The influence of macroeconomic developments on Austrian banks: implications for banking supervision

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This paper aims to assess the effects of macroeconomic developments on risk provisions and earnings of Austrian banks for the 1990s. It seeks to detect economic indicators of potential instability in the banking system. The underlying theory is that bank earnings are to some extent directly (eg via interest rates) and indirectly (eg via their customers) dependent on the state of the economy.

The main findings for the 1990s in Austria are as follows. Austrian banks increase risk provisions in times of falling real GDP growth rates and in times of rising bank operating income or operating results. Net interest income appears to be uncorrelated with real GDP growth and interest rate developments, with the exception that at very low interest rate levels net interest income shrinks. For the Austrian banking sector as a whole, falling short-term and long-term interest rates, along with rising real estate prices and/or inflation, push up bank operating income, and vice versa, which is in line with expectations. When breaking down the Austrian banking sector by peer groups, the explanatory power of short-term interest rates becomes notably lower for most of the individual peer groups of the Austrian banking industry. The operating result of Austrian banks can be explained by and large by the same variables that explain their bank operating income. However, short-term interest rate developments are insignificant for the operating result, which suggests that - at least as far as direct implications are concerned - monetary policy has been of minor significance for Austrian banks during the last decade.

Overall, some macroeconomic variables such as interest rates, real estate and consumer prices can be used to explain the income side, profitability and financial stability of Austrian banks. Structural changes, such as increased competition, joining the single market and the opening up of eastern European markets, have certainly also had a strong impact on Austrian banks. Furthermore, we draw the conclusion that microeconomics, especially sound and prudent bank management - at least during normal (bank) business cycles - probably plays *the* major role in banking and supervision.

1.1 Motivation

During the past two decades, many countries have experienced severe banking crises. Episodes of profound banking system distress have occurred not only in emerging and transition countries, but also in advanced industrialised economies, such as the United States, the Nordic countries and more recently Japan.[2] In all cases, banking sector calamities have resulted in large losses of wealth and led to disturbances in the credit supply to the economy. Resolving the crises has frequently imposed a large burden on public funds.

The serious consequences mentioned above underline the value of indicators that signal a rising probability of banking sector problems before such problems actually occur. They would provide a useful service for the purpose of banking supervision and financial market surveillance.

It is obvious that indicators relating directly to the soundness of the banking system are ideal for the prediction of banking crises. Items from banks' balance sheets or profit and loss accounts should make sufficiently clear when problems are becoming increasingly likely. There is no doubt that banks' earnings performance and the probability of banking system distress mainly depend on the conduct of business within banks, ie on micro factors. Inadequate accounting and auditing practices, insufficient internal controls and poor management are the main causes for bank problems. In other words, bank crises are mainly the result of bad banking. Adverse macroeconomic developments should not cause severe banking problems if the bank management acts farsightedly and reflects the cyclical nature of

[1] The authors are at the Oesterreichische Nationalbank. We thank J Brockmeijer and W Waschiczek for valuable written comments as well as those colleagues at the Oesterreichische Nationalbank who commented in an internal discussion forum.

[2] Austria has not experienced any systemic banking crises since the end of World War II.

the economy in its decisions. As this is not always the case, and because cyclical fluctuations are sometimes unexpectedly extreme, macroeconomic variables might well deliver good indicators for the likelihood of mounting stress within the banking system.

1.2 How do macroeconomic developments influence the stability of the banking system?

Although banking crises are mainly caused by microeconomic factors, disturbances anywhere in the economy are likely to have repercussions on the banking system. Due to the nature of their business, banks are exposed to many potential sources of distress rooted in cyclical developments. The most dangerous characteristics in this respect are banks' above average reliance on creditors' funds (ie deposits) and their low capital ratio when compared to the corporate sector, their risky claims on different sectors of the economy, and the fact that their assets are in effect longer-term and less liquid than their liabilities. Banks' health reflects to a large extent the health of their borrowers, which in turn reflects the health of the economy as a whole.

A useful way to analyse the macroeconomic determinants of banks' health is to look at the main risks of banks: market risk (risk that values of underlying assets will decline), interest rate risk, exchange rate risk, default or credit risk (risk that debtors will be unable to repay their debts) and liquidity risk. All these risks are, at least partly, influenced by macroeconomic developments and policies.

An additional argument in favour of monitoring macroeconomic indicators for macroprudential purposes is the fact that the probability of systemic crises is greater when unsoundness is due to cyclical factors, because all banks are more or less exposed to the same conditions.

The evidence of past crises shows that certain macroeconomic variables typically display a distinctive pattern (boom and bust pattern) both before a banking crisis emerges and while it is unfolding. In general, the pattern is that of a rapid end to a boom: after rising rapidly, real GDP and domestic demand decline; an acceleration in inflation is suddenly reversed; credit from the banking system to the private sector builds up rapidly, peaks, and then contracts; real interest rates increase steadily, etc.

1.3 Development of production and domestic demand (cyclical indicators)

Overall macroeconomic data on production and domestic demand provide information about the state of the business cycle. The position of the cycle determines the earnings power of the public and private sectors and hence influences their debt servicing capability. When nourished by excessive borrowing, buoyant production and demand growth can turn out to be the first phase of a boom-bust cycle, whose second phase is a sharp downturn which often causes debt servicing problems for borrowers. In the boom phase, debt servicing problems are comparatively rare due to the exceptional earnings quality which tempts loan officers and bank managements to underestimate the riskiness of their business and reduce the margins of safety. Buoyant economic growth in combination with declining interest rate spreads gives a strong hint that such risky (mis)behaviour is widespread.

A swift and sharp decline in production, investment and consumption growth weakens the debt servicing capability of borrowers due to the declining financial surpluses of firms and reduced income growth of households. In addition, the value of collateral (equity and real estate) usually falls considerably in an economic slump, thus diminishing borrowers' secondary means of servicing their debt. The accompanying fall in the value of collateral may aggravate the problems of adverse selection and moral hazard.[3]

Indicators selected

- Rate of growth in real GDP
  - Exceptional growth rates may indicate a boom preceding a bust (indicator with a long lead).

[3] Borrowers with low net worth constitute greater moral hazard to lenders, as they have less to lose at default. The less a borrower has to lose, the more he is inclined to engage in risky investments financed by bank loans.

  - Sharply decelerating or negative growth rates point to an increased likelihood of approaching debt servicing problems.

- Rate of growth in nominal GDP
  - As price developments often play a prominent or even dominant role in economic excesses, changes in nominal GDP can provide additional information about changes in real GDP.
- Rate of growth in real domestic demand
  - Exceptional growth rates may indicate a boom (overinvestment and overconsumption) preceding a burst of the investment bubble and the consumption euphoria.
  - Sharply decelerating or negative growth rates may point to beginning debt servicing problems for companies and households.
- Rate of growth in nominal domestic demand

In this analysis we worked with real GDP and real domestic demand growth rates. Since the microeconomic bank data in our analysis are always relative data (eg operating income relative to total assets or risk provisions relative to total outstanding loans), we did not use nominal cyclical indicators.

1.4 Debt burden and leverage (financial fragility indicators)

The soundness of the banking system crucially depends on the sustainability of the level of corporate and personal debt. If the private sector accumulates debt relative to assets beyond a critical level and shifts from borrowing adequately covered by cash flow to borrowing not covered, its debt servicing capacity is likely to be impaired under worsening economic conditions. In addition to the increased likelihood of debt servicing problems, declining net worth of borrowers is also regarded (under the theory of asymmetric information) as an incentive to moral hazard and adverse selection.

Whether and when borrowers with a high debt burden run into debt servicing problems essentially depends on the development of both interest payments and income. An increase in income gearing (interest payments as a proportion of income) caused either by declining earnings or rising interest payments (due to rising interest rates and/or growing debt ratios) reduces the borrowers' scope to service their debt.

Indicators selected

This type of indicator is not incorporated in this paper, since it is only available on an annual basis in Austria.

1.5 Excessive asset price developments

Prices of certain assets can be very volatile, which makes the financing of their purchase or production a risky business, sometimes involving heavy losses. The main reasons for the high volatility of certain asset prices are strong cyclical demand fluctuations (eg commodities), hog cycles due to long gestation periods (eg real estate) and speculative activity (eg shares). Inflated asset prices often lead banks to make lending decisions based on asset values which are unsustainable in the long run. In addition, prudent creditors are likely to be driven into herding behaviour under such circumstances, as they are undercut by those market participants disregarding the long-term risk involved in the loan financing of such assets.

Asset price slumps following excessive price hikes affect banks in various ways: first, they increase borrowers' indebtedness relative to their assets. This enhances the danger that borrowers may default on their payment obligations. Second, they reduce the value of banks' own securities and real estate portfolios, which leads to capital losses. Third, due to negative wealth effects, the demand from households and corporates may decline and hence accelerate the economic downturn.

Indicators selected

- Austrian and European share price indices
- Vienna real estate price index
  - Due to myopic behaviour of (some) investors, a strong increase in real estate prices attracts much more investment in new buildings than will be demanded at this high price once the bulk of the new property enters the market. This overinvestment tends to cause the price bubble to burst at some point and (all) real estate assets to decline in value, potentially leading to negative net worth of the property and debt servicing problems.

1.6 Monetary and financial conditions

Banking soundness to an important extent depends on the general monetary and financial conditions. Experience shows that banking crises often tend to be systemic when they are caused by deteriorating monetary and financial conditions. The increase in (real) short-term interest rates has proved to be a major source of systemic banking problems.

Indicators selected

- Monetary aggregates (M1 and M3)
  - Accelerating money supply growth points to a potential overheating of the economy, while sharply decelerating money supply growth can be, amongst other things, triggered by a recession and perhaps by deflationary effects in the economy, and/or it can be the result of a restrictive monetary policy stance.
- Nominal and real short-term interest rates (three-month money market rate)
  - High and rising short-term interest rates point to restrictive monetary policies, motivated perhaps by an attempt to bring inflation under control. This imposes higher funding costs, while interest income cannot be increased equivalently as the interest rate for the stock of loans is usually fixed for a longer period. Furthermore, high short-term interest rates are likely to hurt banks even if they can be passed on to borrowers in the form of high lending rates. The reason is the tendency for adverse selection, which can increase the proportion of non-performing loans in the medium and long run.
- Nominal and real long-term interest rates (five-year benchmark government bond)
  - Investment project decisions depend on the long-term interest rate. Normally, an internal rate of return is used to test whether investment projects are worth undertaking. Rising long-term interest rates may push projects with an initial positive value towards a negative value on account of the new internal rate of return.
  - Besides the credit risk, the long-term interest rate affects the return on bank securities, and therefore it also imposes a market risk on the sector.
- Overall interest rate margin (average interest rate on banks' assets minus average interest rate on banks' liabilities)
  - Competition may cause banks to make inadequate provisions for detrimental events such as asset price collapses or cyclical downturns, because banks that make adequate provisions are undercut by those disregarding such possibilities for reasons of ignorance or competitive advantage.
- Rate of inflation (consumer price index)
  - High inflation rates usually go hand in hand with high nominal interest rates and will eventually lead to high real interest rates, which reduce the profitability of credit-financed investment projects and increases income gearing in real terms. However, rising inflation may temporarily reduce the real value of (fixed) interest payments by firms, thus increasing profitability for a certain period of time. Generally, a high and volatile nominal interest rate associated with high inflation makes it difficult for banks to perform maturity

transformation. High rates of inflation may proxy for macroeconomic mismanagement, which adversely affects the economy and the banking sector through various channels.

1.7 Bank data

The micro bank data used for this paper are taken from the monthly raw balance sheet and the quarterly income statement which Austrian banks have to report to the supervisory authority and the central bank. These data are delivered on an unconsolidated basis, ie including domestic branch offices and branch offices abroad, but excluding bank and other subsidiaries.

Risk provisions are calculated as total provisions for loans granted to banks and non-banks as a percentage of total loans plus total provisions for loans. This ratio is not taken from audited financial statements (which are available only on an annual basis), since this would not have generated enough observations for our statistical analysis. Therefore, these figures are taken from the monthly raw balance sheets. This implies, as the name already suggests, that the extent of provisions as audited by external auditors at the end of the year might deviate from the figures used for this analysis.

As regards income figures, we based our analysis on the following breakdown:

	Interest income
–	Interest expense
=	NET INTEREST INCOME
+	income from securities
+	net income from fees and commissions
+	net profit (loss) on financial operations
+	other operating income
=	OPERATING INCOME
–	operating expenses
=	OPERATING RESULT
–	RISK PROVISIONS
–	taxes
+/–	extraordinary items
=	PROFIT

Income from securities includes income from shares and other variable yield securities, income from participating interests and income from shares in affiliated companies.

Operating expenses include personnel and other administrative expenses, value adjustments on intangible and tangible fixed assets (such as land and buildings), but *exclude* value adjustments for loans and securities. Therefore, both operating income and the operating result do not include provisions for loan losses or for losses on securities.

Our analysis is based on net quarterly data, ie data on the second quarter do not include data from the first quarter in any given year.

For the purpose of supervisory analysis, Austrian banks are grouped into ***peer groups***, according to the structure of their assets. Some banks, due to their special status, had to be classified in special groups heuristically (ie by conceptual assumption) a priori.

– All large banks with total assets exceeding EUR 2 billion were placed in Peer Group 1. The total assets of this peer group amount to nearly three quarters of the total assets of all Austrian banks.

– All foreign banks (foreign assets of more than 30% of total assets) that do not come under the group of large banks constitute Peer Group 2.

– All specialised banks (those of the special purpose bank sector, including building and loan associations, etc) were grouped into Peer Group 3.

– The remaining banks were classified according to their balance sheet structure. The liabilities side of the balance sheet proved too blunt an instrument for differentiation; notably because savings deposits tend to correlate strongly with the balance sheet total, this breakdown would have been too close to the total asset criterion. Therefore, it was decided to use the assets side as a grouping criterion. Except for off-balance sheet business, the assets side reflects a bank's risk potential fairly accurately. The relation between domestic

interbank claims (DIC) and claims on domestic non-banks (CDNB) was used as a group membership criterion. This parameter covers approximately 85% of the balance sheet volume.

Table 1

Peer groups

Peer group	Designation	Number of banks		Definition
		1999	2000	
1	Large banks	30	30	Total assets > €2 billion
2	Foreign banks	37	41	Foreign assets as a % of total assets> 30%
3	Specialised banks	91	90	
4	*"Retail banks"*	22	31	CDNB – 2* DIC > 60%
5		186	204	CDNB – 2* DIC > 35%
6		216	188	CDNB – 2* DIC > 15%
7		142	127	CDNB – 2* DIC > 0%
8		172	167	CDNB – 2* DIC > - 30%
9	*"Interbanking banks"*	74	72	CDNB – 2* DIC <= - 30%
Total	**Banks, total**	**970**	**950**	

Source: Oesterreichische Nationalbank.

CDNB: Claims on domestic non-banks as a % of total assets.
DIC: Domestic interbank claims as a % of total assets.
The multiplication factor 2 in the above table for domestic interbank claims (DIC) was introduced as a weighting factor to offset size-related differences against claims on domestic non-banks (CDNB).
From the data contained in the December monthly return, group membership is recalculated annually for the next following year.

1.8. General remarks on the macro and micro data used

Since the bank data required are not available before 1990, the econometric models are based on only half an interest rate cycle, ie falling rates between 1990 and 1999. We use quarterly data from 1990 Q1 to 1999 Q4. These data were transformed into annual growth rates, ie the logarithms and seasonal differences of the original quarterly time series. Data were sourced from the Austrian National Bank, the OECD, WIFO and Datastream.

2.1 When do Austrian banks form risk provisions?

Economic theory provides several lines of explanation which are partly contradictory:

First hypothesis:

Banks form provisions when their debtors show signs of financial strain. In our macroeconomic approach, this means that banks would increase their provisions during economic downturns and recessions, while economic upswings and booms should lead to reduced provisioning.

The underlying theory is that banks act under uncertainty and in particular are not able to ascertain whether a macroeconomic shock (positive or negative) is temporary or fundamental.

According to this view, banks behave ***procyclically***.

Second hypothesis:

Banks increase, or at least do not reduce, risk provisioning in times of high real GDP growth rates, because they are well aware that the economy behaves cyclically and that a boom is usually followed by a downturn. Farsighted banks even take into consideration that their debtors tend to stretch themselves somewhat during an upswing, which might become problematic during an economic downswing.

As a consequence, banks behave ***anticyclically***.

Third hypothesis:

Banks increase risk provisions when they engage in riskier business. This might well be correlated with higher returns, ie increased operating income for banks, since riskier business should lead to higher returns on average.

Fourth hypothesis:

Banks increase risk provisions in times of rising operating returns. This behaviour is partly connected to the behaviour described under hypothesis three, since operating return is defined as operating income minus operating expenses and therefore depends to some extent on returns.

Another argument for this type of behaviour is the attempt of banks to reduce the income tax burden by evening out profits and losses over time. Another, somewhat similar, reasoning is that banks want to produce a constant income stream, perhaps in order to generate trust among the public. Therefore, banks generally aim to reduce the volatility of their net income.

However, some banks might increase risk provisions simply when they can "afford" to do so, depending amongst other things on accounting standards and supervisory rules.

Econometric models:

We tested different multiple regression models to assess which of the above-mentioned explanations comes closest to the behaviour of Austrian banks.

In our models, risk provisions are defined as a percentage of total outstanding loans. For 1995 Q4-1996 Q3, a dummy variable (D96) has been used, due to a change in the definition of risk provisions in per cent of total outstanding loans by December 1995.

Test of the first hypothesis:

First, we formulated a multiple regression model in the form of (all variables in log and seasonally adjusted)

Provisions = c + b1 * GDP(r) + b2 * RealEstateLag2Q + b3 * RealInterestRate3M + b4 * D96.

Changes in risk provisions relative to total loans depend on ***real GDP*** growth rates, ***real estate price*** developments (lagged by two quarters), the development of ***real interest rates*** (three-month money market rate minus annual inflation rate) and the dummy variable. Asset prices, like ***real estate prices***, obviously play a role in risk provisions, since the underlying assets are often used as mortgage. Since real estate price developments and their possible implications for loan provisioning become visible only with a certain time lag, we lagged this time series by two quarters.

This model delivers a good proxy. All variables are highly significant, the explanatory power of the model is very high (adjusted R^2 of 0.92), and we experience only low positive autocorrelation (Durbin-Watson: 1.6). According to this model, ***risk provisions rise when real GDP growth declines (procyclical behaviour), they rise when real estate prices rise (anticyclical behaviour), and they rise when real interest rates fall*** (see Table A1.1[4]).

Since risk provisions of all Austrian banks significantly depend negatively on real GDP growth, ***Austrian banks behave procyclically*** when it comes to forming risk provisions.

The sign of the first independent variable (real GDP growth) ***confirms the first hypothesis*** mentioned above, but the sign of the second independent variable, ***real estate prices***, is questionable. When real estate prices rise, banks should be relieved as the value of mortgages rises, because this should reduce the likelihood of loan losses and therefore provisioning for real estate loans. Conversely, declining real estate prices should set bells ringing at banks, as the value of their mortgages declines and the chance that they may suffer a loss in the case of debt service problems of borrowers rises. However, it cannot be ruled out - even though we regard it as less likely - that banks behave "anticyclically" when it comes to real estate developments. In general, we are somewhat hesitant to accept that the Vienna real estate price index should have such a significant influence on risk provisions.

[4] Table numbers prefixed by an A can be found in the Appendix.

Rising ***real interest rates*** should indicate growing financial strains in an economy. Rising real interest rates tend to increase financial fragility via an increase in the interest service burden for debtors, which should be reflected in banks' risk provisions. On the other hand, rising real interest rates are typical for times of (prolonged) strong economic growth, while falling real interest rates are typical for the early stages of an economic trough and during recessions.

When we replace the three-month real interest rate with the ***consumer price index***, our ***model delivers a nearly perfect fit*** (adjusted R^2 of 0.94) with very high significance levels and no autocorrelation (Durbin-Watson test of 2.0). The results are shown in Table 2. According to this model, ***risk provisions rise when real GDP growth rates decline***, ***and they rise when real estate prices (lagged by two quarters) along with inflation increase***. Rising inflation usually increases risks and uncertainties for market participants in general, which in turn might lead to higher risk provisions. Even though this result is in line with expectations, we would like to add a word of caution, since the inflation rate in Austria never exceeded 4% during the 1990s, and the very significant regression results for inflation on risk provisioning might be somewhat overstated for reasons we do not yet know. (An "AR model" can be found in Table A1.2; since we experience some, albeit statistically insignificant, autocorrelation at a lag of four quarters, the AR (4) model even delivers slightly better results, which however do not change the picture described above.)

Table 2

Risk Provisions

Dependent variable: ProvisionsGlobalD4L
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficent	Std error	t-statistic	Prob
Constant	–0.032094	0.035585	0.901893	0.3745
GDPREALD4L	–2.580486	0.769412	–3.353841	0.0022
RESTATELAG2QD4L	0.463379	0.180112	2.572724	0.0155
CPID4L	5.472041	1.185861	4.614405	0.0001
D96	–0.357705	0.012099	–29.56426	0.0000

R-squared	0.943623	Mean dependent var	0.010556
Adjusted R-squared	0.935847	SD dependent var	0.173110
SE of regression	0.043846	Akaike info criterion	–3.281210
Sum squared resid	0.055752	Schwarz criterion	–3.056745
Log likelihood	60.78056	F-statistic	121.3489
Durbin-Watson stat	2.030604	Prob (F-statistic)	0.000000

Test of the second hypothesis:

The test of hypothesis one indicates that hypothesis two, ie provisions rise when real GDP rises, can be rejected (null hypothesis).

Test of the third hypothesis:

In the next step, we assess whether risk provisions might be influenced by bank earnings, ie we test hypothesis three.

In this model, risk provisions are explained by ***operating income*** (and the dummy variable) (see Table A1.3). We get a ***highly significant positive regression***, ie risk provisions rise when operating income rises. This is in line with our reasoning that higher returns are based on higher risks, which in turn lead to higher risk provisions.

A note of caution: R^2 is high with 0.76, but we experience autocorrelation. In fact, this simple model underestimates risk provisions in the early 1990s and overestimates them in the late 1990s.

Test of the fourth hypothesis:

Now we explain risk provisions by ***operating result*** (see Table A1.4). Again, we find a ***significant positive link***. Since the operating result is defined as operating income minus operating expenses, it is not surprising that the significant positive link of operating income with risk provisions is also found in this model.

Because the explanatory power of the operating result is somewhat less significant (and autocorrelation even higher), we are inclined to argue that risk provisions can be explained better by operating income than by the operating result. However, it cannot be ruled out that banks tend to increase their risk provisions in "good times", ie because the bank operating result is high. Whether this type of behaviour is mainly triggered by tax or by confidence considerations, or perhaps something else, is difficult to assess.

To ***summarise*** these results, Austrian banks appear to behave procyclically, ie they increase risk provisions in times of declining real GDP growth rates. In addition, Austrian banks form risk provisions when their operating income rises. It cannot be ruled out that banks form risk provisions because the operating result rises. The model also delivers the result that rising inflation and rising real estate prices lead to higher risk provisions. While the first result is in line with expectations, even though it is somewhat astonishing that relatively moderate inflation rates have such a significant impact on risk provisioning, the latter result is not in line with expectations.

Putting the above findings in a single model delivers the expected result; see Table 3 and Figure 1. The statistical tests highlight that the explanatory power of this model with an adjusted R^2 of 0.95 and very high significance levels is exceptionally high (see table and corresponding Figure below). (The Durbin-Watson statistic indicates autocorrelation; however a close analysis of the residuals comes to the conclusion that the autocorrelation of the residuals is statistically not significant (probability values ≥ 0.15) and therefore does not pose a problem. Nevertheless, for an AR(4) model which deals with this insignificant autocorrelation, see Table A1.5.)

2.2 What determines net interest income?

Austrian banks' operating income (still) very much depends on net interest income. This is also confirmed by a simple regression analysis, where operating income is very well explained by net interest income (see Table A2.1).

According to our multiple regression analysis, net interest income is not well explained by market ***short- and long-term interest rate*** developments and appears to be uncorrelated with ***real GDP*** growth (see Table A2.2; very much the same holds if net interest income is lagged by one year versus interest rate developments). However, we cannot rule out that net interest income reacts to interest rate developments with a very long time lag of perhaps three or four years. Since our data cover only 10 years, a time lag of that magnitude leads to serious econometric problems and could not be tested by us.

Anecdotal evidence as well as a graphic analysis of recent net interest developments in Austria lead us to the conclusion that ***the level of interest rates most likely has some influence on net interest income*** (see Figure 2). When short-term interest rates (three-month money market rates) hovered around or below 3.5%, and long-term interest rates (five-year government bonds) fell below 5%, net interest income started to fall (with a certain time lag). This might be explained by the fact that interest rates for customer deposits reached a point where they could not fall much further (eg in the case of retail overnight deposits), and/or customers started to move to other, higher-yield forms of investment (eg mutual funds). In the latter case, banks had to refinance themselves in other, usually more expensive ways (eg via money markets and bonds). On the other side of the balance sheet, interest rates for loans still had room to go down further and low rates were attractive for debtors. This caused the spread between active and passive interest rates to narrow.

Table 3

Risk Provisions

Dependent variable: ProvisionsGlobalD4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.022176	0.031594	–0.701901	0.4885
IncomeGlobalD4L	0.351733	0.109022	3.226241	0.0032
GDPREALD4L	–1.887156	0.635363	–2.970202	0.0060
RESTATELAG2QD4L	0.406306	0.155008	2.621185	0.0140
CPID4L	4.773383	1.080456	4.417935	0.0001
D96	–0.368167	0.009352	–39.36569	0.0000

R-squared	0.956389	Mean dependent var	0.010556
Adjusted R-squared	0.948602	SD dependent var	0.173110
SE of regression	0.039246	Akaike info criterion	–3.479142
Sum squared resid	0.043127	Schwarz criterion	–3.209784
Log likelihood	65.14542	F-statistic	122.8089
Durbin-Watson stat	1.427442	Prob (F-statistic)	0.000000

2.3 Which macroeconomic developments influence Austrian banks' operating income?

Short- and long-term interest rates

First, the explanatory power of changes in nominal interest rates is tested, by applying the following model (reminder: all data are annual growth rates, ie in log and seasonal differences):

Operating income = c + b1 * InterestRate3Month + b2 * InterestRate5Years.

The variance of operating income of all Austrian banks is not significantly explained by the movement of short-term interest rates and just significantly explained by the movement of long-term interest rates. ***Falling long-term interest rates lead significantly to higher operating income and vice versa***. Short-term rates have the same sign as long-term rates, but are not significant. The Durbin-Watson statistic indicates some positive autocorrelation (see Table A3.1).

Short-, long-term interest rates and the volume of loans

When the above model is extended by the volume of loans, its explanatory power rises, even though short-term interest rates remain just below the significance level of 5%; changes in the volume of loans and long-term rates are significant. The results are in line with expectations: ***operating income rises significantly with the volume of loans and significantly when long-term interest rates fall*** (see Table A3.3).

Figure 1

Risk Provisions

(annual growth rates; rhs)

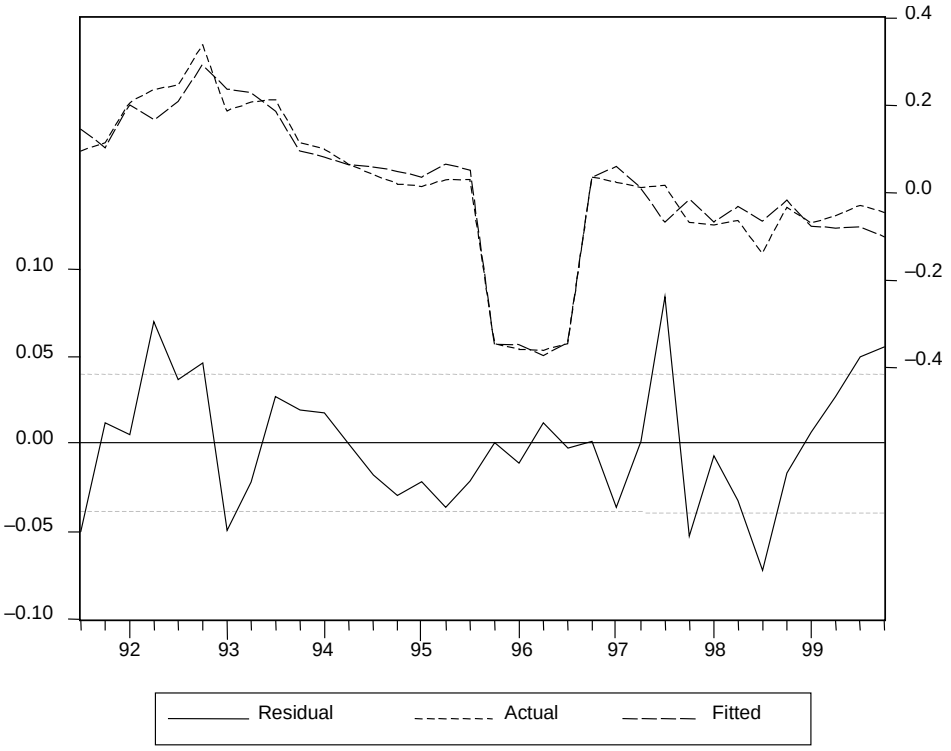
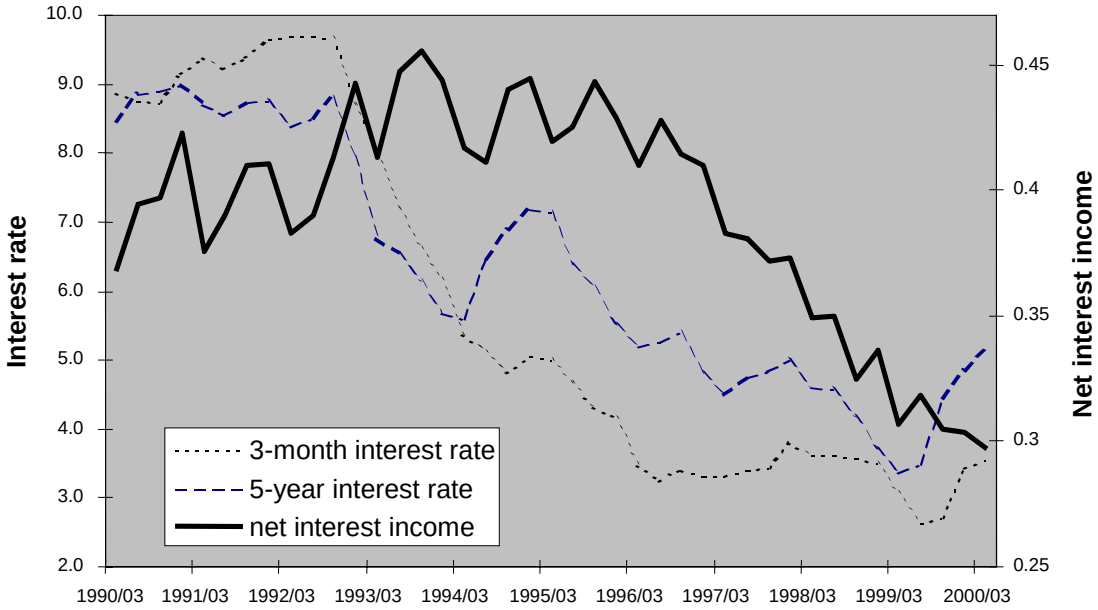


Figure 2

Net interest income in % of total assets and interest rates



Short-, long-term interest rates and real estate prices

In this model we use real estate prices in Vienna, lagged by two quarters, as one of the explanatory variables. A lag of two quarters is introduced, since it certainly takes time before real estate price developments and their effects on customers (loans, etc) show up in bank income. Lagging this real estate index by four quarters leads to similar but somewhat less significant results.

According to this model specification, operating income is significantly explained by short- and long-term interest rates, as well as real estate prices. ***Operating income rises when short- and long-term interest rates fall and real estate prices increase*** (we are not confronted with autocorrelation; see Table 4 and Figure 3).

Table 4

Operating income

Dependent variable: IncomeGlobalD4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.063169	0.010388	–6.080930	0.0000
IRATE3MD4L	–0.166282	0.058541	–2.840465	0.0080
IRATE5YD4L	–0.125043	0.058192	–2.148786	0.0398
RESTATELAG2QD4L	0.587049	0.183582	3.197747	0.0033

R-squared	0.459964	Mean dependent var	–0.013839
Adjusted R-squared	0.405961	SD dependent var	0.070250
SE of regression	0.054145	Akaike info criterion	–2.884188
Sum squared resid	0.087949	Schwarz criterion	–2.704617
Log likelihood	53.03120	F-statistic	8.517298
Durbin-Watson stat	2.024644	Prob (F-statistic)	0.000305

This type of behaviour is ***in line with expectations***. Banks in general seem to refinance themselves short-term, while they tend to invest long-term (this holds not only for investment banking, but also for investments in eg equipment, real estate and human capital). In an environment of falling (short- and long-term) interest rates, operating income rises, and vice versa. Rising real estate prices are positive for operating income, since banks' profits from their own real estate transactions rise and the business of their real estate subsidiaries becomes more profitable, thus influencing operating income. In addition, rising real estate prices should lead to higher demand for mortgage-backed debt, which in turn increases the volume of fees, etc and probably increases margins.

Short-, long-term interest rates and the consumer price index

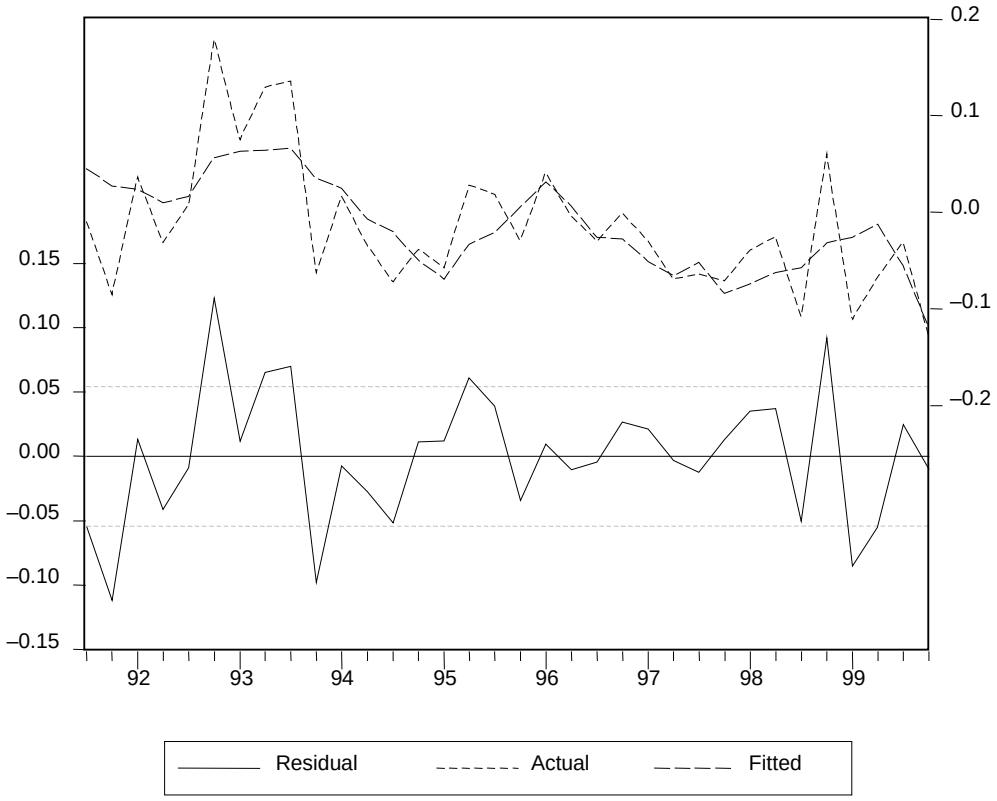
Using the consumer price index (CPI) along with short- and long-term interest rates to explain banks' operating income, we obtain a large extent the same - econometrically - good results (R^2 = 0.36: Durbin-Watson = 2.1).[5] ***Operating income rises significantly with inflation and increases significantly when long-term interest rates fall*** (and not significantly when short-term interest rates fall; see Table A3.4).

[5] Since we use nominal interest rates and the CPI in one multiple regression model, some multi-collinearity can not be ruled out, even though we have econometric evidence that this should not pose too much of a problem. Multiple regressions which do not use nominal interest rates and the CPI in one model confirm the explanatory power of nominal interest rates respectively the CPI.

Figure 3

Operating income

(annual growth rates; rhs)



In relation to bank operating income in Austria during the 1990s, the CPI might well be used as an indicator for structural changes in the Austrian economy during this period. Rising inflation rates can be - amongst other things - an indicator for inefficiency and protected or fragmented markets. Falling inflation rates can go along with increased competition. In this respect, falling inflation rates would hint at rising competition in the economy in general and amongst banks in particular. The latter is very much in line with developments in Austria during the 1990s, especially after joining the European Economic Area with its single market in 1994 and the European Union in 1995.

Real short- and long-term interest rates

Using real interest rates instead of nominal rates and the CPI, the result is that ***falling real long-term interest rates***[6] ***significantly lead to rising operating income, while falling real short-term rates have an insignificant effect*** on operating income (see Table A3.5).

The same analysis for ***different sectors of the Austrian banking system*** as a whole leads to different results (for different peer group definitions of Austrian banks, please see pages 6 and 7):

Large banks

The development of operating income of large Austrian banks can be explained by a similar model to that for the banking industry as a whole. ***Operating income of large banks depends significantly and negatively on long-term interest rate developments and significantly and positively on real estate price developments in Vienna*** (lagged by two quarters). The difference compared to the model for the banking industry as a whole is that short-term interest rates become totally insignificant

[6] For practical reasons, real long-term interest rates are defined as the yield of five-year government benchmark bonds minus the annual inflation rate in the corresponding quarter.

(see Table A4.1). Nevertheless, the explanatory power of this model remains high (adjusted R^2: 0.44; Durbin-Watson test: 2.1). Viennese real estate prices become even more significant, which fits well with expectations. The largest Austrian banks are based in Vienna and are usually very active in the Viennese real estate sector.

Substituting the CPI for real estate prices brings, to some extent, the same results: The operating income of large banks ***depends significantly and negatively on long-term interest rate developments and significantly and positively on CPI developments*** (R^2: 0.28; no autocorrelation; see Table A4.2). Short-term interest rate developments fall slightly short of being significant, ie remain slightly above the probability level of 5%, but, unlike the results so far, correlate positively with operating income.

Using real interest rates instead of nominal rates and the CPI, the result is that ***falling real long-term interest rates significantly lead to rising operating income***, while rising real short-term rates have an insignificant effect on operating income.

Retail banks (peer group 4 and 5)

Applying the model with ***interest rates and real estate prices*** as the explanatory variables to "peer groups 4 and 5", ie retail banks, ***does not explain operating income*** developments (see Table A5.1). Neither interest rate nor real estate price developments in Vienna have a significant influence on the operating income of retail banks. This is not surprising, since small retail banks are mainly involved in the customer deposits and lending business, which is in general, according to our analysis of net interest income, not well explained by interest rate developments. The fact that real estate price developments in Vienna do not explain the operating income of small retail banks is reasonable. Small retail banks are usually not based in Vienna and in general do not have significant real estate operations in Vienna.

Substituting the CPI for real estate prices leads to very much the same results. ***Consumer price developments*** and - according to our interpretation of CPI developments during the 1990s - increased competition ***appear to have no significant effect*** on the operating income of small retail banks (see Table A5.2).

Banks specialising in interbank business

The operating income of - relatively small - banks operating mainly in the interbank area (peer group 8 and 9) cannot be explained by interest rates and real estate prices. Changes in ***real estate prices and long-term interest rates do not have any explanatory power; moreover, short-term interest rates are insignificantly (negatively) correlated with operating income***. Inflation does not significantly explain the operating income of this banking sector, either (see Tables A6.1 and A6.2).

Foreign banks

Foreign banks' operating income, ie the operating income of relatively small Austrian banks with sizeable operations abroad, ***does not have any significant regressions*** with real estate developments in Vienna and with interest rates, which is by and large in line with expectations. CPI developments in Austria have no significant effect on the operating income of small Austrian banks operating abroad, either (see Table A7.1).

In ***conclusion***, for the banking industry as a whole, developments in short-term interest rates and long-term interest rates, along with real estate and/or the inflation rate, appear to have a significant influence on operating income. But this can be traced mainly to the behaviour of large banks, even though the influence of short-term interest rates on the operating income of large banks becomes insignificant or difficult to interpret. Small retail banks, (smaller) foreign banks and (smaller) banks in the interbank business seem to be unaffected not only by real estate price developments in Vienna (which is in line with expectations), but also by consumer prices and interest rate developments.

2.4 Real fundamentals, monetary aggregates and financial market data

Real GDP

In a simple regression model, ***real GDP growth rates correlate significantly negatively with the operating income*** of both the Austrian banking sector as a whole and that of most peer groups, which is contrary to expectations (see Table A3.2). However, in multiple regression models real GDP growth rates usually do not explain operating income significantly.

These results are even more astonishing, as we found strong seasonal patterns in operating income, similar to the ones for GDP; ie the first quarter - in absolute terms - is usually the weakest, and the fourth quarter usually the strongest of the year. The latter might have to do with the fact that banks tend to charge their annual service fees, interest due, etc at the end of the year, ie in the fourth quarter.

Real domestic demand

Real domestic demand growth as an explanatory variable for operating income of Austrian banks leads very much to the same results as for real GDP.

M3 and loans

We found some ***positive correlations*** between M3 growth or loan growth with operating income, which are usually ***not significant*** (apart from Table A3.3). The positive relationship is in line with expectations, since growing monetary aggregates should lead to higher income volumes and probably higher margins.

Stock markets

Stock market developments seem to have ***no significant explanatory power*** for the operating income of Austrian banks.[7] This is in line with expectations, since stocks play only a minor role in the Austrian economy. Austrian investors and Austrian banks are not known to be - relative to their size - big players on stock markets (with the exception of eastern European stock markets).

Yield curve

Apart from using short- and long-term interest rates, we also tested how the dynamics of the yield curve might explain operating income. In general, ***no convincing regressions*** were found.

2.5 Banks' operating result and macroeconomic developments

The ***operating result*** is ***operating income minus operating expenses***. Operating expenses are mainly influenced by microeconomic-related costs. Given this definition of the operating result, one might expect models similar to those which explain the operating income to also explain, to some extent, the operating result of Austrian banks.

Short-, long-term interest rates and real estate prices

First, we explain the operating result of the global Austrian banking industry by short- and long-term interest rates, as well as by the Viennese real estate price index lagged by two quarters; see Table 5. The results are largely in line with those achieved with the model for operating income. ***Falling long-term interest rates and rising real estate prices lagged by two quarters significantly lead to a rising operating result***, while short-term interest rates insignificantly explain the operating result.

Short-, long-term interest rates and the consumer price index

Substituting the consumer price index for the real estate price index decreases the explanatory value of the model somewhat; see Table 6. ***Long-term interest rates are highly significant, and the CPI falls slightly short of being significant in explaining the operating result***, while short-term interest rates are totally insignificant. Falling long-term interest rates lead to a higher operating result.

Real short- and long-term interest rates

Using real short- and long-term interest rates instead of nominal interest rates and the CPI leads to the following result: ***real long-term interest rates have a significant negative correlation with the operating result***, while real short-term interest rates have no explanatory power (see Table A8.1).

From the above results, we draw the ***conclusion*** that short-term interest rates, or ***monetary policy, had a minor influence on bank's operating results*** during the 1990s.

[7] We used the Austrian Traded Index (ATX) and Datastream's EU Market Index.

Table 5

Operating result

Dependent variable: ResultGLOBD4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.136654	0.033295	–4.104305	0.0003
IRATE3MD4L	–0.263644	0.185031	–1.424861	0.1645
IRATE5YD4L	–0.588541	0.175562	–3.352321	0.0022
RESTATELAG2QD4L	1.260533	0.477319	2.640861	0.0130
R-squared	0.447993	Mean dependent var		–0.013362
Adjusted R-squared	0.392792	SD dependent var		0.197551
SE of regression	0.153939	Akaike info criterion		–0.794395
Sum squared resid	0.710913	Schwarz criterion		–0.614823
Log likelihood	17.50472	F-statistic		8.115714
Durbin-Watson stat	2.109950	Prob (F-statistic)		0.000419

Table 6

Operating result

Dependent variable: ResultGLOBD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.200163	0.065995	–3.033002	0.0048
IRATE3MD4L	–0.013460	0.166792	–0.080699	0.9362
IRATE5YD4L	–0.661658	0.181228	–3.650971	0.0009
CPID4L	5.357209	2.829680	1.893221	0.0674
R-squared	0.377612	Mean dependent var		–0.017712
Adjusted R-squared	0.319263	SD dependent var		0.197986
SE of regression	0.163352	Akaike info criterion		–0.681380
Sum squared resid	0.853883	Schwarz criterion		–0.505434
Log likelihood	16.26485	F-statistic		6.471614
Durbin-Watson stat	2.079175	Prob (F-statistic)		0.001506

3. Summary and conclusions

We aimed to assess the effects of macroeconomic developments on the risk provisions and earnings of Austrian banks for the 1990s, by seeking to detect economic indicators with a potentially disturbing effect on the stability of the banking system. The underlying theory is that banks' earnings are to some extent directly and indirectly dependent on the state of the economy.

Since the bank data required are not available before 1990, the econometric models are based on only interest rate half cycles, ie falling rates between 1990 and 1999. This, and the structural changes which occurred in the Austrian banking industry and economy during the 1990s, must be kept in mind for any conclusions for the future.

The main findings

Risk provisions

We found evidence that Austrian banks behave procyclically, ie ***banks increase their risk provisions in times of declining real GDP growth rates. They also raise their risk provisions when their operating income increases***. It cannot be ruled out that banks form risk provisions because their operating result rises, with the aim of smoothing their operating results over time, perhaps due to credibility and/or tax considerations.

That banks should increase their risk provisioning in times of rising operating income is in the interest of supervisors, because ***higher return or income goes with higher risks***, for which risk provisions should be expanded accordingly. However, if banks increase their risk provisions because of a rising operating result, several questions arise. Is this behaviour triggered by the aim of evening out the operating result (and thereby profits) over time, in order to generate trust among the public? has it something to do with ***tax considerations***? or do some individual banks increase risk provisions simply when they can afford to do so?

The model also delivers the unexpected and somewhat curious result that rising real estate prices lead to higher risk provisions. Generally in line with expectations is the result that falling inflation depresses risk provisions.

Net interest income

Net interest income appears to be uncorrelated with ***real GDP*** growth. Difficult to interpret is the behaviour of ***net interest income*** in relation to short- and long-term interest rate developments. It appears that net interest income is by and large uncorrelated with interest rate developments, even though we cannot yet rule out that net interest income reacts to interest rate developments with very long time lags of perhaps up to four years.

However, we believe that ***very low interest rate levels lead to declining net interest income***. At very low interest rate levels, interest rates for retail deposits reach a point where they cannot fall much further (eg in the case of overnight deposits), and/or customers start to move to other, higher-yield forms of investment (eg mutual funds), while interest rates on loans still have room left to decline and become even more attractive for debtors.

Bank operating income

When it comes to explaining the development of the ***operating income*** of the Austrian banking industry as a whole, short- and long-term interest rates as well as real estate and/or inflation have a significant influence. ***Falling interest rates and rising real estate prices, as well as rising inflation, lead to higher operating income and vice versa***.

In an environment of falling ***interest rates***, operating income rises and vice versa. This type of behaviour is in line with expectations. Banks in general appear to refinance themselves short-term, while they invest long-term (this holds not only for investment banking, but also for investments in eg equipment, real estate and human capital).

Rising ***real estate prices*** have a positive impact on the operating income of banks, since their own real estate transactions and those of their real estate subsidiaries become more profitable. In addition, rising real estate prices should lead to higher demand for mortgage-backed debt, which in turn increases the volume of commissions, fees, etc and probably margins.

In relation to bank operating income, the ***consumer price index*** might well be used as an indicator for structural changes and especially for competition during the 1990s in Austria. High inflation or rising inflation rates could - amongst other things - be an indicator for inefficiency and protected or fragmented markets. Low inflation or falling inflation rates could be associated with increased competition. The latter is very much in line with developments in Austria during the 1990s, especially after accession to the European Economic Area, and shortly afterwards to the European Union in 1995.

When ***the Austrian banking sector is broken down into peer groups***, the individual peer group results deviate from the overall conclusion: The influence of real estate and the CPI on the operating income of the whole banking sector can be traced solely to large banks. (Small) retail banks, (small) foreign banks and (small) banks specialising in interbank business appear to be unaffected not only by the CPI and real estate price developments in Vienna, but also by short- and long-term interest rate developments. Along with the inflation rate and/or retail prices, long-term interest rates appear to be

significant for the development of the operating income of ***large banks***, which represent nearly three quarters of all Austrian banks in terms of total assets. The influence of short-term interest rates on the operating income of large banks becomes insignificant or difficult to interpret.

Depending on the model specification, ***real GDP*** growth appears to have no significant explanatory value for the income development of the Austrian banking sector. This result is somewhat astonishing, as we have found strong seasonal patterns in operating income, similar to the ones for GDP or domestic demand; ie the first quarter is - in absolute terms - the weakest, the fourth quarter usually the strongest.

Bank operating result

By and large, similar conclusions to those for bank operating income can be drawn for the development of the ***operating result*** of Austrian banks. In particular, declining real estate, but also declining inflation, ie rising competition in Austria during the 1990s, appears to have a negative impact on the operating result of Austrian banks. However, short-term interest rates seem to have no significant influence on banks' operating results.

Real long-term interest rates have a significant negative correlation with the operating result, real short-term interest rate are completely insignificant.

The fact that short-term interest rates had no significant influence on banks' operating results during the 1990s leads us to the conclusion that ***monetary policy appears to have played a minor role in explaining the operating result of the Austrian banking industry***.

Possible implications for banking supervision and some general, tentative conclusions

Austrian banks seem to behave procyclically, ie they increase ***risk provisions*** in times of declining real GDP growth rates. In addition, they form risk provisions when operating income rises. It cannot be ruled out that banks form risk provisions because their operating result rises. From a supervisor's point of view, a ***less procyclical stance***, ie the forming of risk provisions in economic "good times" (rising or high real GDP growth rates), should be encouraged; the expected loan losses should include expected losses due to the business cycle. From a ***European perspective***, further harmonisation efforts in the area of accounting standards, provisioning and taxation should possibly be envisaged to achieve a level playing field.

Overall, some ***macroeconomic variables*** like interest rates, real estate and consumer prices, but not real GDP or domestic demand growth rates, can be used to explain the risk provisions, operating income and operating results of Austrian banks during the 1990s.[8] Consequently, the macroeconomic dimension must not be neglected by supervisory authorities. However, macroeconomic developments alone cannot explain the development of microeconomic bank data in a sufficient way. Other factors apart from macroeconomics obviously play a major role in banking.

Microeconomics, especially sound and prudent bank management - at least during normal (bank) business cycles - probably ***plays the major role for individual banks***. For supervisors, the "bottom up" approach, ie ***standard banking supervision, remains most relevant***.

Structural changes, such as increased competition, accession to the single market and the opening up of eastern European markets, have certainly also been influencing Austrian banks strongly and must be monitored by market participants and the relevant authorities.

[8] However, we regard it as likely that more pronounced business cycles than Austria has experienced during the 1990s might have an impact on bank data.

Appendix

Table A1.1

Risk provisions (of all Austrian banks) explained by real GDP growth, the real estate price index lagged by two quarters, the real three-month interest rate and a dummy variable (D96)

Dependent variable: ProvisionsGlobalD4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.063477	0.021137	3.003051	0.0055
GDPREALD4L	–2.680895	0.907689	–2.953540	0.0062
RESTATELAG2QD4L	1.194800	0.155739	7.671790	0.0000
REALIRATE3MD4L	–0.098680	0.024024	–4.107562	0.0003
D96	–0.369404	0.012471	–29.62151	0.0000

R-squared	0.930840	Mean dependent var	0.010556
Adjusted R-squared	0.921301	SD dependent var	0.173110
SE of regression	0.048563	Akaike info criterion	–3.076845
Sum squared resid	0.068393	Schwarz criterion	–2.852381
Log likelihood	57.30637	F-statistic	97.57939
Durbin-Watson stat	1.555400	Prob (F-statistic)	0.000000

Table A1.2

Risk provisions explained by an AR model (lag four quarters) using real GDP, real estate lagged by two quarters, the CPI and a dummy variable

Dependent variable: ProvisionsGlobalD4L
Method: least squares
Sample (adjusted): 1992:3, 1999:4
Included observations: 30 after adjusting endpoints
Convergence achieved after 11 iterations
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.017004	0.026877	–0.632658	0.5329
GDPREALD4L	–3.077624	0.990161	–3.108205	0.0048
RESTATELAG2QD4L	0.605490	0.162714	3.721204	0.0011
CPID4L	5.019448	0.742043	6.764364	0.0000
D96	–0.357067	0.014583	–24.48497	0.0000
AR(4)	–0.577672	0.156050	–3.701843	0.0011

R-squared	0.959855	Mean dependent var	–0.009767
Adjusted R-squared	0.951492	SD dependent var	0.173154
SE of regression	0.038137	Akaike info criterion	–3.518430
Sum squared resid	0.034906	Schwarz criterion	–3.238191
Log likelihood	58.77645	F-statistic	114.7668
Durbin-Watson stat	1.990391	Prob (F-statistic)	0.000000

Table A1.3

Risk provisions explained by operating income and a dummy variable

Dependent variable: ProvisionsGlobalD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.078750	0.014963	5.262981	0.0000
IncomeGLOBD4L	1.006263	0.200560	5.017257	0.0000
D96	–0.425653	0.043801	–9.717924	0.0000

R-squared	0.776917	Mean dependent var	0.015853
Adjusted R-squared	0.763397	SD dependent var	0.169573
SE of regression	0.082484	Akaike info criterion	–2.072780
Sum squared resid	0.224517	Schwarz criterion	–1.940820
Log likelihood	40.31004	F-statistic	57.46349
Durbin-Watson stat	0.622433	Prob (F-statistic)	0.000000

Table A1.4

Risk provisions explained by operating result and a dummy variable

Dependent variable: ProvisionsGlobalD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.067594	0.016941	3.989960	0.0003
ResultGLOBD4L	0.264865	0.081501	3.249841	0.0027
D96	–0.423443	0.050626	–8.364081	0.0000

R-squared	0.702090	Mean dependent var	0.015853
Adjusted R-squared	0.684035	SD dependent var	0.169573
SE of regression	0.095318	Akaike info criterion	–1.783534
Sum squared resid	0.299824	Schwarz criterion	–1.651574
Log likelihood	35.10361	F-statistic	38.88593
Durbin-Watson stat	0.334897	Prob (F-statistic)	0.000000

Table A1.5

Risk provisions explained by an AR model (lag four quarters) using operating results, real GDP, real estate lagged by two quarters, the CPI and a dummy variable

Dependent variable: ProvisionsGlobalD4L
Method: least squares
Sample (adjusted): 1992:3, 1999:4
Included observations: 30 after adjusting endpoints
Convergence achieved after 14 iterations
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.010389	0.026717	–0.388865	0.7010
IncomeGLOBD4L	0.372042	0.152837	2.434233	0.0231
BIPREALD4L	–2.150079	0.916814	–2.345164	0.0280
RESTATELAG2QD4L	0.537019	0.144434	3.718088	0.0011
CPID4L	4.229359	0.862626	4.902887	0.0001
D96	–0.365138	0.014292	–25.54842	0.0000
AR(4)	–0.451055	0.151922	–2.968994	0.0069

R-squared	0.966697	Mean dependent var	–0.009767
Adjusted R-squared	0.958010	SD dependent var	0.173154
SE of regression	0.035482	Akaike info criterion	–3.638619
Sum squared resid	0.028956	Schwarz criterion	–3.311673
Log likelihood	61.57929	F-statistic	111.2722
Durbin-Watson stat	1.735501	Prob (F-statistic)	0.000000

Table A2.1

Operating income of all Austrian banks explained by net interest income

Dependent variable: IncomeGlobalD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.005177	0.009619	0.538202	0.5939
NetInterestIncomeD4L	0.749191	0.130168	5.755593	0.0000

R-squared	0.521344	Mean dependent var	–0.015505
Adjusted R-squared	0.507266	SD dependent var	0.069608
SE of regression	0.048861	Akaike info criterion	–3.145721
Sum squared resid	0.081172	Schwarz criterion	–3.057748
Log likelihood	58.62298	F-statistic	37.03220
Durbin-Watson stat	1.864855	Prob (F-statistic)	0.000001

Table A2.2

Net interest income of all banks explained by real GDP growth and short- and long-term interest rates

Dependent variable: NetInterestIncomeD4L
Method: least squares
Date: 30 November 2000 Time: 15:40
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.014571	0.031056	–0.469173	0.6421
BIPREALD4L	–1.097277	1.200252	–0.914206	0.3674
IRATE3MD4L	–0.100834	0.067323	–1.497765	0.1440
IRATE5YD4L	0.040665	0.072035	0.564519	0.5763

R-squared	0.097386	Mean dependent var	–0.027605
Adjusted R-squared	0.012766	SD dependent var	0.067085
SE of regression	0.066655	Akaike info criterion	–2.474120
Sum squared resid	0.142174	Schwarz criterion	–2.298174
Log likelihood	48.53417	F-statistic	1.150859
Durbin-Watson stat	0.451051	Prob (F-statistic)	0.343647

Table A3.1

Operating income of all Austrian banks explained by short- and long-term interest rates

Dependent variable: IncomeGlobalD4L
Method: least squares
Date: 24 November 2000 Time: 14:58
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.035499	0.011167	–3.179029	0.0032
IRATE3MD4L	–0.065340	0.052391	–1.247140	0.2211
IRATE5YD4L	–0.136139	0.068295	–1.993385	0.0545

R-squared	0.169034	Mean dependent var	–0.015505
Adjusted R-squared	0.118672	SD dependent var	0.069608
SE of regression	0.065347	Akaike info criterion	–2.538559
Sum squared resid	0.140917	Schwarz criterion	–2.406599
Log likelihood	48.69406	F-statistic	3.356402
Durbin-Watson stat	1.510052	Prob (F-statistic)	0.047111

Table A3.2

Operating income of all banks explained by real GDP growth

Dependent variable: IncomeGLOBD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.034065	0.029198	1.166699	0.2515
BIPREALD4L	–2.493492	1.140224	–2.186844	0.0357

R-squared	0.165788	Mean dependent var	–0.015505
Adjusted R-squared	0.141252	SD dependent var	0.069608
SE of regression	0.064504	Akaike info criterion	–2.590216
Sum squared resid	0.141468	Schwarz criterion	–2.502243
Log likelihood	48.62389	F-statistic	6.757031
Durbin-Watson stat	1.877332	Prob (F-statistic)	0.013715

Table A3.3

Operating income of all banks explained by loan growth and short- and long-term interest rates

Dependent variable:
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.094401	0.027634	–3.416156	0.0017
IRATE3MD4L	–0.092329	0.050389	–1.832336	0.0762
IRATE5YD4L	–0.141305	0.065733	–2.149682	0.0392
DIRECTLOANSD4L	1.060479	0.541573	1.958145	0.0590
R-squared	0.240422	Mean dependent var		–0.015505
Adjusted R-squared	0.169212	SD dependent var		0.069608
SE of regression	0.063446	Akaike info criterion		–2.572829
Sum squared resid	0.128811	Schwarz criterion		–2.396883
Log likelihood	50.31093	F-statistic		3.376218
Durbin-Watson stat	1.655521	Prob (F-statistic)		0.030204

Table A3.4

Operating income of all banks explained by short- and long-term interest rates and the inflation rate (CPI)

Dependent variable: IncomeGlobalBD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.102726	0.021613	–4.753041	0.0000
IRATE3MD4L	–0.047934	0.052286	–0.916769	0.3661
IRATE5YD4L	–0.159694	0.062268	–2.564602	0.0152
CPID4L	2.941452	0.926918	3.173369	0.0033
R-squared	0.418139	Mean dependent var		–0.015505
Adjusted R-squared	0.363589	SD dependent var		0.069608
SE of regression	0.055530	Akaike info criterion		–2.839360
Sum squared resid	0.098673	Schwarz criterion		–2.663414
Log likelihood	55.10849	F-statistic		7.665310
Durbin-Watson stat	2.102175	Prob (F-statistic)		0.000536

Table A3.5

Operating income of all banks explained by real short- and long-term interest rates

Dependent variable: ERTRAGGLOBD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.023019	0.009359	–2.459532	–2.459532
REALIRATE3MD4L	–0.026220	0.020029	–1.309118	–1.309118
REALIRATE5YD4L	–0.095183	0.039199	–2.428205	–2.428205
R-squared	0.249775	Mean dependent var		–0.015505
Adjusted R-squared	0.204307	SD dependent var		0.069608
SE of regression	0.062091	Akaike info criterion		–2.640775
Sum squared resid	0.127225	Schwarz criterion		–2.508815
Log likelihood	50.53396	F-statistic		5.493415
Durbin-Watson stat	1.802876	Prob (F-statistic)		0.008723

Table A4.1

Operating income of large banks explained by interest rates and real estate

Dependent variable: IncomeLargeD4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.062080	0.015208	–4.081982	0.0003
IRATE3MD4L	–0.004138	0.079477	–0.052061	0.9588
IRATE5YD4L	–0.222081	0.083920	–2.646357	0.0128
RESTATELAG2QD4L	0.886387	0.204974	4.324389	0.0002

R-squared	0.493222	Mean dependent var	–0.017344
Adjusted R-squared	0.442545	SD dependent var	0.097072
SE of regression	0.072477	Akaike info criterion	–2.300978
Sum squared resid	0.157585	Schwarz criterion	–2.121406
Log likelihood	43.11662	F-statistic	9.732522
Durbin-Watson stat	2.140879	Prob (F-statistic)	0.000121

Table A4.2

Operating income of large banks explained by interest rates and the CPI

Dependent variable: IncomeLargeD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.102195	0.029315	–3.486153	0.0014
IRATE3MD4L	0.178662	0.088885	2.010036	0.0529
IRATE5YD4L	–0.269259	0.093603	–2.876607	0.0071
CPID4L	3.680551	1.227093	2.999406	0.0052

R-squared	0.338785	Mean dependent var	–0.016194
Adjusted R-squared	0.276796	SD dependent var	0.097023
SE of regression	0.082510	Akaike info criterion	–2.047366
Sum squared resid	0.217850	Schwarz criterion	–1.871420
Log likelihood	40.85259	F-statistic	5.465247
Durbin-Watson stat	1.980203	Prob (F-statistic)	0.003785

Table A5.1

Operating income of peer groups 4 and 5, retail banks, explained by interest rates and real estate

Dependent variable: IncomePG45D4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.034131	0.033081	1.031750	0.3104
IRATE3MD4L	0.145402	0.129408	1.123599	0.2701
IRATE5YD4L	–0.038197	0.177246	–0.215501	0.8308
RESTATELAG2QD4L	0.193000	0.209572	0.920926	0.3644

R-squared	0.069771	Mean dependent var	0.023466
Adjusted R-squared	–0.023252	SD dependent var	0.114444
SE of regression	0.115767	Akaike info criterion	–1.364341
Sum squared resid	0.402061	Schwarz criterion	–1.184769
Log likelihood	27.19380	F-statistic	0.750037
Durbin-Watson stat	0.806937	Prob (F-statistic)	0.530930

Table A5.2

Operating income of peer groups 4 and 5, retail banks, explained by interest rates and the CPI

Dependent variable: IncomePG45D4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.034384	0.039689	0.866332	0.3928
IRATE3MD4L	0.170521	0.115617	1.474883	0.1500
IRATE5YD4L	–0.044146	0.176110	–0.250675	0.8037
CPID4L	0.269673	1.028666	0.262158	0.7949

R-squared	0.055160	Mean dependent var	0.023539
Adjusted R-squared	–0.033419	SD dependent var	0.111152
SE of regression	0.112994	Akaike info criterion	–1.418520
Sum squared resid	0.408566	Schwarz criterion	–1.242574
Log likelihood	29.53337	F-statistic	0.622722
Durbin-Watson stat	0.795228	Prob (F-statistic)	0.605506

Table A6.1

Operating income of peer groups 8 and 9, banks in the interbank business, explained by interest rates and real estate

Dependent variable: IncomePG89D4L
Method: least squares
Sample (adjusted): 1991:3, 1999:4
Included observations: 34 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.042172	0.047567	–0.886573	0.3824
IRATE3MD4L	–0.166970	0.208208	–0.801935	0.4289
IRATE5YD4L	–0.007988	0.103242	–0.077376	0.9388
RESTATELAG2QD4L	0.012593	0.299057	0.042109	0.9667

R-squared	0.053570	Mean dependent var	–0.018884
Adjusted R-squared	–0.041073	SD dependent var	0.120722
SE of regression	0.123176	Akaike info criterion	–1.240269
Sum squared resid	0.455172	Schwarz criterion	–1.060697
Log likelihood	25.08457	F-statistic	0.566022
Durbin-Watson stat	2.200606	Prob (F-statistic)	0.641663

Table A6.2

Operating income of peer groups 8 and 9, banks in the interbank business, explained by interest rates and the CPI

Dependent variable: IncomePG89D4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.070415	0.072175	–0.975606	0.3366
IRATE3MD4L	–0.176617	0.136126	–1.297451	0.2038
IRATE5YD4L	–0.021942	0.094445	–0.232324	0.8178
CPID4L	1.010476	2.014571	0.501584	0.6194

R-squared	0.079505	Mean dependent var	–0.023720
Adjusted R-squared	–0.006792	SD dependent var	0.119538
SE of regression	0.119943	Akaike info criterion	–1.299159
Sum squared resid	0.460363	Schwarz criterion	–1.123212
Log likelihood	27.38486	F-statistic	0.921299
Durbin-Watson stat	2.156738	Prob (F-statistic)	0.441657

Table A7.1

Operating income of peer group "foreign banks" explained by interest rates and the CPI

Dependent variable: IncomeFOREIGND4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	0.028314	0.134467	0.210565	0.8346
IRATE3MD4L	–0.002192	0.315491	–0.006948	0.9945
IRATE5YD4L	0.228094	0.507387	0.449546	0.6561
CPID4L	1.573079	4.007207	0.392562	0.6972

R-squared	0.026777	Mean dependent var	0.044486
Adjusted R-squared	–0.064463	SD dependent var	0.259783
SE of regression	0.268025	Akaike info criterion	0.308967
Sum squared resid	2.298798	Schwarz criterion	0.484913
Log likelihood	–1.561405	F-statistic	0.293478
Durbin-Watson stat	1.091311	Prob (F-statistic)	0.829792

Table 8.1

Operating results of all banks explained by short- and long-term real interest rates

Dependent variable: ResultGLOBD4L
Method: least squares
Sample (adjusted): 1991:1, 1999:4
Included observations: 36 after adjusting endpoints
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std error	t-statistic	Prob
Constant	–0.034995	0.026227	–1.334322	0.1912
REALIRATE3MD4L	0.027982	0.055066	0.508144	0.6147
REALIRATE5YD4L	–0.377049	0.095164	–3.962083	0.0004

R-squared	0.311869	Mean dependent var	–0.017712
Adjusted R-squared	0.270164	SD dependent var	0.197986
SE of regression	0.169140	Akaike info criterion	–0.636521
Sum squared resid	0.944078	Schwarz criterion	–0.504561
Log likelihood	14.45738	F-statistic	7.477999
Durbin-Watson stat	2.056598	Prob (F-statistic)	0.002097

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