## **The cost-income ratio**

In empirical work, the cost-income ratio is often used to capture developments of the quality of management (with an expected negative relation to margins). The specification of Maudos and de Guevara (2004), for example, includes the CIR alongside the operating-expense ratio, which is supposed to represent the cost burden. A positive relation to margins is expected (and found) for the OER in their regressions, as banks seek to recover risen costs in subsequent profits.

In our regressions, only responses to shocks to the CIR are evaluated.<sup>25</sup> The contemporaneous responses of net interest margins, spreads and profit measures are found to be significantly negative (negative deviations of the ROE from its baseline path are significant also in subsequent quarters). This is in line with, for example, Gischer and Jüttner (2003) who test different cost measures and conclude that, whatever variable they use, a lowering in the cost-structure ratio unsurprisingly increases profitability. However, these results suggest that Austrian banks do not immediately pass over cost increases to, for example, higher interest margins. Interest margins and profits at least return to their previous levels as the negative cost effects are only relevant in the very short term.

## **5.3 Interest rates, GDP growth and the cyclicity of margins**

Interest rate and business cycles are captured by including the bond yield variable as well as GDP growth in our vector autoregressions. Responses following shocks in these two variables are the only results from the augmented models that are shown in Tables 6 to 12. Relating to the effects of the variables already discussed, any major differences to our basic results will nevertheless be mentioned in the following paragraphs.

## **Interest rates**

In Tables 6 to 8 we see that the (significantly) positive long-term effects of shocks in the bond yield, which emerged in the bivariate setting on net interest margins and the total spread, diminish if we control for all the other variables. Nevertheless, after the contemporaneous negative response of these bank performance variables, the deviation from the path without the shock turns positive after some time.

Contemporary reactions of all interest margins and spreads are more negative than before and are found to be statistically significant for both net interest margins. One line of reasoning to explain the latter result could be related to some kind of interest rate smoothing on outstanding credit amounts. Any increase in deposit and saving rates in this case will contribute to a fall in net interest income (which could also be observed if, for example, interest-bearing liabilities increased relative to interest-earning assets after a shock in the interest rate). In section 5.4, however, we will see that the most likely explanation emerges from the distinction of different sources of net interest income. The practically smaller and still insignificant responses for the non-bank interest spread inherently indicate that the loan and savings business with non-banks may not be the source of the short-term shrinking in net interest margins following an interest rate shock.

For the returns on equity and assets, contemporaneous responses are a bit larger in absolute magnitude (they are negative) and therefore still significant. The non-interest spread also deviates negatively from its baseline path, though not significantly.

## **Business cycles**

In this section, we examine whether the observed countercyclicality of net interest margins and returns on equity and assets remains present after controlling for all the variables we discussed up to now. If the latter represent the channels through which the countercyclicality of interest margins and profits operates, we would expect GDP growth not to remain statistically significant.

From our results in Tables 6 to 12 we see that this is not the case.<sup>26</sup> Only the net interest spread for the business with non-banks only as well as the non-interest margin feature no significant responses to shocks in the growth rate of real GDP (with the deviations of the non-interest margin from the path without the shock being positive in many quarters). The statistically significant negative responses of margins, spreads and profit measures emerge mainly in the first and second quarter after the shock in GDP growth. In almost every case, they start to diminish after the first quarter following the shock.

Without any additional information, it could be assumed that the margin countercyclicality has several sources as appropriate changes in interest rates, changes in the volumes and structure of assets and liabilities, or all of these, maybe differently for outstanding amounts and new business, or the loans and savings vs. other business parts. Although it is not possible to bring out the

ultimate explanation(s), some of these possibilities can be relatively safely ruled out. First, there is empirical evidence for Austria that the differential between bank loan and deposit interest rates (for new business) does *not* decrease in economic expansions (Braumann 2004, Burgstaller 2006).<sup>27</sup> Second, we would not expect that, in upturns, the interest-bearing liabilities show larger increases than the interest-earning assets.

It might also be the case that the financing behavior of firms changes during the cycle. In upturns, firms increasingly make use of financing instruments different from bank loans. During recessions, on the other hand, the majority of firms relies on banks.<sup>28</sup> While our specification certainly suffers from not containing a measure of the time-varying importance of the banking sector in total finance (and financial investments) or relative to GDP, we will see in the next section that the main explanations are different from the ones just discussed.

In the end, we see that at least in the short run, net interest margins and interest spreads shrink in an economic upturn. However, their responses (calculated on the basis of a one percentage point change in GDP growth), as well as those of the profit measures, are estimated to be rather small. Soon, these negative deviations from baseline paths will be reduced, but also the following increases will be very small.

Another result is that, although the included variables cannot explain the cyclicity of margins and profits, they actually stave off any asymmetric effect of growth. So among them are the relevant channels through which the asymmetry that was found works.

Additionally remarkable are some of the changes in the effects of our basic explanatory variables in this setting, which partly seem to have been biased in the case of not considering interest rates and business cycles. Responses to shocks in the concentration ratio increase (previously negative responses decrease in absolute terms). Consequently, they draw near zero for margins and spreads, but remain statistically insignificant for the returns on equity and assets. As mentioned before, responses to shocks in the equity ratio lose their negative significance in the short run.

#### **5.4 Auxiliary results for income and profit levels**

To gain further insights and to disentangle some of the possible explanations for our previous results, additional models with the levels of net interest income, net interest income from business with non-banks, operating profit and non-interest income as variables of interest were estimated. Their temporal development is depicted in Figures 5 and 6. Also equity capital, loans, cash and operating expenses are applied in levels. All these variables are measured in millions of euros. The results from impulse response analysis are to be found in Tables 13 to 17.

The effects on the net interest income estimated for a shock in interest rate volatility are still negligible and the net interest income indeed shrinks after a rise in banking sector openness. However, only the maximum negative deviation from the path without the openness shock is indicated to be

statistically significant. The influence of the concentration and the equity ratio in our previous regressions seems to be driven by balance sheet level effects to some extent. Following shocks in the concentration ratio, we observe that net interest income is higher than before the shock in all quarters thereafter. On the other hand, the negative short-run relation of equity with interest income is not present in this setting, neither in terms of statistical nor practical significance. The level of loans, on the other hand, gains in explanatory power. Differences to our former results also emerge for non-interest income and operating expenses as, after shocks in both variables, the net interest income increases after falling below no-shock-levels in the short run. The associated deviations from no-shock-paths, however, are never statistically significant. Results for the interest rate cycle are, more or less, confirmed, but overall effects of a GDP growth shock on net interest income turn positive after a year.

In the case of the operating profit (Table 14), there are practically no qualitative changes to previous results. Operating expenses, as well as non-interest income, are excluded as explanatory variables as they one-for-one pass over to profits. With non-interest income (Table 15), positive reactions to a rise in openness or GDP growth are more pronounced than indicated by results with all variables included as ratios. Also the levels of loans and operating expenses are positively significant contemporaneously.

The most insightful results emerge from the responses of net interest income from non-banks. Table 16 reports the basic model, and Table 17 shows the augmented model including the bond yield and GDP growth. From the former we see that neither shocks in openness nor in the equity capital result in significant deviations of the net interest income in the business with non-banks from its baseline path. Though also not statistically significant, responses to concentration-ratio shocks are always positive. Net interest income from non-banks also reacts positively to impulses in the volume of loans, and negatively to increases in operating expenses in the quarter the shock occurs. The negative contemporaneous reaction to shocks in interest rate volatility disappears in the full model (Table 17).

Shocks representing a rise in the concentration ratio lead to a significantly rising net interest income from non-banks in the augmented model. Two additional effects point to the necessity to differentiate net interest income according to its source. First, one can observe the fact that, relatively quickly after the shock, the one earned by granting loans to, above all, firms and households (which are financed by their deposits and savings) rises after an interest rate shock. This indicates that the negative contemporaneous reaction of total net interest income originates from the banking sector's net position in the interbank and the securities markets (including the cost to bear for own outstanding debt in the form of bonds). Second, the net interest income from non-banks is not countercyclical as it is above its baseline level already in the first quarter after a shock in GDP growth. So the previously observed countercyclicality of margins and spreads is, to a large extent, a product of (cyclical) changes in the level and composition of the banking sector's balance sheet.

## 6 Concluding remarks

In this paper, the empirical determinants of the Austrian banking sector's net interest margins (spreads) and profitability using quarterly time series data for the period from 1987 to 2005 were analyzed. The proposed influential measures contain proxies for structural changes (occurring within the banking sector as well as in its business environment) and macroeconomic variables. Changes in interest rates and GDP growth represent the factors used to examine the development of ex-post margins, spreads and profits over the business and the interest cycle.

The basic results show that, after controlling for interest and business cycle effects, shocks in the concentration ratio, the loan ratio and the cash ratio produce no statistically significant responses in net interest margins, interest spreads and profitability measures. There also is no practically important trade-off between net interest and non-interest income. Most of our banking performance measures transitorily shrink after an unexpected increase in the cost-income ratio. Banking sector openness, measured via the sum of foreign assets and liabilities which was rising over the sample period, explains a significant part of the observed decrease in net interest margins and spreads in Austria. Apart from the margin in non-interest income, all bank performance measures appear to evolve countercyclically, although not all of them show statistically significant responses to shocks in the growth rate of real GDP. Interest margins, spreads and returns on equity and assets contemporaneously fall after an interest rate impulse.

Auxiliary regressions, using income and profit levels instead of ratios to balance sheet figures, enable a more sensible interpretation of these results. Both the countercyclicality and the contemporaneous fall of net interest income after interest rate increases are due to corresponding changes in net interest income from securities as well as interbank claims and liabilities. The net interest income from the loans-and-deposits business with non-banks significantly increases with higher interest rates, more loans and rising concentration in the banking industry. The ongoing increases in banking sector openness have not led to significant income losses from these transactions.

The results suggest that the extensive use of net interest margins and returns on assets (and other ratios) in studies of banking performance and behavior should be reconsidered, as these measures do not tell the whole story. As changes in net interest income may be attributable to the development of several factors (interest rates for outstanding amounts and new business on both sides of the balance sheet, the level and the structure of interest-earning assets and interest-bearing liabilities), further research will have to go more into these details. One should, however, be careful when deriving causal effects from the reported results. The use of time series data only allows a certain number of explanatory variables. Therefore, important determinants of bank profitability (off-balance-sheet business, for example) may also have been missed. Additionally, our variables may not adequately account for some trends that were important for the structure, conduct and performance of the Austrian banking sector.



The countercyclical behavior of many of the examined margins and profit measures, in principle, is in line with the financial accelerator hypothesis. There are, however, some obstacles to conclude from our results that Austrian banks amplify the business cycle. First, net interest income from granting loans and taking deposits actually moves with the cycle and the effects of shocks in GDP growth on the spread in the non-bank business are not significantly different from zero. Having in mind that lending-deposit rate differentials, at least for new business, do not change very much with economic activity in Austria, the reason for the observed behavior of the non-bank spread is likely to stem from substitution processes within loans and within deposits. Second, the negative responses of the net interest margins to growth shocks were shown to be due to the countercyclical movements of the net interest income from securities and interbank relations, and to endogenous changes in the level and structure of balance sheets. Third, the respective adjustments in margins and spreads are not very large in magnitude.

## Notes

<sup>1</sup>Several studies present theoretical reasons for countercyclical markups in goods markets. For example, Rotemberg and Saloner (1986) argue that oligopolists behave more competitively in periods of high demand and therefore markups are countercyclical. Chevalier and Scharfstein (1996) emphasize the relevance of financial constraints (capital-market imperfections) for imperfectly competitive firms to compete less aggressively during recessions and for the resulting countercyclical markups of price over marginal cost. However, Bloch and Olive (2001) point out that the empirical results related to markup cyclicality in manufacturing are mixed.

<sup>2</sup>One clear obstacle is that these financial markups in the banking sector cannot be stringently interpreted as finance premiums faced by firms and households.

<sup>3</sup>Generally, one expects a financial accelerator to emerge with banks maximizing profits in the short term by providing ample credit during economic upturns. At the same time, loan markups go down because of increasing competition between banks and the procyclical value of collateral additionally increases credit demand (Braumann 2004).

<sup>4</sup>However the term “interest spread” is used for two different measures. On the one hand, differences between contractual or posted interest rates (e.g. gaps between specific bank lending and deposit rates) are called spreads. On the other hand, “spreads” are also calculated (ex post) from balance sheet and income statement data. Throughout this paper, measures which fall in the latter category will be used. In referring to contractual or posted rates, the term “interest rate differential” will be used to avoid confusion.

<sup>5</sup>An increase in efficiency and a therefore possible decrease of margins and spreads may be induced e.g. by more competition within the banking sector. Such changes in margins (spreads) do not indicate changes in bank efficiency if they are due to, for example, changes in taxation or in the loan default rate (Demirgüç-Kunt and Huizinga 1999).

<sup>6</sup>Monopolistic as well as oligopolistic versions of the micro-model of the banking firm can also be found in Freixas and Rochet (1997) or Corvoisier and Gropp (2002).

<sup>7</sup>Annual bank-level data for 80 countries (developed and developing countries from all continents) from 1988 to 1995 are analyzed by Demirgüç-Kunt and Huizinga (1999). Banks from five major EU countries (France, Germany, Italy, Spain and the United Kingdom) are featured in the data sets of Goddard et al. (2004) (1992-1998) and Maudos and de Guevara (2004) (1993-2000). This set of countries is enlarged (with data from Switzerland and the USA) by Saunders and Schumacher (2000), whose sample period starts in 1988 and ends in 1995. Drakos (2003) utilizes panel data for banks from 11 Central and Eastern European countries (1993-1999), and about 300 U.S. banks are in the data set of Angbazo (1997) (1989-1993). Brock and Rojas-Suarez (2000) analyze quarterly bank-level data from six Latin American countries from the 1990s.

<sup>8</sup>The most comprehensive list of countries appears in Demirgüç-Kunt et al. (2004), where data averaged over the period from 1995 to 1999 are examined for a cross-section of 72 countries. Panel data for the euro area countries appears in Corvoisier and Gropp (2002) (1993-1999), and Gischer and Jüttner (2003) apply panel data from 19, mostly European, industrial countries (1993-1998).

<sup>9</sup>Goddard et al. (2004) also control for the industry Herfindahl, which has a positive influence on the ROE.

<sup>10</sup>Domestic banks also report the relevant data for their (foreign) branches, but not for e.g. affiliated (foreign) banks in which they have stakes. This refers to the balance sheet as well as to the income statement data. Therefore, the assets and profits of the foreign banks acquired in the past are not in the data, but the business with them is (e.g. claims against them).

<sup>11</sup>The Austrian banking laws had to be harmonized with the standards of the European Union (EU). The whole process has spurred competition and concentration, and improved efficiency in the banking sectors of the EU (Bikker and Groeneveld 2000).

<sup>12</sup>The calculation of the total spread also requires the definition of the interest-bearing liabilities. These, in our case, include interbank liabilities, deposits from non-banks and the banking sector's issues of secured debt. The differing maturity of (and maturity structure across different types of) assets and liabilities was not considered in the calculation of interest margins and spreads.

<sup>13</sup>Subordinated debt is included, whereas undisclosed reserves do not appear in the balance sheet. The latter, however, account for a large fraction of tier 2 capital.

<sup>14</sup>The interest margins and spreads, as well as the profitability measures (ROE and ROA), appear to be very small. This stems from the (non-)interest income and profit figures in the respective numerators being quarterly levels (of flow variables) divided by stocks from the balance sheet.

<sup>15</sup>Some of the variables listed in the review of the empirical literature are not used in this paper for the following specific reasons. No quarterly data for a quite long time period is available for taxes and loan loss provisions. For both variables, only a quarterly preview for the whole year (including already charged-off loans and, respectively, pre-paid taxes) would be available from 1996 on. Gischer and Jüttner (2003) are followed in not including a variable for implicit interest payments. As argued by them, there has been a trend towards explicit pricing of banking services, as implicit interest payments have been eroded by deregulation, technological advances and increased competition. However, accounting for non-interest income (as will be done in our regressions) amounts to using quite a similar variable. Several arguments exist that lead us to not account for the importance of the banking sector (besides the one that other variables used might also proxy for or be a product of the disintermediation trend). The banking sector's total assets divided by GDP do not show a disintermediation trend as they rise over time. The volume of outstanding credit (relative to GDP) is ignored because loans (their share in total assets) will be used as a potential determinant of margins and profitability. Among others, Demirgüç-Kunt et al. (2004) are in favor of stock market capitalization relative to real GDP as a measure for competition from other segments of the financial system. But the problem is that (also with the Austrian data) stock market developments are largely price-driven. Additionally, there is evidence from the literature that, to a certain extent, bank and stock market finance might be complements rather than substitutes. What would be needed is something like the share of new loans in the total of new bond, share and private equity (venture capital) issues as well as new loans, for the corporate sector only (no government bonds, for example), on a quarterly level, for a fairly long time period. Besides the fact that this data is unavailable, such a measure would, again, only tell half the story, because the changing importance of the banking sector also with respect to deposits and financial investments should be accounted for. A measure like the total assets of investment (mutual) funds relative to deposits at banks would, as it is sharply rising over time, overrate the disintermediation trend. Finally, the inflation rate is assumed to be captured with the inclusion of nominal interest rates (as well as interest rate volatility), so that degrees of freedom can be saved.

<sup>16</sup>Demirgüç-Kunt et al. (2004) argue that concentration measures reflect many factors such as regulatory restrictions, efficiency, market power, etc. In their study, the effect of concentration on net interest margins disappears when proxies for regulation issues are included.

<sup>17</sup>These are methods which do not use information on the structure of the banking market (and are therefore called non-structural approaches). Bikker and Groeneveld (2000), Bikker and Haaf (2002) or Weill (2004) calculate the so-called Panzar-Rosse H-statistic, Bikker (2003) uses the Bresnahan-Lau method to determine the degree of market power of the average bank. However, we cannot follow these methods. Both approaches would require bank level data, which are not available to us up to the necessary extent, for calculating competition time series. Nevertheless, some comments on the results for Austria in these studies are potentially relevant in our interpretation of concentration effects. Weill (2004), for example, finds that the Panzar-Rosse H-statistic for Austria decreased between 1994 and 1999, which suggests reduced competition (the statistic is farther away from its value for perfect competition). This is not suited to the presumed effects of deregulation and liberalization, but to the subsequent reactions of the Austrian banking sector. Banks were increasingly shifting abroad (into CEE, but also EU countries), which is evident in the development of the concentration ratio. As mainly the larger banks expanded abroad, the concentration ratio rose from

about 54 to 59 percent between 1994 and 2000. Weill (2004) also speaks of trends that lead both competition and concentration to rise in this period. The expected single currency and cross-border mergers forced banks to improve efficiency and to gain market shares to create barriers to entry. This does not mean that the EU did not succeed in spurring banking competition (see the improved efficiency), but that certain trends and expectations induced reactions in the banking sectors that prevented the increased competitive behaviour to show up in lower concentration ratios and higher H-statistics. Bikker and Groeneveld (2000) suppose that the effects of deregulation and liberalization policies and of increasing concentration on competition have partly offset each other. Bikker and Groeneveld (2000), on the other hand, based on a simple regression for 1995 (for 15 countries including Austria), report a negative relation between the Panzar-Rosse H-statistic and the top 5 concentration ratio. This means that higher (national) concentration is accompanied by less competitive behaviour. As these considerations may imply different and changing relations between competition and concentration, interpreting any relations between the concentration ratio and, for example, interest margins must be undertaken cautiously. Gischer and Jüttner (2003), however, argue that n-bank concentration ratios are unsuitable to measure market power when dealing with global competition.

<sup>18</sup>For questions related to the equity capital data see the description of the return on equity. The relation to the regulatory capital requirements measures (which are only available to us from 1998 on) is that the equity ratios used in that respect include supplementary capital (tier 2 capital) in the numerator and divide by risk-weighted assets. Therefore, our equity ratios will be considerably smaller than the ones published and interpreted when capital adequacy is discussed.

<sup>19</sup>Potential endogeneity of explanatory variables is an issue which is typically ignored in existing empirical work on the determinants of net interest margins.

<sup>20</sup>Equation (2) actually corresponds to a specification with interactions or, in technical terms, to a threshold model with  $\Delta\text{GROWTH}$  as the threshold variable. The threshold value is implicitly zero, and different intercepts and slopes in different regimes are allowed for.

<sup>21</sup>This result also emerges if we use the level of GDP instead of GDP growth.

<sup>22</sup>As mentioned before, the choice of the lag structure is based on the Schwarz information criterion, but also the Hannan-Quinn criterion almost in every case leads us to choose 1 lag. The balance sheet total of the previous quarter is included as an exogenous variable, but treating it as being endogenously determined does not qualitatively change our results. Additionally, we allow for shifts in the constant term at the beginning of 1994 and 1998. The VAR model for the return on equity (ROE) does not contain the equity ratio, and the one for the non-interest margin does not contain the share of non-interest income in total operating income.

<sup>23</sup>The results also illustrate that, in alternative variable orders, some of the measures which appear after openness here, feed back into it contemporaneously. In these exercises, we also observe that between all balance-sheet-related variables, feedback relations are not implausible. However, some alternative setups were examined, but the responses of interest (those of net interest margins, spreads and profitability) were not largely affected by changes in the variable ordering.

<sup>24</sup>Angelini and Cetorelli (2003) come to a similar conclusion for the Italian banking sector. They find a positive relation between concentration and competition, which is not consistent with the structure performance hypothesis. Italian banks mainly reacted to the threat of entry (made possible by implementation of the Single Banking License) with consolidation and restructuring. Parts of the achieved efficiency gains were passed on to customers, so falling margins and more competition can be observed alongside increasing concentration.

<sup>25</sup>If we include the operating-expense ratio besides the CIR, margins and profit measures respond negatively to both.

<sup>26</sup>The result is in line with the cross-sectional results of, for example, Demirgüç-Kunt et al. (2004) who also find that GDP growth is negatively associated with net interest margins. By Maudos and de Guevara (2004), GDP growth is seen as a proxy for possible cost reductions and therefore higher growth generates lower margins.

<sup>27</sup>Certain often-proposed explanations for countercyclicality are therefore also precluded if applied to the lending-deposit rate differential. One is the argument that favorable economic conditions are associated with lower credit risk and increased value of collateral, and a second argues that the competition for loans among banks increases in an economic upturn and hence banks reduce “margins” to protect their market share.

<sup>28</sup>The argument here is not solely a probably rising competition within the banking sector, but a procyclical rivalry between different sources of corporate finance. For example, the determinants of share issues (stock prices, etc.) vary with the business cycle.

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# A Figures

Figure 1: Net interest margins

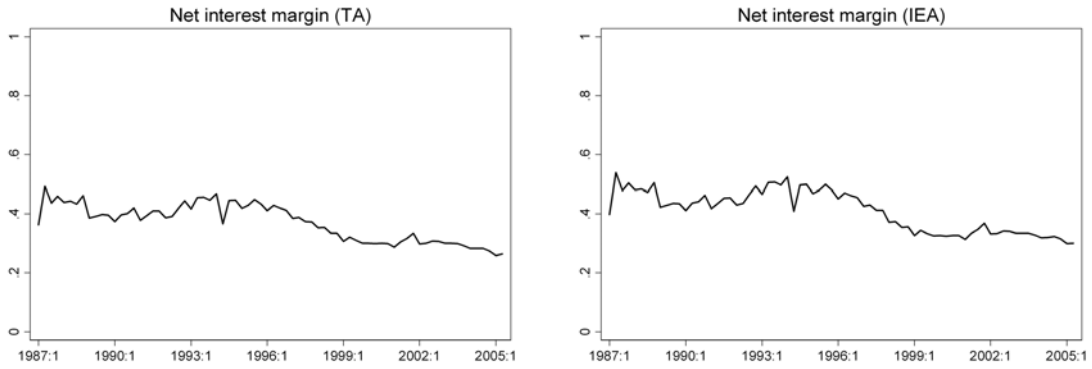


Figure 2: Net interest spreads

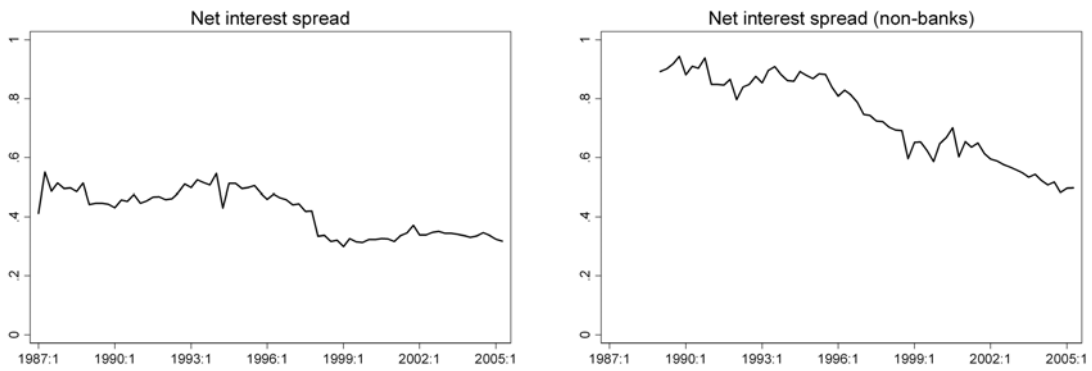


Figure 3: Profitability measures (ROE and ROA)

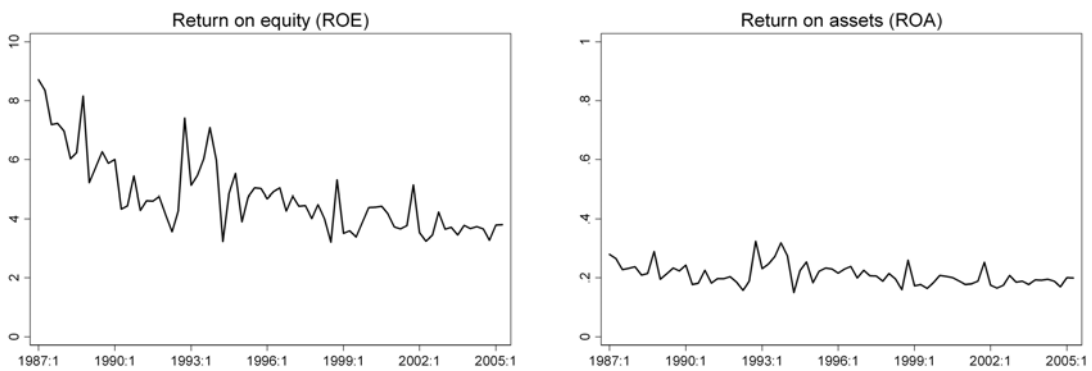




Figure 4: The non-interest margin

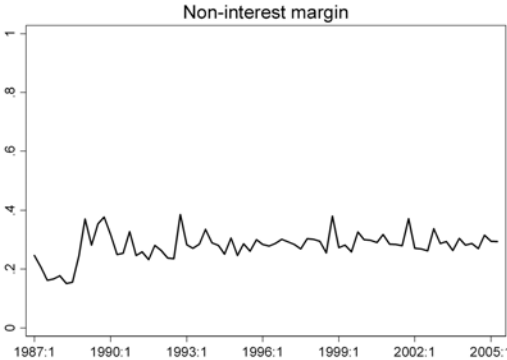


Figure 5: The level of net interest income

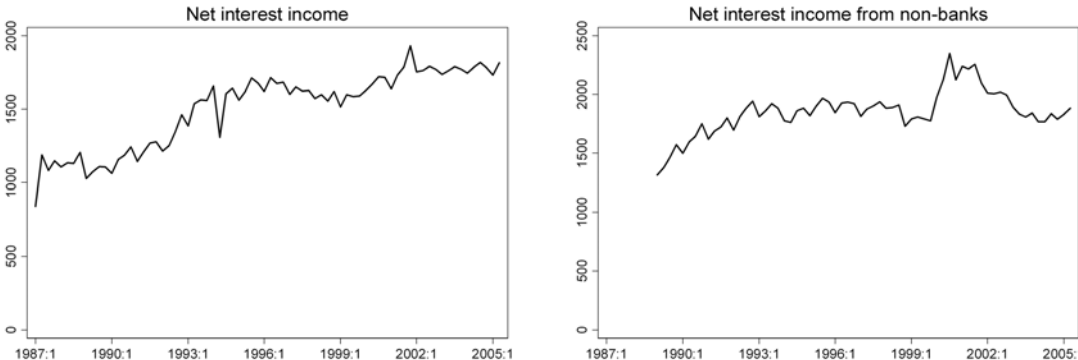
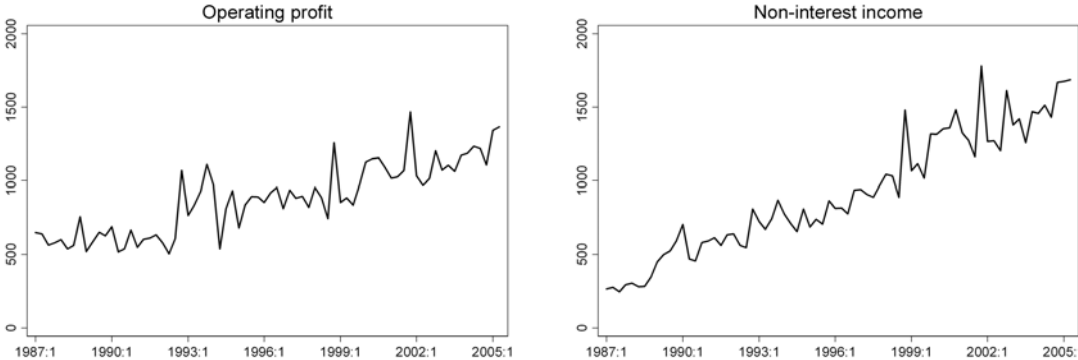


Figure 6: The level of banking sector profits and non-interest income



## B Tables

Table 1: Shares in the total banking sector balance sheet<sup>a</sup>

Assets	1990	1995	2000	2005
Cash and central bank balances	1.7	1.6	1.1	0.9
Domestic interbank claims	17.7	16.3	17.7	15.4
Loans to domestic non-banks	43.4	45.1	38.7	37.3
Domestic securities and participations	11.7	12.7	12.1	10.9
Foreign interbank claims	15.5	13.4	10.2	11.4
Loans to foreign non-banks	5.6	5.0	7.7	8.5
Foreign securities and participations	1.6	2.5	9.2	12.4
Liabilities	1990	1995	2000	2005
Domestic interbank liabilities	18.4	17.4	19.1	17.3
Domestic non-bank deposits	36.7	38.4	31.0	31.6
Domestic issues of secured debt	11.9	13.1	11.2	11.2
Domestic equity capital	4.0	4.5	4.5	4.9
Foreign interbank liabilities	15.2	12.0	16.0	12.7
Foreign non-bank deposits	4.0	5.2	5.2	4.6
Foreign issues of secured debt	5.5	4.8	9.1	12.9
Foreign equity capital	0.1	0.1	0.1	0.4
Balance sheet total (billions of euros)	291.6	379.4	561.9	677.6

<sup>a</sup> Calculations are based on averages of the reported monthly (end-of-month) stocks. Figures for 2005 comprise the period from January to June only.

Table 2: Shares of profit and loss accounts items in total operating income

Item <sup>a</sup>	1990-1994	1995-1999	2000-2004
Staff costs	36.6	36.1	33.8
Administrative expenses	18.3	21.2	22.2
Operating profit	32.0	30.9	32.3
Net interest income	59.9	56.3	50.4
Income from securities and participations	7.1	8.8	13.4
Net fee-based income (fees and commissions)	16.3	19.2	22.7
Item <sup>b</sup>	1990-1994	1995-1999	2000-2004
Interest expenses	66.0	57.0	53.0
Fee-based expenses (fees and commissions)	1.4	2.2	3.4
Staff costs	11.9	14.7	14.7
Administrative expenses	5.9	8.6	9.7
Operating profit	10.4	12.6	14.1
Interest income	85.5	79.9	75.0
Income from securities and participations	2.3	3.6	5.9
Fee-based income (fees and commissions)	6.8	10.1	13.3

<sup>a</sup> Total operating income consists, according to standard calculation routines, of net interest income, income from securities and participations, net fee-based income, net profit or loss on financial operations and other operating income. The expenses side then reduces to staff and general administrative expenses, depreciation and other operating expenses. Operating profit (before-tax) corresponds to total operating income (as defined above) less these expenses.

<sup>b</sup> In this part of the table, interest and fee-based expenses are explicitly part of the expenses, and also are not deducted from the respective income figures in the calculation of total operating income.

Table 3: Descriptive statistics

Variable	Mean	Std. Dev.	Minimum	Maximum
Net interest margin (TA)	0.371	0.063	0.259	0.493
Net interest margin (IEA)	0.409	0.069	0.299	0.539
Net interest spread	0.417	0.076	0.299	0.551
Net interest spread (non-banks)	0.737	0.143	0.482	0.944
Return on equity (ROE)	4.792	1.293	3.210	8.720
Return on assets (ROA)	0.211	0.036	0.150	0.325
Non-interest margin	0.280	0.048	0.151	0.386
Bond yield	5.83	1.74	2.92	8.94
GDP growth	2.29	1.38	-0.65	4.65
S.D. of bond yield	0.12	0.06	0.02	0.29
Openness	51.07	6.08	42.98	64.04
Concentration ratio	55.87	1.40	53.75	59.09
Equity ratio	4.52	0.55	3.17	5.29
Loans ratio	48.59	2.10	44.85	52.49
Cash ratio	1.41	0.30	0.82	1.78
Non-interest income (share in total)	43.14	6.91	25.47	53.51
Cost-income ratio	67.68	3.93	54.14	76.77

Table 4: Cyclicity in bivariate models with either bond yield or growth<sup>a</sup>

Responses to shocks in the bond yield	0	1	2	4	8
Net interest margin (TA)	-0.013	-0.008	-0.003	0.010	0.022 *
Net interest margin (IEA)	-0.011	-0.007	0.000	0.015	0.027 *
Net interest spread	-0.004	-0.002	0.006	0.021 *	0.033 *
Net interest spread (non-banks)	-0.003	0.004	0.006	0.010	0.008
Return on equity (ROE)	-0.847 *	-0.590 *	-0.484 *	-0.253	-0.050
Return on assets (ROA)	-0.035 *	-0.025 *	-0.012	0.001	0.004
Non-interest margin	-0.024	-0.010	-0.008	-0.002	-0.001

Responses to shocks in GDP growth	0	1	2	4	8
Net interest margin (TA)	-0.002	-0.006 *	-0.003	-0.003	-0.002
Net interest margin (IEA)	-0.002	-0.007 *	-0.003	-0.003	-0.002
Net interest spread	-0.002	-0.006 *	-0.003	-0.002	-0.002
Net interest spread (non-banks)	-0.003	-0.006	-0.006	-0.005	-0.003
Return on equity (ROE)	-0.125	-0.244 *	-0.193 *	-0.091 *	-0.020
Return on assets (ROA)	-0.004	-0.009 *	-0.006 *	-0.003 *	-0.001
Non-interest margin	0.007	0.002	0.000	-0.001	0.000

<sup>a</sup> The number of lags for these bivariate vector autoregressions was chosen according to the suggestions of the Schwarz information criterion. With the bond yield, the VAR order typically is two. With the growth rate of real GDP it is two for the first three margins (spreads), and one in the remaining cases.

Table 5: Asymmetry of ROA responses in the bivariate model with GDP growth<sup>a</sup>

Responses to shocks in GDP growth	0	1	2	4	8
Symmetric model	-0.004	-0.009 *	-0.006 *	-0.003 *	-0.001
Asymmetric model (GDP growth rises)	-0.005	-0.013 *	-0.009 *	-0.004 *	-0.001
Asymmetric model (GDP growth falls)	-0.004	-0.007	-0.004	-0.002	0.000

<sup>a</sup> The asymmetric model is specified as in Equation (2).

Table 6: Responses of the net interest margin (TA)

After quarter	0	1	2	4	8
S.D. of bond yield	-0.006	0.006	0.013	0.009	0.002
Openness	-0.005 *	-0.004	-0.005 *	-0.006 *	-0.007 *
Concentration ratio	-0.007	-0.003	-0.003	-0.002	-0.006
Equity ratio	-0.012	-0.093 *	-0.044	-0.006	0.052
Loans ratio	-0.005	0.003	0.003	0.004	0.012
Cash ratio	0.035	0.026	0.011	0.015	0.021
Non-interest income	-0.001	-0.001	-0.001	-0.001	-0.001
Cost-income ratio	-0.004 *	-0.001	0.000	0.000	0.000
Bond yield	-0.021 *	-0.003	0.002	0.006	0.008
GDP growth	-0.002	-0.009 *	-0.004	-0.002	-0.002

Table 7: Responses of the net interest margin (IEA)

After quarter	0	1	2	4	8
S.D. of bond yield	-0.006	0.018	0.015	0.012	0.004
Openness	-0.006 *	-0.005 *	-0.007 *	-0.008 *	-0.009 *
Concentration ratio	-0.009	-0.006	-0.005	-0.005	-0.009
Equity ratio	-0.031	-0.098 *	-0.052	-0.005	0.063
Loans ratio	-0.007	0.003	0.004	0.006	0.015
Cash ratio	0.048	0.035	0.016	0.021	0.028
Non-interest income	-0.001	-0.001	-0.001	-0.001	-0.001
Cost-income ratio	-0.004 *	-0.001	0.000	0.000	0.001
Bond yield	-0.022 *	-0.003	0.003	0.007	0.008
GDP growth	-0.003	-0.010 *	-0.006 *	-0.003	-0.003

Table 8: Responses of the net interest spread

After quarter	0	1	2	4	8
S.D. of bond yield	-0.002	0.041	0.012	0.015	0.004
Openness	-0.006 *	-0.007 *	-0.008 *	-0.009 *	-0.010
Concentration ratio	-0.010	-0.010	-0.008	-0.008	-0.012
Equity ratio	-0.064	-0.093 *	-0.060	-0.005	0.066
Loans ratio	-0.006	0.004	0.005	0.007	0.017
Cash ratio	0.068 *	0.036	0.024	0.027	0.034
Non-interest income	-0.002	-0.001	0.000	0.000	-0.001
Cost-income ratio	-0.003 *	-0.001	0.000	0.000	0.000
Bond yield	-0.018	-0.004	0.003	0.007	0.007
GDP growth	-0.005	-0.011 *	-0.007 *	-0.004	-0.003

Table 9: Responses of the net interest spread (non-banks)

After quarter	0	1	2	4	8
S.D. of bond yield	-0.111	-0.027	0.000	-0.003	-0.009
Openness	-0.012 *	-0.006	-0.007	-0.007	-0.009
Concentration ratio	-0.006	0.000	0.001	0.001	-0.006
Equity ratio	-0.060	-0.123	-0.073	-0.023	0.009
Loans ratio	-0.002	-0.002	0.001	0.004	0.012
Cash ratio	0.021	0.065	0.032	0.025	0.029
Non-interest income	0.001	0.001	0.001	0.000	-0.001
Cost-income ratio	-0.004 *	-0.003	-0.001	-0.001	0.000
Bond yield	-0.013	0.003	0.007	0.008	0.005
GDP growth	-0.005	-0.007	-0.007	-0.003	-0.002

Table 10: Responses of the return on equity (ROE)

After quarter	0	1	2	4	8
S.D. of bond yield	0.531	1.404	0.520	0.534	0.502
Openness	0.036	0.012	-0.004	-0.023	-0.040
Concentration ratio	-0.022	0.086	0.112	0.088	0.010
Loans ratio	-0.150	-0.222	-0.266	-0.270	-0.223
Cash ratio	-0.135	-0.333	-0.094	0.033	0.123
Non-interest income	0.008	-0.022	-0.008	-0.002	0.001
Cost-income ratio	-0.210 *	-0.059 *	-0.038 *	-0.022	-0.016
Bond yield	-1.001 *	-0.483	-0.342	-0.245	-0.129
GDP growth	-0.046	-0.221 *	-0.131	-0.073	-0.046

Table 11: Responses of the return on assets (ROA)

After quarter	0	1	2	4	8
S.D. of bond yield	0.026	0.048	0.006	0.011	0.010
Openness	-0.001	-0.002	-0.003	-0.003	-0.003
Concentration ratio	-0.001	0.001	0.001	0.001	-0.002
Equity ratio	-0.078	-0.066	-0.054	-0.022	-0.012
Loans ratio	-0.007	0.000	0.000	-0.001	0.001
Cash ratio	0.003	-0.011	-0.005	0.003	0.008
Non-interest income	0.003	0.000	0.001	0.000	0.000
Cost-income ratio	-0.009 *	-0.001	0.000	0.000	0.000
Bond yield	-0.037 *	-0.014	-0.009	-0.001	0.003
GDP growth	-0.001	-0.008	-0.004	-0.002	-0.001



Table 12: Responses of the non-interest margin

After quarter	0	1	2	4	8
S.D. of bond yield	0.060	0.021	-0.016	-0.026	-0.030
Openness	0.003	0.003	0.004	0.005	0.006
Concentration ratio	0.009	0.004	0.002	0.002	0.005
Equity ratio	0.012	0.103	0.097	0.062	-0.006
Loans ratio	0.014	0.010	0.009	0.008	0.002
Cash ratio	0.013	-0.042	-0.025	-0.016	-0.020
Cost-income ratio	-0.002	0.000	0.000	0.001	0.000
Bond yield	-0.018	-0.012	-0.004	-0.001	0.000
GDP growth	0.009	-0.002	0.000	0.002	0.004

Table 13: Responses of the net interest income

After quarter	0	1	2	4	8
S.D. of bond yield	-59.588	18.983	-55.446	-92.224	-114.850
Openness	-5.818	-11.818	-13.198 *	-12.602	-7.857
Concentration ratio	-11.835	4.032	7.830	11.202	8.571
Equity capital	0.040	-0.005	-0.012	-0.003	0.043
Loans	0.004	0.003	0.006	0.009 *	0.009
Cash	0.028	-0.001	0.002	0.005	0.007
Non-interest income	0.166	-0.052	0.032	0.038	0.047
Operating expenses	-0.107	-0.181	-0.046	0.024	0.035
Bond yield	-68.729 *	-22.467	0.235	24.973	45.133
GDP growth	-2.596	-29.642 *	-11.471	-1.890	4.701

Table 14: Responses of the operating profit

After quarter	0	1	2	4	8
S.D. of bond yield	-40.015	195.178	26.416	9.706	-32.421
Openness	12.842	-9.026	-9.022	-6.953	-4.140
Concentration ratio	3.222	7.812	3.989	1.455	-0.300
Equity capital	0.102	0.014	0.003	0.008	0.022
Loans	0.019	0.000	-0.001	0.001	0.003
Cash	0.020	-0.040	-0.010	0.003	0.005
Bond yield	-115.516 *	-43.453	-24.720	-13.651	0.107
GDP growth	-3.088	-23.372	-9.931	-2.558	0.476

Table 15: Responses of the non-interest income

After quarter	0	1	2	4	8
S.D. of bond yield	-30.338	124.210	-106.492	-26.706	21.946
Openness	26.573 *	-0.844	6.885	6.740	5.028
Concentration ratio	26.081	20.343	14.199	6.628	0.211
Equity capital	0.015	0.040	0.039	0.024	0.000
Loans	0.028 *	0.006	0.004	0.000	-0.002
Cash	-0.003	-0.040	-0.004	0.000	-0.002
Operating expenses	0.254 *	0.216	0.036	-0.004	-0.009
Bond yield	-38.955	8.209	5.082	2.815	-13.126
GDP growth	13.524	18.878	8.322	6.797	1.453

Table 16: Responses of the net interest income from non-banks

After quarter	0	1	2	4	8
S.D. of bond yield	-416.311 *	-363.287	-282.523	-225.135	-232.876
Openness	-18.650	-5.274	-6.200	-11.889	-21.114
Concentration ratio	12.640	29.907	39.580	41.318	31.954
Equity capital	0.008	-0.033	-0.038	-0.037	-0.013
Loans	0.018 *	0.019 *	0.016 *	0.012	0.011
Cash	-0.007	0.003	-0.001	0.001	0.007
Non-interest income	-0.115	0.006	-0.014	0.004	0.021
Operating expenses	-0.323 *	-0.138	-0.167	-0.146	-0.137

Table 17: Responses of the net interest income from non-banks (full model)

After quarter	0	1	2	4	8
Bond yield	-10.405	50.585	81.798 *	85.030 *	69.369
GDP growth	-1.567	6.018	16.168	13.562	0.949
S.D. of bond yield	-261.467	-178.231	-21.970	23.326	37.309
Openness	-14.173	3.290	2.026	-1.646	-9.906
Concentration ratio	11.464	46.841 *	52.391 *	40.021	19.118
Equity capital	0.019	-0.019	-0.031	-0.053	-0.029
Loans	0.014	0.019 *	0.010	0.006	0.003
Cash	-0.013	-0.005	-0.009	-0.004	0.003
Non-interest income	-0.063	0.157	0.012	0.031	0.037
Operating expenses	-0.332 *	0.039	-0.130	-0.106	-0.040

## C Description of the data

Data on profit and loss account items for the banking sector comes from quarterly bank reports, balance sheet data from monthly balance sheet reports (almost all banks operating in Austria report on the legal basis of the Austrian Banking Act). Balance sheet items are quarterly averages of monthly (of three end-of-month) figures and, as the items from the income statement, in millions of euros. In general (exceptions as indicated), the data source is the Austrian Central Bank (the Oesterreichische Nationalbank, OeNB), and the sample period ranges from the first quarter of 1987 to the second quarter of 2005 (74 observations).

### C.1 Bank performance measures

Net interest margin (TA)	Net interest income (interest income less interest expense) divided by total assets (percentage).
Net interest margin (IEA)	Net interest income divided by interest-earning assets (percentage).
Net interest spread	Interest income divided by interest-earning assets less interest expense divided by interest-bearing liabilities (percentage).
Net interest spread (non-banks)	Interest income earned from loans to non-banks divided by total loans to non-banks less the interest expenses paid on deposits from non-banks divided by total demand, time and savings deposits from non-banks (percentage). Data on interest income and expenses are available since the first quarter of 1989 (66 observations).
Return on equity (ROE)	Operating profit (before-tax) divided by equity capital (percentage).
Return on assets (ROA)	Operating profit (before-tax) divided by total assets (percentage).
Non-interest margin	Non-interest income divided by total assets (percentage).

### C.2 Explanatory and control variables

Secondary market yield of bonds	Average yield for all (fixed-interest) bonds listed at the Austrian Stock Exchange with more than one year to maturity. Quarterly averages of daily yields. Data source: OEKB (Oesterreichische Kontrollbank).
Growth rate of real GDP	Growth rate of real GDP (quarterly level) relative to real GDP four quarters ago (percentage). GDP data source: WIFO (Austrian Institute of Economic Research).
Standard deviation of bond yields	Standard deviation of daily bond yields of the respective quarter.
Banking sector openness	Foreign assets plus foreign liabilities of the banking sector divided by total assets (percentage).
Concentration ratio	Share of the 10 largest banks' assets in the balance sheet total of the banking sector (percentage).
Equity ratio	Share of the book value of equity capital in the balance sheet total (percentage).
Loans ratio	Share of loans (claims to domestic and foreign non-banks, in domestic as well as foreign currency) in banking sector assets (percentage).
Cash ratio	Share of cash and central bank balances in total banking sector assets (percentage).
Non-interest income	Share of non-interest income in total operating income (percentage).
Cost-income ratio (CIR)	Operating expenses divided by operating income (percentage).