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by

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The macrodynamics of operating income in the Norwegian banking sector

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Abstract

The banking literature contains only a handful of studies of how bank revenues vary over the business cycle, and nearly all of these studies look exclusively on the net interest margin. The general conclusion has been that the margin tends to increase during recessions and decrease during booms. In this paper we study the effect of macroeconomic variables on the operating income in the Norwegian banking sector. We contribute to the existing literature by looking at how net interest income as well as fee income varies over the cycle in an error correction framework, which allows us to identify both short term and long term relationships. Our paper also differs from most previous studies by taking into account the volume effect as well as the price effect of the business cycle.

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JEL Codes: G21, E32

Keywords: Bank operating income, Business cycles

1. Introduction

Bank revenues have a time variation pattern over the business cycle. Since revenues are a major determinant of bank capital and lending capacity, the time variation may have an impact on the real economy and may potentially amplify the business cycle. It will therefore be useful to understand how bank revenues vary over time, and in particular what are the relationships with key macroeconomic variables.

There are relatively few studies in the banking literature on this question, and the existing research is almost exclusively focused on the net interest margin. The present paper sets out to investigate the relationship between bank revenues and the business cycle more deeply in the context of the Norwegian banking industry. The paper contributes to the existing literature by including volume as well as price effects, and by looking at fee income in addition to net interest income. We are looking at both the short term and the long term effects of the business cycle.

These two income variables account for about 85 per cent of total operating income in Norwegian banking. Net interest income was the dominant component with 67 per cent of operating income in the Norwegian banking sector in 2007. Remaining operating income consists of fee income and trading income. Fee income is the more important of these two components and made for 19 per cent of total bank operating income in 2007. The trading income component is very volatile and does not appear to have a stable relationship with macro variables.

Section 2 below provides a brief overview of the relevant banking literature. Section 3 sketches the theoretical framework for the analysis. Section 4 introduces the data used, whereas section 5 presents the estimation procedure. The results are presented and discussed in sections 6 and 7. Section 8 concludes the paper.

2. Existing literature

Most of the existing research on bank operating income focuses on the impact of competition in the deposit and loan markets. Traditionally this research has been based on what is known as the structure-conduct-performance paradigm. The literature has mainly studied how market concentration allows banks the market power to set interest rates on loans and deposits, using other relevant factors as controls. In some more recent research market structure has been treated as endogenous. This literature on bank competition has recently been surveyed by Degryse, Kim and Ongena (2009). It is of limited relevance for the present paper, where we focus on the dynamics of bank operating income and in particular on the link between bank income and macro variables over the business cycle.

A more relevant strand of literature seeks to identify the determinants of the net interest margin, i.e. the difference between the average loan rate and the average funding rate of banks, in different markets. This margin is generally approximated as net interest income relative to total assets. Most studies build on the model framework of Ho and Saunders (1981), and explain the net interest margin by structural characteristics of national banking industries. Recent examples include papers by Demirgüç-Kunt and Huizinga (1999), Saunders and Schumacher (2000), Demirgüç-Kunt, Laeven and Levine (2004), Maudos and de Guevara (2004), Claeys and van der Vennet (2005), Schwaiger and Liebig (2008) and Hawtrey and Liang (2008). The studies typically find that the net interest margin depends positively on market concentration, the average ratio of equity to assets, the volatility of interest rates and the level of non-interest operating costs.

An early analysis of the dynamics of the net interest margin is found in McShane and Sharpe (1985), but they did not include macroeconomic variables in their model specification. More relevant for our purpose are a few papers that explicitly investigate the cyclical behaviour of the net interest margin. This literature builds on the well documented fact that

the price mark-up in most non-financial industries exhibit a counter-cyclical pattern, with higher mark-ups in recessions and lower mark-ups in booms. Dueker and Thornton (1997) and Aliaga-Diaz and Olivero (2005) for the US, da Silva, Oreiro, de Paula and Sobreira (2007) for Brazil, Turgutlu (2010) for Turkey and Mandelman (2006) for a panel of more than 100 countries find the same cyclical pattern for banks' net interest margin: Margins tend to be higher during recessions and lower during booms.

There are a number of possible explanations for this counter-cyclicality of net interest margins: Banks may have a preference for smoothing total income and thus compensate for lower volumes by charging higher margins during recessions. Furthermore, credit risk and adverse selection may be more severe problems for banks during recessions and thus require higher mark-ups. Also, the loan markets may be less contestable during recessions, meaning that incumbents who resort to limit pricing may maintain higher margins without encouraging potential entrants. All of these explanations rely on banks having some market power, and that market power may itself be stronger during recessions. Aliaga-Diaz and Olivero (2007) present a theoretical model of counter-cyclical margins, where the market power of banks is derived from customer switching costs and asymmetrical information among lenders. They note that the counter-cyclical behaviour of margins will act as a financial accelerator, amplifying the effects of any shocks on the macro economy.

A fourth stream of papers tries to identify the interest rate risk faced by banks by using gap analysis. This involves measuring the duration (repricing) mismatch between assets and liabilities on the bank balance sheet, and has a long tradition in bank analysis; see e.g. Wright and Houpt (1996). Bank assets and liabilities are sorted into duration buckets, and each item is assumed to be repriced with changes in market interest rates and with the appropriate lag. The implicit assumption is that this duration mismatch between assets and liabilities captures the substance of interest rate risk. Recent experience has taught us that time variation in credit or

liquidity premiums may also be significant risk factors. One further problem is that accurate data on repricing periods are almost never available to the researcher: Securities must be allocated to a limited number of duration buckets. Furthermore, information on off-balance sheet hedges, such as interest rate swaps, is rarely available. Gap analysis performed without detailed inside information on bank assets and liabilities may therefore tend to overestimate the sensitivity of bank income to interest rate changes.

A recent example of a gap analysis approach is found in Drehmann, Sorensen and Stringa (2010), who proposes a bank model for the stress testing exercises at the Bank of England. Their motivation for choosing this approach is that it facilitates a very transparent exposition of banks' dependence on market interest rates. Their framework also allows for the introduction of shocks on liquidity and credit premiums. Their model parameters are calibrated rather than estimated.

Other papers have tried to identify banks' exposure to interest rate risk by looking at the time series relationship between bank profitability and interest rates. Early examples are papers by Flannery (1981, 1983), who found that his samples of US banks were not much affected by interest rate changes. Flannery measured profitability from accounting data. A more recent paper also using accounting data is Maes (2004), who looked at Belgian banks without finding much impact of interest rate changes.

A closely related parallel literature looks at stock market prices as indicators of profitability. A significantly negative relationship is generally found between unanticipated interest rate changes and financial stock returns. A recent example is Fraser, Madura and Weigand (2002) who also explored how the sensitivity of individual banks to interest rate changes depends on a number of bank characteristics. They found that banks with little equity capital, little non-interest income, high loan volumes and high dependence on demand

deposits are more sensitive. Surveys of the literature on financial stock prices and interest rates are found in Staikouras (2003, 2006).

A few papers examine the diversification benefits of introducing more non-interest income activities as a supplement to the net interest income from credit intermediation. Recent papers include Smith, Staikouras and Wood (2003), Stiroh (2004), Chiorazzo, Milani and Salvini (2008), Lepetit, Nys, Rous and Tarazi (2008) and Calmès and Liu (2009). Most of these papers find that interest and non-interest income correlate positively both in time series and in cross section dimensions, and that there is consequently no diversification benefit.

In the present paper our concern is to model the dynamics of net interest and fee income for the banking sector. We choose to look at the total net interest and fee income components rather than the margins and volumes separately. One reason is that the income variables can be precisely measured from accounting data, whereas the margins can only be approximated. The common practice of measuring the net interest margin as the ratio between net interest income and total assets may be misleading because the composition of total assets may change over time and because total assets always refer to specific points in time whereas income is a stream variable. As discussed below there may also be an endogeneity problem.

As far as we are aware the only published paper focussing on the dynamics of bank income components rather than interest margins is by Albertazzi and Gambacorta (2009). They used panel data for ten countries over the period 1981-2003, and found that GDP have a positive effect on both net interest and non-interest income. This is in contrast to the short term negative impact of GDP growth generally found on the net interest margin, see above. This may be explained both by the different time horizons and by the volume effects of GDP growth.

3. Theoretical framework

We make the standard assumption that banks optimise the probability distribution of their future net revenues by making simultaneous decisions on the interest rates for deposits and loans, on lending volume rationing, on market funding volumes and on the fees charged for services. The optimisation is constrained by a number of exogenous conditions affecting the demand for loan and services and the funding costs, as exemplified by GDP growth, the level of market interest rates, asset prices etc.

We shall assume a reduced form solution of the optimisation problem, without specifying the detailed decision structure. It should be noted that reduced form relationships may tend to be less stable as complex structural relationships will be incorporated into the estimated parameters. In the reduced form each component of bank profitability may depend on the contemporary and lagged values of the exogenous variables. However, to avoid endogeneity problems only lagged values of bank decision variables will be included as independent variables.

The variables that we wish to analyse are net interest income and fee income in real terms. This is in contrast to much of the existing literature where focus is on the net interest margin. In this literature the margin is typically measured by taking the ratio of net interest income to total assets or some other scale variable. This may be a reasonable approach for cross section studies, but it is less satisfactory when we are looking at the dynamics of the income components. In this context it becomes important to recognise that total assets and other scaling variables are themselves endogenously determined by the banks' optimisation process.

The existing research referred to in section 2 documents that the dynamic behaviour of the net interest margin is generally counter-cyclical, and that the margin depends on banks' market power. The business cycle indicators used in these previous studies include GDP

growth, loan growth and the slope of the yield curve. Money market interest rates, interest rate volatility and the inflation rate are among the variables being used as controls. As for market power indicators, Mandelman (2006) finds that the occurrence of foreign entries into a banking market is a useful indicator for market contestability and thus important for explaining the time pattern of the net interest margin. But the impact is short-lived and the market share level of foreign banks does not appear to be an important determinant of bank income.

Notice that gap analysis implicitly takes the slope of the yield curve to be relevant for net interest income in other ways than as a business cycle indicator. The predominance of floating rate lending in Norwegian banking may, however, have enabled the banks to eliminate most maturity (repricing) mismatches, and may thus have made interest rate risk less relevant for banks here than in many other countries. But as Norwegian banks have to notify their customers six weeks before their lending rates are increased, periods of increasing policy rates may put pressure on the lending rate margins and thus on the net interest income.

The determinants of non-interest income are less well analysed, but it would seem reasonable to expect that rapid economic growth will stimulate the demand for bank services. This volume effect may be counteracted by the higher level of contestability during booms, as is the case for the net interest margin. Indicators of market power may naturally also be relevant for fee income.

We are using quarterly data. The level and first differences of the following independent macro variables will be considered:

- Real GDP
- Real housing wealth
- The real 3 month money market interest rate

- The difference between the 5 year and the 3 month interest rates (the steepness of the yield curve)

These variables are included as business cycle indicators. In addition to that the change in the market share of foreign branches will be included as an indicator of competition on the Norwegian banking market.

4. Data definitions

Net interest income includes lending fees and is an aggregate for all Norwegian banks, thus including subsidiaries of foreign owned banks, but excluding branches of foreign banks. The Bank Statistics have quarterly data from 1992. From 1988 to 1991 data were reported every four months, and we have constructed quarterly observations by interpolation. Prior to 1988 the net interest income was only reported annually. Our data set will thus start in 1988 and include all quarters up to and including the second quarter of 2007. New regulations from July 2000 reduced banks' float income from payment transactions. But this does not seem to have had much effect on net interest income, and we shall not represent it as a break in the time series. Real net interest income is obtained by deflating with the consumer price index CPI (2004 = 100). Real growth rates are represented by quarter-on-quarter log differences.

Banks increasingly use interest rate swaps to transform fixed rate funding into floating rates. The net interest income variable should ideally be corrected for payments from these contracts, but the Bank Statistics do not provide that information. There is, however, information on net revenues from all financial derivative contracts, starting in 1996. These data indicate that derivatives were unimportant until 2003, and that net revenues from these contracts the past few years have fluctuated around zero. We have chosen not to include them in the net interest income variable, because we do not know precisely how much comes from interest rate swaps. They will be included in a robustness check of our results, however.

Fee income includes the revenues generated from fees charged on a variety of bank services, but exclusive of lending fees that are part of the net interest income. Quarterly data for the aggregate of Norwegian banks can be constructed starting from 1990. Fees on payment transactions are the dominant component, with more than 50 per cent of total fee income in most of the observation period. The fee income data from the Bank Statistics are deflated by the CPI in the same way as the net interest income data, see above, and growth rates are represented by quarter-on-quarter log differences.

Real GDP will be for the Mainland economy, i.e. excluding the petroleum and shipping industries that buy a large part of their banking services off-shore. Data are from the National Accounts in fixed 2004 prices. Growth rates are represented by quarter-on-quarter log differences.

Housing wealth is a measure of the wealth held by the household sector as housing capital. The exact construction of the time series is described in Berge et al. (2006). Quarterly data are available from 1990. We deflate by the CPI in order to make the variable comparable to real GDP. Since the real stock of houses moves very slowly, changes in this variable will mostly reflect price changes.

Interest rates will be represented by the effective three month real money market rate (NIBOR), and the *slope* will be measured by the difference between the effective real yield on five year government bonds and the three month rate. The yields will be the mean of daily observations throughout the quarter, and deflated by the year-on-year CPI rate of the same quarter. Data are from the Norges Bank database, available on www.norges-bank.no.

Foreign market share is the share of total banking assets held by branches of foreign banks. Notice that the present paper does not count these foreign branches as part of the Norwegian banking sector, and they are thus not included in the net interest income and fee income measures. Data are from the Bank Statistics.

The two interest rate variables and the market share are measured in percentages, and quarter-on-quarter changes will thus be in percentage points. The main variables described above are graphed in figures A1 through A4 in the Appendix.

5. Estimation procedure

In contrast to Albertazzi and Gambacorta (2009) we assume an error correction structure for both the real net interest income and the real fee income relationships. This allows us to investigate both the short and long term relationships. The procedure involves a set of co-integrating level variables, and short term dynamics describing how the dependent income variable reverts to the level determined by the co-integrating relationship.

For *net interest income* the long term co-integrating relationship is initially assumed to be with GDP, housing wealth and the 3 month and 5 year interest rates, with the change of market shares of foreign branches as an unrestricted variable to control for the degree of competition: the latter is in line with Mandelman's use of foreign entry as an indicator of market power; confer the discussion in section 3. Quarterly dummies are added to account for seasonal factors.

In the short term dynamics the change in net interest income is taken to depend on changes in the same exogenous variables plus lagged changes in the fee income and in the net interest income itself. Growth in GDP or housing wealth should have a positive effect on demand for bank loans and thus on loan volume, but that may be counteracted by the negative effect previous studies have found on the net interest margin. We would expect that any effect from the level of interest rates will be positive. This is because higher interest rates may facilitate increased interest rate spreads; confer the results of Dueker and Thornton (1997) and Aliaga-Diaz and Olivero (2005).

The slope of the yield curve has been used as a business cycle indicator, with a steeper curve forecasting faster GDP growth and an inverted yield curve indicating recessions; see e.g. Chen (1991). The effect on the net interest margin should thus be negative, but again the volume effect could counteract that.

The estimation will be done in two steps. We first identify the variables to be included in the long term relationship by performing a co-integration analysis. In a second step we estimate the short term dynamics, conditional on the co-integrating level variables identified in the first step. We assume a general form where first differences of all independent variables have a maximum lag of four quarters, and employ an elimination procedure to arrive at a more parsimonious representation of the relationships. The co-integrating variables and the quarterly dummies are always retained in the equations, however.

Notice that the resulting equation will to some extent depend on the exact path chosen from the general to the specific form. We have used the automated procedure of the PC Give 12 statistical package to check all possible paths and select a best fit, as adjusted for the number of parameters and using the Schwartz criterion.

The general form of the equation to be estimated for net interest income is:

$$\begin{aligned}\Delta \ln RNET = {} & \alpha_0 + \alpha_1 * \ln RNET_{-1} \\ & + \alpha_2 * \ln GDP_{-1} + \alpha_3 * \ln HW_{-1} + \alpha_4 * R3M_{-1} + \alpha_5 * R5Y_{-1} \\ & + \sum \beta_{1k} * \Delta \ln RNET_{-k} + \sum \beta_{2k} * \Delta \ln FEE_{-k} + \sum \beta_{3k} * \Delta \ln GDP_{-k} + \sum \beta_{4k} * \Delta \ln HW_{-k} \\ & + \sum \beta_{5k} * \Delta R3M_{-k} + \sum \beta_{6k} * \Delta R5Y_{-k} + \beta_7 * \Delta FORB_{-1} + \sum \beta_{8k} * Q_k + \eta \end{aligned} \quad (1)$$

where RNET is the real net interest income of Norwegian banks, including subsidiaries but not branches of foreign banks,
GDP is the real mainland gross domestic product,
HW is housing wealth in nominal terms, deflated with the CPI
ΔFORB is the change in the share of total banking assets held by branches of foreign banks,
R3M is three month real yield on Treasuries,
R5Y is the five year yield on Treasuries, and
Q's are dummies for quarters 2-4.

The lags k will be assumed to have a maximum value of four quarters.

There is no guidance in existing literature on the relevant determinants for the fee income. We shall assume that the fee income equation involves the same variables as the net interest income equation, except for the housing wealth variable that is presumably less relevant. The estimation procedure is also the same.

$$\begin{aligned}\Delta \ln FEE = {} & \alpha_0 + \alpha_1 * \ln FEE_{-1} \\ & + \alpha_2 * \ln GDP_{-1} + \alpha_3 * R3M_{-1} + \alpha_4 * R5Y_{-1} \\ & + \sum \beta_{1k} * \Delta \ln RNET_{-k} + \sum \beta_{2k} * \Delta \ln FEE_{-k} + \sum \beta_{3k} * \Delta \ln GDP_{-k} \\ & + \sum \beta_{4k} * \Delta R3M_{-k} + \sum \beta_{5k} * \Delta R5Y_{-k} + \beta_6 * \Delta FORB_{-1} + \sum \beta_{7k} * Q_k + \eta \end{aligned} \quad (2)$$

For notational simplicity we have used the same parameter symbols in equations (1) and (2), but they will naturally not be assumed equal in the estimation procedure.

6. Co-integrating relationships

We have analysed several information sets for Norwegian banks from the period 1990-2007, when we have data for both income variables. The results we report below are based on a VAR in the two endogenous variables *net interest income* and *fee income,* where we consider GDP, housing wealth, and the short and long interest rate variables R3M and R5Y as exogenous variables that are candidates to enter the long run relationships for the bank income variables.

We have looked at different lag lengths for the VAR (1, 2 and 4), and we find that even a VAR of the first order gives a satisfactory description of the data[1], when we also include seasonals and the change in the market share of foreign branches (ΔFORB) as unrestricted variables in the VAR. Univariate unit root tests suggest that all variables are I(1) and hence we can carry out a Johansen test for the co-integration rank, i.e. to determine the number of

[1] The system tests are: Vector AR(1-5) test: F(20,94) = 0.97 [0.51], Vector Normality test: $\chi 2(4)$ = 3.06 [0.55], Vector Hetero test: F(36,127) = 0.65 [0.93], Vector Hetero-X test: F(81,84) = 0.90 [0.67], where p-values are given in square brackets.

co-integrating vectors (Johansen, 1988). The trace tests of co-integration rank give the results shown in table 1.

Tests based on a VAR(1) in lnRNET, lnFEE conditional on lnGDP, lnHW, R3M, R5Y (restricted) and ΔFORB (unrestricted). Data is from 1990Q2 – 2007Q2.

Hypothesis	Trace statistics	Approximate p-value*	Eigenvalue
$r = 0$	56.278	$p < 0.05$	0.42
$r \leq 1$	18.667	$p \approx 0.07$	0.24

*) Critical values are intra- and extrapolated from Table IV in MacKinnon et al (1999) and Table 6(c) in Pesaran et al (2000).

Table 1: Tests of co-integration rank

Since we are considering a partial VAR, i.e. conditioning on a set of exogenous variables, the standard critical values for the Johansen test, as found e.g. in Osterwald-Lenum (1992), do not apply. Instead we refer to critical values from MacKinnon et al (1999) and Pesaran et al (2000); confer also Harbo et al (1998). The second co-integration vector is somewhat doubtful according to the p-value even though the eigenvalue is estimated as high as 0.24. Adopting a higher order VAR yields a similar picture.

We have, however, imposed on the VAR two co-integration vectors which in our case can be written as (normalising on the two endogenous variables):

$$\text{lnRNET} + \beta_{10}\text{lnFEE} + \beta_{11}\text{lnGDP} + \beta_{12}\text{lnHW} + \beta_{13}*\text{R3M} + \beta_{14}*\text{R5Y} \qquad (3)$$

$$\beta_{20}\text{lnRNET} + \text{lnFEE} + \beta_{21}\text{lnGDP} + \beta_{22}\text{lnHW} + \beta_{23}*\text{R3M} + \beta_{24}*\text{R5Y} \qquad (4)$$

We let the matrix $\boldsymbol{\alpha}$, with elements $[\alpha_{ij}]$, i,j=1,2, denote the loadings of the vectors in the co-integrated VAR.

Next we proceed to impose identifying and over-identifying restrictions on the two vectors and the loadings. The results in table 2 show that if we identify the equation by assuming that lnRNET and lnFEE do not influence each other in the long run (that is $\beta_{10}=\beta_{20}=0$), we find that net interest income (RNET) in the long run depends positively on GDP and the short interest rate, whereas the fee income (FEE) is determined by GDP and the difference between the long and short interest rates. These qualitative conclusions are robust

with respect alternative identifying restrictions and we also find the same end result if we redo the analysis with a higher order VAR (of order 2 or 4). Recursive graphs of the estimated long run coefficients from Panel 5 in table 2 areshown in figure 1 below.

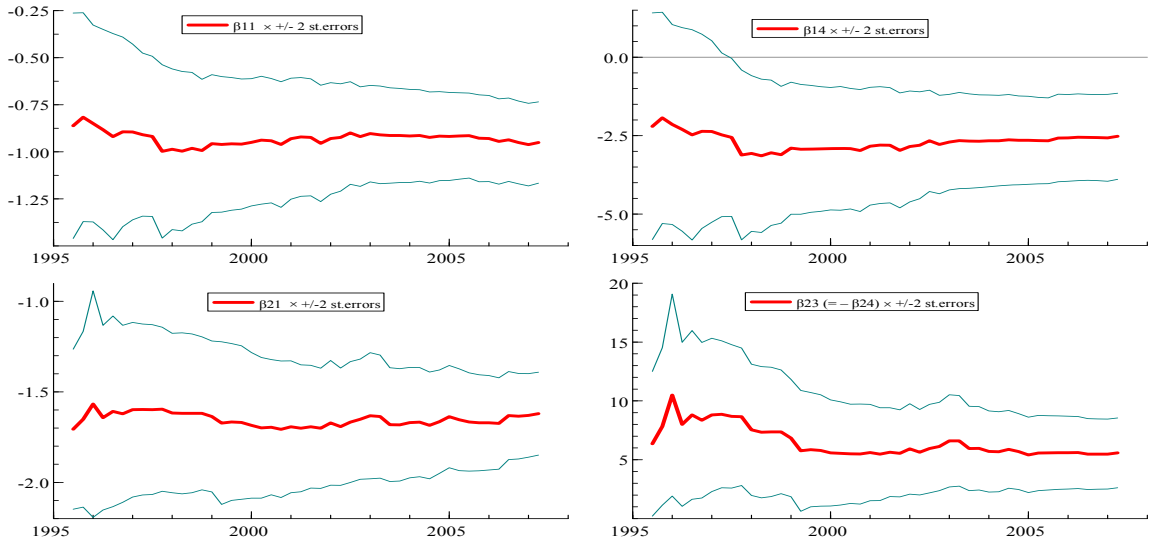

Figure 1: Recursive graphs the estimated long run coefficients from Panel 5 of Table 2.

Tests of over-identifying restrictions on a VAR(1) in lnRNET, lnFEE conditional on lnGDP, lnHW, R3M, R5Y (restricted) and ΔFORB (unrestricted). Identifying restriction: $\beta_{10}= \beta_{20}=0$. Data is from 1990Q2 – 2007Q2. Standard errors are given in parentheses, and p-values in square brackets.
a) Panel 1 = Weak exogeneity of lnRNET and lnFEE across equations: $\alpha_{12} = \alpha_{21} = 0$.
lnRNET – 0.79 lnGDP – 0.02 lnHW + 2.07 R5Y – 3.41 R3M (0.35) (0.11) (1.58) (0.99) lnFEE – 1.94 lnGDP + 0.13 lnHW– 4.70 R5Y + 5.21 R3M (0.55) (0.17) (2.52) (1.58)
α_{11} = 0.54 (0.09), α_{22} = 0.33 (0.08) $\chi2(2) = 5.65$ [0.06]
b) Panel 2 = a) and only the interest rate difference (SLOPE) matters in A2 $\beta_{23}= -\beta_{24}$
lnRNET – 0.80 lnGDP – 0.02 lnHW + 2.01 R5Y – 3.39 R3M (0.34) (0.11) (1.55) (0.98) lnFEE – 2.03 lnGDP + 0.15 lnHW – 5.35 R5Y + 5.35 R3M (0.50) (0.17) (1.57) (-)
α_{11} = 0.54 (0.09), α_{22} = 0.34 (0.08) $\chi2(3) = 5.74$ [0.12] $\chi2(1) = 0.10$ [0.75]
c) Panel 3 = b) and no effect of lnHW in A1 $\beta_{12}= 0$
lnRNET – 0.87 lnGDP + 1.97 R5Y – 3.41 R3M (0.11) (1.56) (0.99) lnFEE – 2.05 lnGDP + 0.15 lnHW – 5.34 R5Y + 5.34 R3M (0.49) (0.17) (1.57) (-)
α_{11} = 0.53 (0.09), α_{22} = 0.33 (0.08) $\chi2(4) = 5.79$ [0.22] $\chi2(1) = 0.04$ [0.84]
d) Panel 4 = c) and no effect of R5Y in A1 $\beta_{14}= 0$
lnRNET – 0.95 lnGDP– 2.50 R3M (0.11) (0.68) lnFEE – 2.01 lnGDP + 0.14 lnHW – 5.54 R5Y + 5.54 R3M (0.48) (0.17) (1.53) (-)
α_{11} = 0.50 (0.09), α_{22} = 0.33 (0.08) $\chi2(5) = 7.49$ [0.19] $\chi2(1) = 1.70$ [0.19]
e) Panel 5 = d) and no effect of lnHW in A2 $\beta_{22}= 0$
lnRNET – 0.95 lnGDP– 2.52 R3M (0.11) (0.69) lnFEE – 1.62 lnGDP – 5.59 R5Y + 5.59 R3M (0.11) (0.17) (-)
α_{11} = 0.50 (0.09), α_{22} = 0.33 (0.08) $\chi2(6) = 8.25$ [0.22] $\chi2(1) = 0.76$ [0.38]

Table 2: Tests of restrictions on the long term relationships

7. The short term dynamics.

The co-integration tests above indicate the presence of two co-integrating vectors; with one long term relationship between real net interest income, real GDP and the 3-month interest rate; and the second long term relationship between real fee income, real GDP and the slope of the yield curve (defined as SLOPE = R5Y - R3M). The lagged values of these level variables are then retained in the equations (1-2) from section 5, together with the change in the market share of foreign branches and the quarterly dummies. Notice, however, that the coefficients are being re-estimated and will in general deviate from those reported in table 2.

The difference variables in equations 1-2 enter with a maximum of four quarter lags. As explained in section 5, we use the automated search procedure of the PC-Give statistical package to eliminate insignificant terms in a search process until we arrive at a preferred parsimonious representation. The coefficient estimates for both relationships are listed in tables 3-4 below.

Dependent variable: ΔlnRNET	Coefficient	t-value
$lnRNET_{-1}$	-0.622	-5.98
$lnGDP_{-1}$	0.593	5.61
$R3M_{-1}$	1.835	4.37
ΔFORB	-0.018	-2.61
$\Delta R3M_{-1}$	-1.332	-2.27
Constant	-2.129	-2.92
Q2	0.033	2.03
Q3	0.064	3.60
Q4	0.049	2.71

R^2	= 0.497	1990Q2 – 2007Q2
Sigma	= 0.045	
RSS	= 0.116	
F(8,56)	= 6.39 [p-value= 0.00]	
AR 1-5 test F(2,54)	= 0.72 [0.49]	
Normality test Chi^2(2)	= 2.16 [0.34]	
Hetero test F(2,52)	= 0.05 [0.95]	

Table 3: Estimated relationship for the determination of real net interest income

In table 3 the estimated long term coefficients are very similar to those reported in table 2. Net interest income will according to these estimates tend to grow nearly in step with GDP, with a ratio of 0.95 (0.593/0.622). Divergence from this long term relationship has an implied quarterly adjustment coefficient of 0.62, which is relatively high and close to the value we found in the co-integration analysis. The volume effect thus appears to outweigh the interest margin effect identified in previous studies. The level of interest rates as represented by the three month money market rate also has a positive impact on net interest income. This is in line with previous research (Dueker and Thornton, 1997; Aliga-Diaz and Olivero, 2005) and can be interpreted as saying that a higher (real) interest rate makes it easier for banks to obtain a higher interest rate margin. Alternatively a high real interest rate could be interpreted as a second business cycle indicator, with the central bank pushing up the short rate when the economy's production capacity is fully utilised.

The short term dynamics indicate that changes in the degree of competition as represented by the market share of foreign branches has the expected negative impact. Consistent with the findings of Mandelman (2006), we have assumed no long term effect of foreign entry. The other change variable in the final specification is the change in the money market interest rate, which has a negative impact. This could reflect the regulation that banks can only raise loan rates with six weeks notice. But it could also be seen as a correction on the long term effect; the net effect of a higher money market rate is slightly positive in the first quarter and then gradually builds up to the long term effect.

As explained in section 4, net interest income should ideally have been corrected for the effect of interest rate swaps. That information is not available, but swap revenue are part the total derivatives revenue. We have re-estimated equation (1) with all derivatives revenues added to net interest income. The coefficient estimates and the test statistics remained

practically unchanged. This indicates to us that correcting for interest rate swaps would not be important.

Dependent variable: ΔlnFEE	Coefficient	t-value
$lnFEE_{-1}$	-0.371	-3.98
$lnGDP_{-1}$	0.597	3.69
$SLOPE_{-1}$	1.507	2.65
ΔFORB	-0.003	-0.48
ΔlnGDP	0.944	3.27
$\Delta lnFEE_{-4}$	0.234	2.08
Constant	-4.817	-3.47
Q2	0.024	1.46
Q3	0.007	0.37
Q4	-0.001	-0.03

R^2	= 0.502	1990Q2 – 2007Q2
Sigma	= 0.046	
RSS	= 0.115	
F(9,55)	= 6.15 [p-value = 0.00]	
AR 1-2 test F(2,53)	= 0.10 [0.91]	
Normality test Chi^2(2)	= 2.83 [0.24]	
Hetero test F(4,50)	= 0.23 [0.89]	

Table 4: Estimated relationship for the determination of real fee income

In table 4 the estimated long term coefficients are again similar to those reported in table 2. *Fee income* will according to these estimates tend to grow significantly faster than GDP, with a ratio of 1.6 (0.597/0.371). Divergence from this long term relationship has an implied quarterly adjustment coefficient of 0.37, which is slightly higher than the value found in the co-integration analysis. The slope of the yield curve as represented by the difference between 5 year and 3 month interest rates also appears to have a positive impact on fee income. Steeply rising yield curves may be associated with situations with slow growth and where the short term interest rate has been reduced to stimulate economic activity. This result could then be interpreted as a correction of the very strong effect found from GDP: Periods with GDP close to capacity have during our observation period to a large extent been characterised by negatively sloping yield curves. On the other hand a steep yield curve is also known to predict higher GDP growth in the next year (see e.g. Chen, 1991). These

expectations may stimulate the demand for banking services. This is also consistent with Schuerman and Stiroh (2006), who finds that a steeper yield curve has a positive impact on bank stock returns.

The short term dynamics depends on the current GDP growth and on the lagged change in fee income itself. The positive impact of lagged fee income indicates a significant momentum effect on that income component. The positive impact of GDP growth is readily explained as a demand side factor in the market for bank service volumes. This is in line with the conclusions of Calmès and Liu (2009), but in contrast to the findings of Albertazzi and Gambacorta (2009). The difference may be explained by the fact Albertazzi and Gambacorta looked at non-interest income in total, whereas this paper follows Calmès and Liu by looking specifically at fee income. The change in the market share of foreign branches is retained because it has been used as a control variable in the co-integration analysis, but it does not appear as statistically significant in this final equation. Foreign entries do not seem to have an immediate effect on other bank services than lending.

The total GDP effect may seem too high, however, with fee income increasing much faster than GDP even when taking the modifying yield curve effect into account. A possible explanation could be that there is a spill-over effect in the data from the gradual build-up of transaction volumes that started in the early 1990's. In this period high prices on paper-based payment transactions made for a substantial shift of transactions into cheaper electronic payment systems, which again generated a rapid increase in the number of transactions handled by banks. This structural change in the payment system was gradual and it would therefore be hard to represent it properly in the model specification. We have checked that the upward trending time series of prices on electronic and manual transactions are not statistically significant explanatory variables. Consistent data on transaction volumes are only available from 1997.

The standard test statistics generated by PC-Give on the residuals indicate that the relationships in tables 3 and 4 are both well behaved. The plot of recursive coefficient estimates in figures 2 and 3 indicates reasonable stability of the coefficients.

Figure 4 shows the actual and fitted values of quarter-on-quarter growth in net interest income, and the corresponding residuals. We notice that the fit is relatively poor in the mid 1990's, but is becoming much better after that. Correspondingly, figure 5 shows the actual and fitted values of quarter-on-quarter growth in fee income. Again, the fit appears to be relatively good.

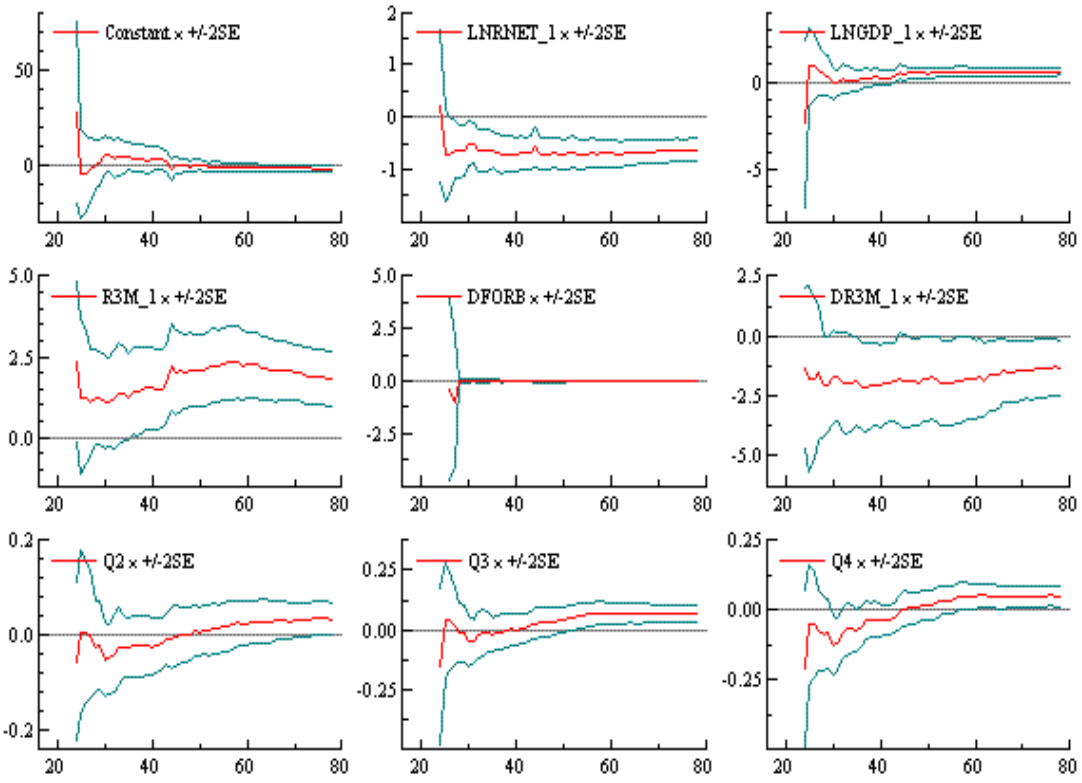

Figure 2: Recursive parameter estimates for the net interest income relationship.

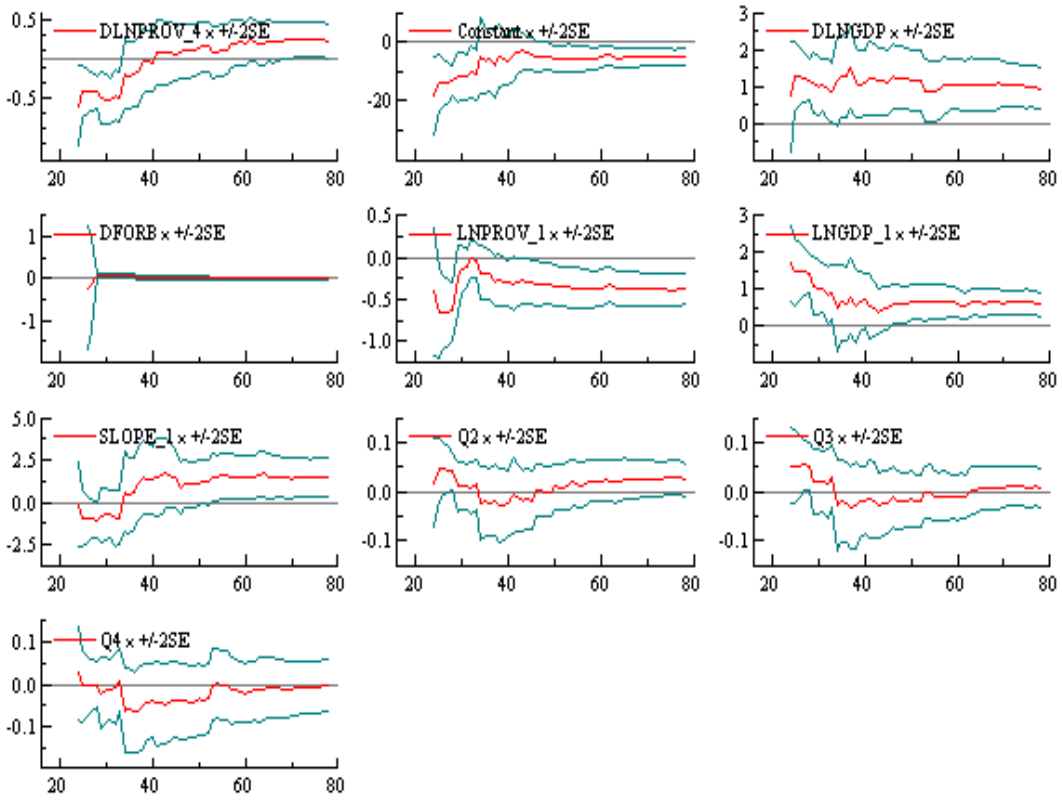

Figure 3: Recursive parameter estimates for the fee income relationship

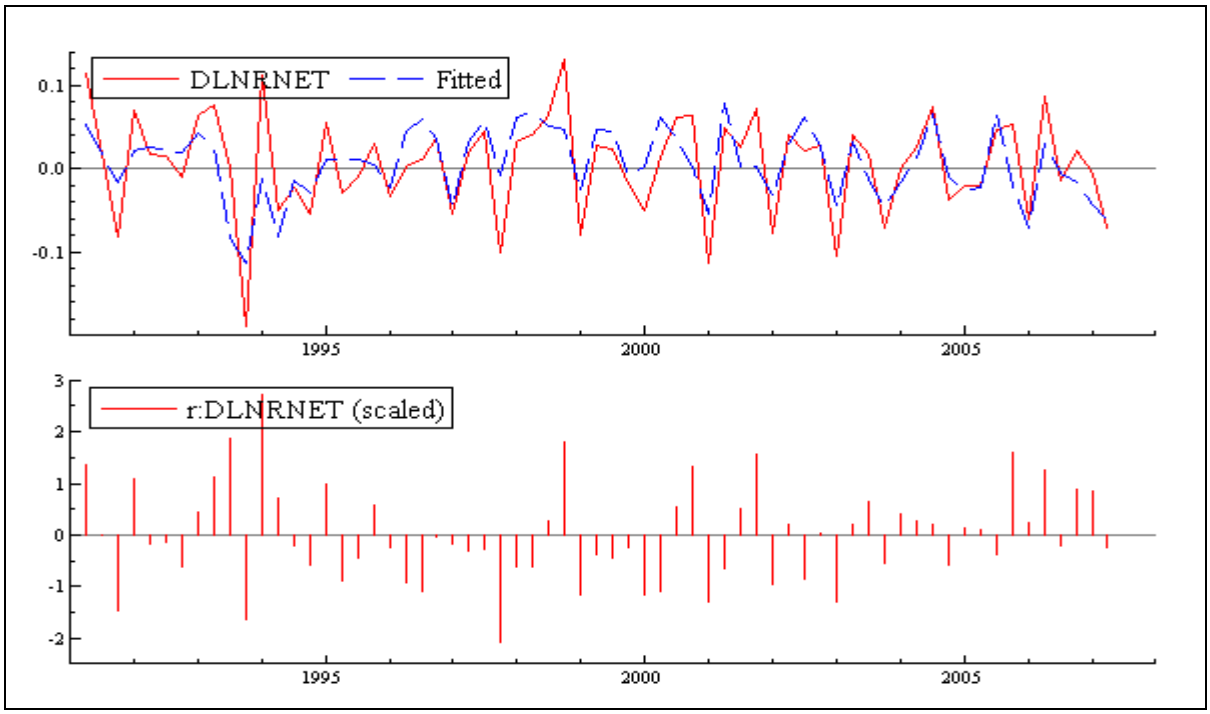

Figure 4: Actual and fitted quarterly changes in real net interest income in the upper panel and residuals in the lower panel.

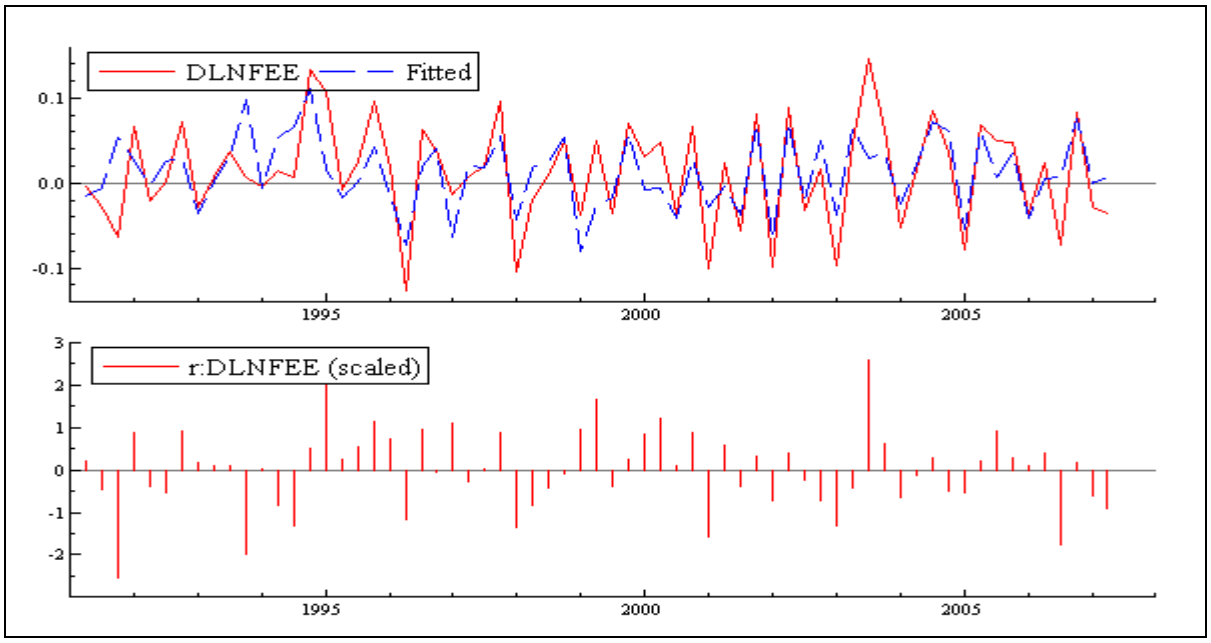

Figure 5: Actual and fitted quarterly changes in real fee income in the upper panel and residuals in the lower panel.

8. Conclusion

In this paper we have investigated the relationship between the two main components of real bank operating income and the macro economy. For net interest income we find a long term co-integrating relationship with real GDP and the real interest rate. Reversion to this relationship is relatively fast. We also find that net interest income is in the short term negatively related to foreign entry, and that there is no additional role for business cycle indicators to explain the time pattern of net interest income. This is consistent with the results on the net interest margin presented by Mandelman (2006). For fee income we find a similar long term co-integrating relationship, with slightly slower convergence. The short term dynamics exhibits a strong positive co-variation with the business cycle. This is probably mainly due to the volume effect.

Because the fee variable is not available until 1990 and because of the four quarter lags allowed for, our estimates are actually based on data starting in 1991. The data are thus

mostly from periods with small fluctuations in the macro economy. The last couple of years of the Norwegian banking crisis 1988-92 are included, but do not dominate the estimates obtained. We are very much aware that the relationships may not be valid in a crisis environment. Since crisis data are rare, this is a general problem with most relationships based on time series data.

Our observation period covers a gradual introduction of cost-based transaction pricing and an increasing use of electronic payments in Norwegian banking; see Enge and Øwre (2006). This development was encouraged by Norges Bank and other government authorities. Some transaction pricing was first introduced in 1981, but at a very modest scale. More important steps were taken around 1990, and during the next few years pricing became gradually more important. Pricing encouraged the use of cheaper electronic payment services, which gradually replaced paper-based payments. A side effect important for fee income was that the number of transactions handled by banks increased very rapidly with the introduction of electronic payment terminals at retailers. By the end of the decade around 70 per cent of bank fees were earned on payment transaction services. This share has since been somewhat reduced, but the gradual build-up of payment fees during the early 1990's may still have spilled over into the very high estimated impact that we find from GDP on fee income. This potential error can not be easily corrected by using a dummy variable, because the changes were gradual and affected both prices and volumes.

Our estimation period is also characterised by increased competition in the Norwegian banking market. For that reason we introduced the change in market share of foreign owned bank branches as a control variable. It is not a perfect indicator, but it has been used in previous research and is probably the best measure of competition that we could get. As is well known, measures of market concentration do not work well, because collusion and contestability is so important in banking markets.

The present paper only considers the banking sector at an aggregated level. A next step will be to look more closely on individual banks, and see whether some banks are more vulnerable than others. In particular we would expect that different business models, as represented by the composition of banks' balance sheets, will make a difference for banks' dependency on the macro economy.

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Data appendix

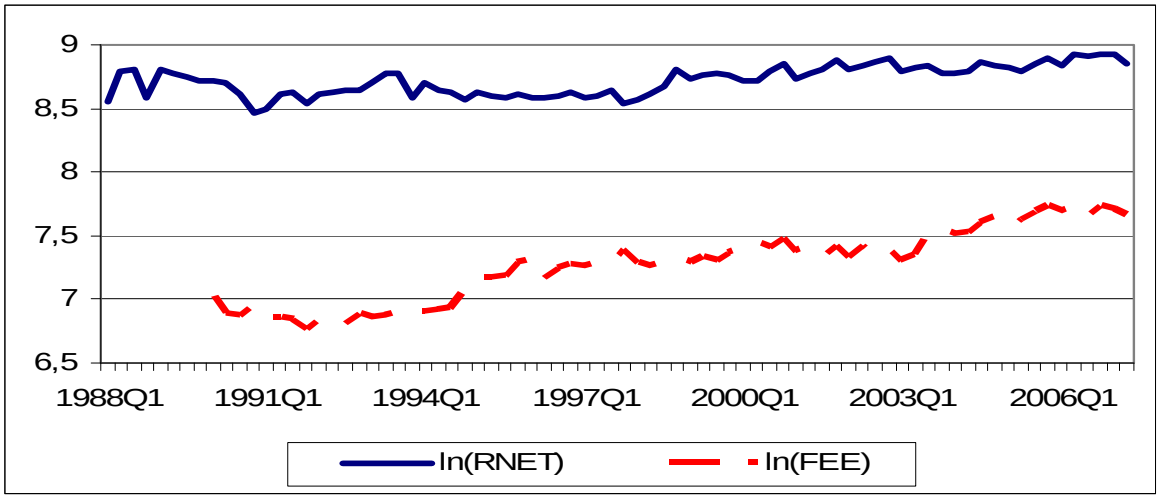

Figure A1: Logs of net interest and fee income. Base variables are in millions of NOK.

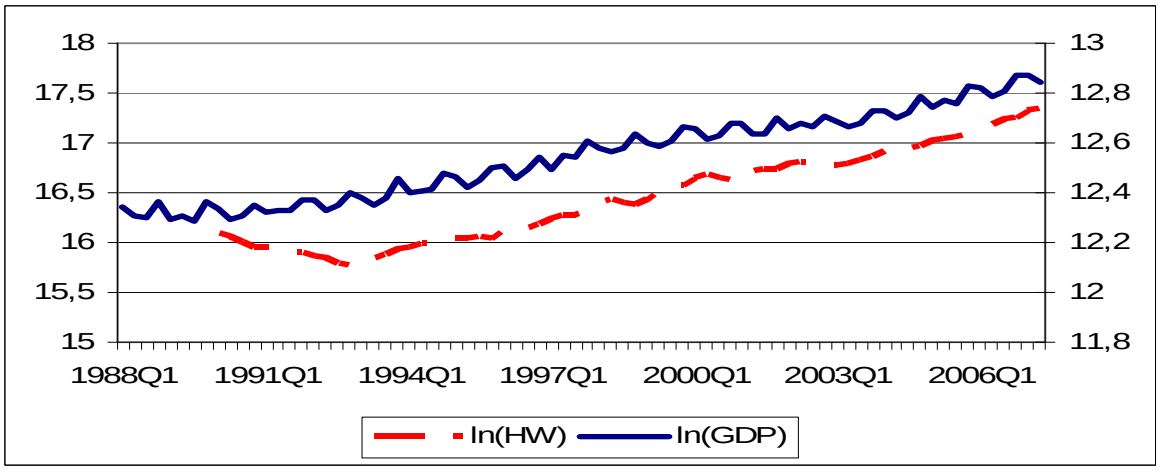

Figure A2: Logs of real housing wealth (left axis) and real GDP (right axis). Base variables are in millions of NOK.

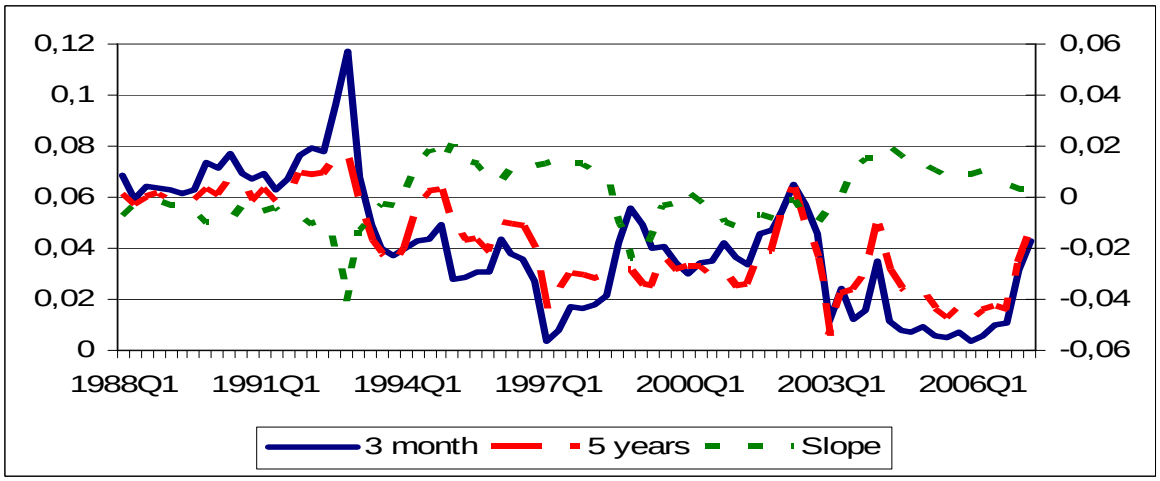

Figure A3: Three month and five year real interest rates (left axis) and the yield difference or slope (right axis).

Figure A4: The market share (per cent of total assets) of branches owned by foreign banks.