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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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Banks' net interest margins and interest rate risk: communicating vessels?*

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Abstract

This study investigates the effects of a flattening of the yield curve and decreasing interest rates on the net interest margin (NIM) of 41 Dutch banks during the period 2008Q1 to 2016Q2. Our contribution to the literature is that we distinguish explicitly between net interest income from pure maturity transformation and a residual part representing market power, compensation for risks and other mark-ups. Our results show that the residual part increased when the yield curve flattened and interest rates fell, while total NIM remained constant. In other words, banks managed to keep net interest margins more or less constant by compensating for a loss in income from maturity transformation.

Keywords: net interest margin, banks, interest rate risk, income from maturity transformation.
JEL classifications: D21, D22, G21.

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1. Introduction

One of the feared side-effects of exceptionally expansive monetary policies and the flattening of yield curves is the reduction in banks' net interest margins (NIM). Since banks cannot or prefer not to reduce interest rates on deposits any further when they approach zero, banks' net interest margins might shrink when interest rates fall. Banks are especially reluctant to reduce deposit rates for retail customers, for whom the alternative of holding bank notes is thought to be a realistic alternative. On the asset side of the balance sheet banks usually have to follow lower interest offered by competing market-based lenders or alternative finance sources. As is explained in Claessens et al. (2018), this has two effects. First, the pass-through of lower policy rates to lending rates is imperfect and depends on the structure of the particular segment of the credit market. This implies imperfect pass-through of monetary policy to the real economy when banks preserve margins by keeping lending rates at a higher level. Second, to the extent that banks are constrained in lowering the deposit rate, compression of the margins may erode banks' profitability and capital positions. This paper focuses on the second effect.

The relationship between bank's net interest margins and interest rates has received ample attention in both the theoretical and empirical literature. In a seminal contribution to the literature on bank interest margins, Ho and Saunders (1981) present a dealer model of a bank, representing the bank as a demander of deposits and a supplier of loans. They find that bank interest margins depend positively on interest rate volatility and market power. Whereas the loans extended by banks in the Ho and Saunders model are homogenous, Allen (1988) extends the model to allow for heterogeneous loans, where demand for one type of loans (e.g consumer loans) affects demand for other loans (e.g. commercial loans). The effect of this heterogeneity on the banks' net interest margin is a priori ambiguous.

Angbazo (1997), building on Ho and Saunders (1981), was one of the first to include a measure of interest rate risk in his model of net interest margins for banks in the US. He finds that interest rate risk has a negative influence on the NIM in panel estimations. Depending on the type of bank, interest margins are positively related to default risk. Off-balance sheet activities appear to generate higher interest margins to compensate for higher risk. In fact, when these off-balance instruments are included in the model, the influence of the interest rate risk measure disappears.

Borio et al. (2015) find a significant impact of short-term rates and the slope of the yield curve on bank profitability. Borio's results suggest that a long period of unusually low interest rates can erode bank profitability. Banks' net interest income is positively correlated with short-term interest rates and with the slope of the yield curve. Entrop et al. (2015) focus on the impact of maturity transformation on margins for interest income and interest expenses separately. Their model, another extension of Ho and

Saunders (1981), predicts a negative effect of the term spread on the margin. They use a sample of the entire German commercial banking sector and confirm their model's prediction of a negative effect of the term spread on NIM, though the effect is fairly small. The negative effect is entirely due to interest income. Using quarterly data for 2000 to 2016 for Euro area banks, Altavilla et al. (2018) find a small but positive effect of the short-term interest on the NIM. The coefficient on the yield slope is negative but statistically insignificant.

Empirical results on the impact of low interest rates on bank profitability yield different results. Claessens et al. (2018) find a negative effect of low interest rates on banks' net interest margin. In a sample of 47 countries, the authors find that a one percentage point lower interest rate reduces the net interest margin by 8 basis points. The effect of an interest rate reduction is larger at low interest rates, and another additional effect is found when interest rates are low for long. Focussing on banks in the Netherlands, earlier research by Chaudron (2018) shows that net interest margins of Dutch banks are – contrary to conventional wisdom – fairly insensitive to changes in interest rates and the slope of the yield curve. Tan (2019) finds that banks with high deposit ratios, which are expected to be more affected by negative interest rates, increase their lending volumes to maintain profitability. Other research on interest rate risk born by European banks (e.g. Hoffmann et al., 2019 and Lopez et al. 2018) seems to confirm this observation.

This paper's contribution to the literature lies in the explicit distinction it makes between net interest income from pure maturity transformation and a residual part representing income from market power, compensation for risks and other markups. Income from maturity transformation (the margin from borrowing short and lending long) depends on banks' interest rate risk position and is likely to be influenced by other factors than the residual. Results show that this distinction is indeed crucial, since the residual part of the margin appears to increase when the yield curve flattens and income from pure maturity transformation falls. As a result of these two opposing effects, total net interest margins remain constant when the yield curve flattens, an effect which remains obscured if the NIM is analysed as a whole.

2. Model

2.1 Model specification

This section presents the empirical specification. We assume that the relationship between banks' interest rate margin and bank-specific as well as macroeconomic control variables can be summarised by a homogeneous dynamic panel model as in equation (1).

$$y_{it} = (1-\theta)y_{it-1} + \theta\alpha_i + \theta\beta\boldsymbol{x}_{it} + \theta\gamma\boldsymbol{z}_t + \varepsilon_{it} \quad (1)$$

The lagged dependent variable accounts for the possibility that institutions do not adjust their behaviour completely but only partially during one period, e.g. due to adjustment costs. For the dependent variable y_{it} we use the two different definitions of the net interest margin (NIM), i.e. including and excluding income from maturity transformation. α_i are time-invariant bank fixed effects, $\boldsymbol{x}_{it}$ is a vector of bank-specific time-variant control variables and $\boldsymbol{z}_t$ is a vector of macroeconomic control variables (short-term interest rate, economic growth and inflation) with corresponding coefficient vectors β and γ. The coefficient θ represents the speed of adjustment and ε_{it} is an idiosyncratic error term.

2.2 Model variables

In this section, we discuss the definition of the dependent variable, i.e., the net interest margin, followed by the explanatory variables, i.e., the macroeconomic variables, the measures of competition and cost efficiency, and other bank specific variables. See Table 1 for details.

2.2.1 Measures of net interest rate margin

The definition of the net interest margin (NIM) has varied among earlier studies. One of the earliest and most renowned studies in this area, Ho and Saunders (1981), do not define their measure of the net interest margin in accounting terms. They derive a 'pure spread' from the constant that is obtained by regressing bank margins on measures for (1) implicit interest expenses, (2) the opportunity cost of required reserves and (3) default premiums on loans, for each separate year in their dataset. They then take the regression constant as an estimate of the pure spread. A drawback of this approach is that their regression to isolate the pure spread does not take the difference in maturity between loans and deposits into account. It is very likely though that such a maturity spread is present in the pure margins they estimate.

Although some studies follow the same approach (e.g. Saunders and Schumacher, 2000), most other studies have included explanatory variables for maturity differences between assets and liabilities in the estimations of the net interest margin directly. However, none of the earlier research reviewed in Section 1 has aimed to isolate net interest margins excluding income from maturity transformation. The reason for this could be that maturity transformation does not play an explicit role in the theoretical models on margins underlying this work. Most of these studies therefore fail to correct sufficiently for a possible influence of maturity transformation on the size of the margin. Some studies include a measure for interest rate risk (such as the gap between the durations of assets and liabilities) but few have information on the actual interest rate risk position of the bank. An important omission is information on banks' hedging positions, since this can seriously alter banks' ultimate interest rate risk positions. Assuming that banks take income from maturity transformation into account when setting 'pure spreads', earlier studies may suffer from serious biases in estimating the various influences on these spreads.

We therefore employ a novel approach based on Chaudron (2018). We use the results from a decomposition of net interest income to calculate net interest margins excluding income from maturity transformation[1]. In order to do this we take equation (3) from Chaudron (2018) reproduced here as equation (2).

$$NII_{it} = (r_{it}^{a} + m_{it}^{a})BA_{it} - (r_{it}^{l} + m_{it}^{l})BL_{it} \tag{2}$$

We then use the accounting identity

$$BL_{it} = BA_{it} - E_{it} \tag{3}$$

and divide both sides by banking book assets to arrive at

$$NIM_{it} = \frac{NII_{it}}{BA_{it}} = (r_{it}^{a} - r_{it}^{l}) + \left[r_{it}^{l} \cdot \frac{E_{it}}{BA_{it}}\right] + \left[(m_{it}^{a} - m_{it}^{l}) + m_{it}^{l} \cdot \frac{E_{it}}{BA_{it}}\right] \tag{4}$$

In these equations, *NIM* stands for net interest margin, *NII* for net interest income, *BA* for banking book assets, *E* for equity, r_{it}^{a} and r_{it}^{l} for the average interest rates earned on assets and payed for liabilities, respectively, while m_{it}^{a} and m_{it}^{l} represent the mark-ups for assets and liabilities. Index *i* represents individual banks and *t* indicates time. The first and second terms on the right hand side of equation (4) are determined on the basis of information on the interest rate risk positions as reported for supervisory purposes. The third term follows as residual and, importantly, excludes income from maturity transformation and hence should therefore offer a better measure to gauge the effects on net interest margins of competition, non-financial costs and other bank specific and macroeconomic variables. Most research uses unadjusted NIM data and includes explanatory variables for income from maturity transformation or interest rate risk into the estimation. Entrop et al. (2015) e.g. include their measure for the income from maturity transformation based on 'revolving portfolios' in their econometric models[2]. As we show, this approach will actually conceal underlying relationships if income from maturity

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[1] Busch and Memmel (2016) also decompose the NIM but use a different approach. They model the separate components of the NIM econometrically.

[2] See footnote 19 on page 9 in Entrop et al. (2015): "… in our setting we prefer the single-step approach as it allows the revolving portfolios and the variables proxying for the interest risk in the intermediation fees to be correlated."

transformation and commercial margins are negatively related. In other words, when they are 'communicating vessels'. Figures 1 and 2 show the mean, 10th and 90th percentiles of NIM including and excluding income from maturity transformation, respectively.

[Figure 1 and 2]

2.2.2. Interest rates, yield curve measures and other macroeconomic variables

A low level of interest rates is often associated with smaller margins, as is the case in recent years with interest rates approaching the lower-bound. The most common explanation for smaller margins is that banks are reluctant to pass on negative deposit rates to customers while loan interest rates often contractually follow market rates (Claessens et al., 2018). We therefore expect a positive coefficient for the short-term interest rate. A steeper slope of the yield curve is also usually associated with higher NIMs. The traditional view of banks as maturity transformers, borrowing short and lending long, leads one to expect that the NIM including income from maturity transformation depends positively on the slope of the yield curve, while the NIM excluding income from maturity transformation would be insensitive to the slope. Theory also predicts that margins increase with the volatility of interest rates. If a bank's management is risk averse, a mean-preserving increase in the uncertainty surrounding future interest rates would prompt the bank to increase its margin. Figure 3 shows the one year interest rate and its difference with the 10 year interest rate. Since 2009, there was a decrease of the interest rate and a flattening of the yield curve.

[Figure 3]

GDP is often included to control for shifts in the demand for loans. Since higher GDP growth is often associated with higher demand for loans, we expect a positive influence on the NIM. While inflation has been extremely low and stable during the period under investigation, we include it to compare our results with earlier studies. The expected influence of inflation on NIMs is unclear from the literature. Some have referred to nominal contracting (Entrop et al. 2015) as an explanation to include the inflation rate, while others have pointed to the association between operational costs (a large part of which consists of wages) and inflation (e.g. Demirgüc-Kunt and Huizinga, 1999).

2.2.3 Measures of competition and cost efficiency

In this section several alternative measures of competition and cost efficiency are discussed. We start with the Lerner index, as the method we use to derive it is also used in the other measures of competition and cost efficiency.

Lerner index

An indicator of competition often used in earlier studies of the NIM is the Lerner index. The Lerner index is an indicator of a bank's price-cost margin. It varies by bank and over time. A Lerner index of (near) zero is an indication of competitive markets. A positive Lerner index is an indication of market power. We have serious concerns about the Lerner index being endogenous in our model, since the Lerner itself is in fact a mark-up. We therefore consider its use as an explanatory variable problematic. We include the Lerner index in a number of specifications to allow comparison with previous studies of the NIM but we do not consider these as our baseline specification. Instead, we rely on marginal and average non-financial costs.

We follow Coccorese (2014) and estimate the Lerner index by fitting the following equation on data from individual banks using stochastic frontier estimation:

$$RC_{it} = a_Q + a_{QQ} \ln Q_{it} + \sum_{h=1}^{2} a_{Qh} \ln(W_{hit}/W_{3it}) + a_{TQ}T + a_{EQ} \ln E_{it} + v_{it} + u_{it} \qquad (5)$$

In this equation, RC_{it} is the ratio of revenues to costs for bank *i* in quarter *t*, where revenue is defined as interest income from the banking book, so excluding interest from trading portfolios. Costs consist of interest expenses and administrative costs (staff expenses and other costs). Q_{it} stands for output or production and equals total assets in the banking book (all financial assets except those that belong to the trading portfolios). W_{hit} represents input prices of deposits, i.e. labour and capital indexed by subscript h = 1, 2, respectively. For the input price of deposits we take interest expenses as a percentage of banking book liabilities. For the input price of labour, we take staff expenses divided by total assets. The input price of capital is approximated by depreciation plus other operational expenses divided by total assets[3]. T is a time trend to capture technological change and E_{it} equals total equity. The Lerner index is then derived by transforming the u_{it} term from the stochastic frontier estimation – a measure of cost-inefficiency. Figure 4 shows the mean, 10th and 90th percentiles of the Lerner index for our sample.

[3] Others, such as Bikker et al. (2012) and Coccorese (2014), use variables such as fixed or non-financial assets to scale capital costs. A number of banks in our sample have no fixed or non-financial assets but rent or lease their premises. For this reason, we scale capital costs by total assets, in line with Angelini and Cetorelli (2003) and Ariss (2010).

[Figure 4]

Non-financial costs

An important bank-specific explanatory variable in explaining differences between NIMs is the level of non-financial or operational costs. Almost all previous studies include measures for one or the other. Average operational costs (total operational costs divided by assets) are often used when a suitable measure for marginal operational costs is unavailable. Our specifications include both, also to assess whether average operational costs is a good proxy for marginal costs.

As noted above, we calculate the Lerner index from a revenue-cost ratio in which revenues include interest income on the banking book. In the estimations of the NIM, net interest margins are thus explained by a ratio of income over costs. This probably creates endogeneity problems. We therefore choose a specification using marginal costs with respect to banking book assets (which we take as a measure of the 'production' of the bank), in the calculation of which we leave out the partial derivative with respect to the interest costs of deposits (similar to Maudos and De Guevara, 2007, p. 2108). Otherwise, the marginal cost measure would suffer from the same problem as the Lerner-index. The idea behind this approach is that banks operate subject to scale effects (either costs or benefits) and larger banks are thus at a competitive (dis)advantage.

Marginal costs are defined as usual as:

$$MC_{it} = \frac{\partial TC_{it}}{\partial Q_{it}} = \frac{TC_{it}}{Q_{it}} \frac{\partial \ln TC_{it}}{\partial \ln Q_{it}} \quad (6)$$

where the term $\partial \ln TC_{it} / \partial \ln Q_{it}$ is the first derivative of a translog production function with respect to output, Q_{it} (loans):

$$\frac{\partial \ln TC_{it}}{\partial \ln Q_{it}} = a_Q + a_{QQ} \ln Q_{it} + \sum_{h=2}^{3} a_{Qh} \ln W_{hit} + a_{TQ} T + a_{EQ} \ln E_{it} \quad (7)$$

where *W*, *T* and *E* are defined as before. Usually, marginal costs are calculated by estimating a transformed version of a translog production function and using the coefficients in equation (7). We follow a slightly different route in that all coefficients of equation (7) can be taken directly from the estimation of the transformed revenue-cost function (5), except a_{Q3}, which is calculated as $-a_{Q1} - a_{Q2}$ by virtue of the homogeneity restriction on a_{Qh}. We leave out interest costs (W_{1it}) from the calculation of marginal costs, since we want to focus on operational costs.

The marginal costs are then calculated as:

$$MC_{it} = \frac{\partial TC_{it}}{\partial Q_{it}} = \left[a_Q + a_{QQ} \ln Q_{it} + \sum_{h=2}^{3} a_{hQ} \ln W_{hit} + a_{TQ} T + a_{EQ} \ln E_{it}\right] \frac{TC_{it}}{Q_{it}} \quad (8)$$

Figure 5 shows the mean, 10^{th} and 90^{th} percentiles of the marginal operating costs for our sample.

[Figure 5]

Herfindahl-Hirschman index (HHI)

The most conventional measure for concentration within a sector is the Herfindahl-Hirschman index (HHI). It is calculated as the sum of the squared individual banks' market shares. The highest possible value of 1 for the HHI represents a monopoly. The lower its value, the more competitive the sector. We calculate the HHI for each quarter separately. In most specifications, we also include the loan market share of the individual bank as an explanatory variable. The HHI suggests that concentration decreased during the sample period (Figure 6).

[Figure 6]

2.2.4 Other bank specific explanatory variables

We include a number of additional variables in our estimations of the NIM to control for bank-specific effects that vary over time, as suggested by the literature. One of these measures is banks' risk aversion, proxied here by banks' TIER-1 capital and leverage ratios, as suggested in earlier research such as Saunders and Schumacher (2000), Maudos and De Guevara (2004) and Chortareas et al. (2012). Higher risk aversion (higher capital ratio and lower leverage) should lead to higher margins. We also include the duration of equity, which measures banks' ultimate interest rate risk position, to check for any (residual) influence on the NIM. Since this measure is used to calculate income from maturity transformation, the NIM excluding income from maturity transformation should be uncorrelated with it. Another important variable suggested by theory is credit risk. We employ a measure for actual loan losses (realised losses on impaired loans) as well as a measure for expected loan losses, measured as the capital requirement for credit risk.

Liquidity indicators are often included in this type of analyses. We consider three: the cash ratio (cash and balances with central banks divided by total assets), the loan to deposits ratio (banking book assets divided by total deposits) and the deposit ratio (total deposits divided by total assets). The cash ratio indicates the part of assets held in the form of notes or in deposits at the central bank that usually earns no (or even negative) income. A higher cash ratio should therefore lead to a lower NIM. Its effect is often interpreted as the opportunity costs of reserves. Since the loan to deposits ratio and the deposit ratio are closely related, we only use the former. The coefficient on the loan to deposits ratio shows the net effect of two factors. Banks with a high and stable deposit base can pay less interest on deposits. In fact, since a large part of deposits in the Netherlands is uncompensated, a low loan to deposit ratio (or high deposit ratio) proxies for implicit savings on interest expenses. A bank with a low loan to deposit ratio (or a high deposit ratio) should therefore have a high NIM. On the other hand, banks with a high and stable deposit base can also charge less 'liquidity premium' on loans, leading to a lower NIM. We expect the first factor to be dominant and therefore postulate a negative coefficient on the loan to deposit ratio.

To account for possible (positive or negative) scale economies and the effects of market power, we also include the size of the bank (measured by the logarithm of banking book assets) and the banks' market share in the loan market[4]. Finally, we include a measure of other income, which consists of all income outside the banking book (income from trading, fees and all other income) divided by total assets. Some studies have found interest income and other income to be either substitutes (e.g. Nguyen, 2012 and Entrop et al., 2015) or complementary (Valverde and Fernandez, 2007). In the first case, banks shift attention to other non-traditional activities when margins decline and the coefficient on other income should be negative. In the second case, when banks sell other products along with extending loans, other income should have a positive effect on both NIMs.

2.2.5 Variable definitions and summary statistics

Table 1 gives the model variable definitions including the expected signs for the coefficients, and Table 2 presents summary statistics.

[Table 1 and 2]

3. Estimation method and data

3.1 Method

[4] We also included a market share of deposits but it turned out to be highly collinear with the market share of loans. We therefore only use the market share of loans.

Since equation (1) is a so-called dynamic fixed-effects panel model and contains a lagged dependent, estimation of the coefficients suffers from Nickell bias (Nickell, 1981) through the dependence between y_{it-1} and the bank fixed effects α_i. The unbalanced panel data set contains data for 41 banks. The average number of observations for which all variables are available is 26 quarters, but varies between 4 and 34 quarters for individual banks. There are no gaps. Although the Nickell bias is found to be small for panels with the number of observations in time approaching 30, the fact that the panel is unbalanced should also be taken into account in choosing the estimation technique. Flannery and Hankins (2013) note that the choice of an efficient estimator is especially important for quarterly data, since it contains smaller innovations than annual data, increasing the difficulty of estimating coefficients accurately. Following the advice of Flannery and Hankins (2013) which was confirmed by Dang et al., (2015), we use the bias-corrected least-squares dummy variable (LSDVC) estimator proposed by Bruno (2005) as well as standard fixed effects and compare the outcomes. We are reluctant to use GMM-methods as these are primarily suited to panels with large N and small T, whereas our sample has both moderate T and moderate N. We thereby avoid the complexity of selecting appropriate instruments. Before proceeding, we test all dependent variables for non-stationarity using the Fisher type augmented Dickey-Fuller test. These tests all reject the null hypothesis that all panels contain unit roots with very high significance (p<0.01%).

3.2 Data

3.2.1 Banking data

All our banking data comes from quarterly supervisory reporting on a consolidated basis. The balance sheet and profit and loss data come from FINREP reports. Risk indicators and solvability measures come from COREP reports. Data on banks' interest rate risk are reported quarterly, along with the FINREP and COREP data. For more information on this data, see Chaudron (2018). The sample consists of 41 banks representing roughly 90% of the balance sheet total of the Dutch banking sector during this period. In the supervisory reports that we use in our analysis, accounting items are reported cumulatively year-to-date. We transform the data into quarterly information by subtracting the data from the previous quarter from those for the second, third and fourth quarters. Obviously, the data for the first quarter is used as reported. All financial variables are in euros. The data spans the period from the first quarter of 2008 to the second quarter of 2016.

3.2.2 Interest rates and other macroeconomic variables

Risk-free interest rates are calculated from the zero yield curve information based on prices of German bunds provided by the Deutsche Bundesbank. German bunds are widely regarded as benchmark instruments for risk-free bonds in the euro area. The volatility of interest rates is measured by the annualised standard deviation of the one year risk-free interest rate on German bunds. GDP growth and inflation are obtained from Statistics Netherlands.

4. Results

4.1 Baseline results

Our baseline model includes all variables specified in Table 1 except the Lerner index (see below), with either the NIM or the NIM excluding income from maturity transformation as dependent variables.[5] Table 3 provides two sets of estimates (both for the NIM and the NIM excluding income from maturity transformation). The first using standard fixed effects and the second using bias corrected LSDV as proposed by Bruno (2005). We report robust standard errors with all the results, corrected for cross-sectional heteroscedasticity and within-panel (serial) correlation, which is equivalent to standard errors clustered by bank. Comparison between the standard fixed effects and the LSDVC estimates shows that the Nickell bias is fairly small, usually not more than 10% of the coefficient estimates. We will therefore focus our discussion primarily on the standard fixed effects results.

[Table 3]

None of the macroeconomic variables is significant in specification (1), the standard fixed effects estimation on the NIM including income from maturity transformation. Nor are these variables significant in the LSDV specification (2). Hence, we do not find evidence of a negative effect of low interest rates or a flat yield curve on NIM. In both estimations for the NIM *excluding* income from maturity transformation, however, the Herfindahl-Hirschman index is statistically significant, and so are GDP growth, the short-term interest rate and the slope of the yield curve (specifications (3) and (4)). Contrary to expectations though, the coefficients on the short-term interest rate and the slope of the yield curve are negative. As both variables have declined during the period, our estimations indicate that the NIM excluding income from maturity transformation has increased, while the gross NIM has remained fairly constant – as least with regard to interest rates. The coefficient on the Herfindahl-Hirschman index is almost twice as large in the estimates for the NIM excluding income from maturity transformation. It seems increased concentration over the period studied had a positive effect on margins but this only becomes visible after removing income from maturity transformation from the NIM.

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[5] An earlier specification also included a Boone indicator (see Boone, 2008). It turned out that the Boone indicator is highly correlated with the one year interest rate. While this might be purely accidental, we decided to exclude the Boone indicator from our estimations since we are mainly interested in the effects of low interest rates on margins.

Similar to the interest rate variables, the duration of equity – the measure for the ultimate interest risk position of the bank – is not significant in the estimation for the NIM but is significant in the estimation for the NIM excluding income from maturity transformation. Also similar to the interest rate variables, its coefficient is negative, contrary to theory. Theoretically, the duration of equity should have a positive effect on the NIM and be unrelated to the NIM excluding income from maturity transformation. Here, we observe precisely the reverse. Our findings are consistent with those of Angbazo (1997) who also found that interest rate risk (measured by net short term assets as a percentage of equity at book value) has a negative influence on the NIM of US banks in panel estimations.

Regarding the bank specific control variables, it is notable that neither the Tier-1 capital ratio nor the leverage ratio (which earlier studies have taken as an indicator of a bank's risk aversion) have a significant effect on both NIM measures. Loan losses and credit risk, however, do have significant effects, which indicates that banks price at least some of their credit risk into their margins. The cash ratio, which represents non-interest earning assets, is consistently negative and significant, as expected. Altavilla et al. (2018), using quarterly data for 2000 to 2016 for Euro area banks, also find a positive effect of liquidity. The loan-to-deposit ratio is borderline significant in specification (1) and has the expected sign, but is not significant in specification (2). Size on the other hand is consistently significant in all specifications; its negative coefficient suggests scale effects. This is consistent with the findings of Maudos and De Guevara (2004) who report a positive effect of size on the NIM for nearly 16,000 banks from five EU countries. Marginal costs have (as expected) a consistently positive effect on margins although the coefficients are only marginally significant. Results for average costs (not reported but available from the authors upon request) are similar. Market share and other income also perform disappointingly.

4.2 Robustness tests

In order to verify the robustness of our results, we estimate a number of alternative specifications. First, we estimate both a static version of the baseline and a specification with additional lags of the dependent variable to address possible autocorrelation issues. Second, we apply weighed least squares in our panel set-up where each bank is weighed according to the average of its total assets over the period analysed. Third, to ensure some comparability with earlier research, we also estimate our baseline specification complemented with the Lerner index and – since most regard the Lerner index as endogenous – apply instrumental variables. Lastly, we include interaction terms for the use of derivatives.

4.2.1 Autocorrelation

When testing the residuals of the estimations reported in Table 3 using a simple AR model, we find that both the estimations for the NIM and for the NIM excluding income from maturity transformation suffer significant second order autocorrelation in the errors[6]. We therefore also report specifications (1) and (3) in Table 4 including the two quarter lagged dependent in addition to the one quarter lagged dependent. Using the same method, the residuals from these specifications are completely free of any autocorrelation. The results between the specifications (1) and (3) in Table 3 and 4, however, vary only marginally. Since the Nickell bias corrected estimate only allows for a one period lagged dependent, we have chosen specifications (1) and (3) as our baseline. We also report the static version of the model, i.e. without any lagged dependent variable (specifications (2) and (4) in Table 4). Although the coefficients of this model have a different interpretation from those of the dynamic models, the main argument – that NIM and NIM excluding income from maturity transformation are affected differently by interest rates – remains valid.

[Table 4]

4.2.2 Weighted least squares

The banking sector in the Netherlands is highly concentrated with a few large universal banks and a few dozen more specialised niche institutions. As the variables used in our estimations are ratios, small banks receive equal weights as large banks in our estimations. Our sample of banks is relatively small which makes splitting the sample into large banks and small banks problematic due to the too small number of observations. In order to check whether our results are influenced by a disproportionate weighing of small banks in the baseline model, we employ weighted least squares (WLS) to correct this. We use the averages of banks' total assets over the period of observation as weights normalised to 1 so that the total of the weights sums to the number of banks. Since the bias corrected LSDV estimator does not allow for the use of weights, we only apply WLS to the standard fixed effects specification. Since the previous results indicated the Nickell bias was negligible anyway, we do not expect this to significantly affect the results.

The results of the WLS estimated for the fixed effects model are presented in Table 5. They differ from the baseline specification in a number of ways. First of all, inflation has significant but negative coefficients. Additionally, the volatility of both the interest rate and the slope of the yield curve have positive and significant coefficients. The coefficient on the interest rate is also significantly negative, although for the NIM only marginally. For the other variables, the differences are minor. These results

[6] Unreported results available from the authors upon request.

suggest that large banks have a somewhat more sophisticated process for the determination of interest margins, taking into account the volatility of interest rates.

[Table 5]

4.2.3 The Lerner index and instrumental variables

The results for the baseline specification extended with the Lerner index are presented in Table 6. To take into account the possibility that the Lerner index might be endogenous, we supplement the fixed effect and bias corrected LSDV estimates with instrumental variables estimates. The Lerner is instrumented with the lagged value of the NIM, its own first difference and the levels of the other variables.

[Table 6]

Inclusion of the Lerner index leads a number of other variables to become more significant. Whereas interest rate volatility did not attain significance in the baseline specifications (models (1) and (3) in Table 3), it does so here and in fact for all estimations methods (standard fixed effects, bias corrected LSDV and instrumental variables). The Herfindahl-Hirschman index is now also significant in the estimations for the NIM. The results for the other macroeconomic and sectoral variables are qualitatively the same as in the baseline.

The estimated coefficients of the Lerner index are significant and of the predicted positive sign in all specifications. This confirms results of Maudos and De Guevara (2004) and Maudos and Solis (2009) who for nearly 16,000 banks from five EU countries and 43 Mexican banks, respectively, find that the influence of the Lerner index is significant and positive on NIM. Tier-1 capital ratio and Leverage also perform (much) better in most specifications than in the baseline. The results for the remaining variables on the other hand are largely comparable with the baseline.

4.2.4 Differences between users and non-users of derivatives

Table 7 presents the baseline specification including interaction terms with a dummy variable indicating whether the bank used derivatives or not. We assess the use of derivatives by looking at whether a bank reports having traded derivatives or having hedged any kind of asset or liability in the banking book in its FINREP report, in the same way as in Chaudron (2018). This criterion (adopted from Purnanandam, 2007) indicates that a bank has the ability to use derivatives, although it does not necessarily use them to hedge interest rates.

[Table 7]

Again, the main conclusions hold. However, there are a few differences between banks that use derivatives and those that do not. While the volatility of the interest rate had a positive effect according to the previous results (although not very significantly), its coefficient is now negative for the NIM excluding income from maturity transformation for banks that do not use derivatives. The coefficient on the slope of the yield curve is only significant and negative for banks that use derivatives. Together with the difference in the coefficient on the duration of equity, this suggests that banks that use derivatives primarily determine the outcome in the baseline. Hence, we do not confirm the finding of Angbazo (1997) that interest rate risk effects on the NIM are absent for banks using derivates.

5 Conclusions

We investigated the effects of a flattening of the yield curve and decreasing interest rates on the net interest margin (NIM) of Dutch banks during the period 2008Q1 to 2016Q2. We distinguish explicitly between net interest income from pure maturity transformation and a residual part representing market power, compensation for risk and other markups. Our results show that the residual part increased when the yield curve flattened and interest rates fell, while total NIM remained constant. In other words, banks managed to keep net interest margins more or less constant by increasing other margins, compensating for any loss of income from maturity transformation.

We also show that the relationship between NIM and interest rates is related to banks' hedging behaviour. The simple relation between NIM and interest rates, hypothesised in the other research, cannot be generalised. Earlier empirical work already indicated this. Our results are therefore fully in line with earlier work in this field such as Angbazo (1997) and Entrop (2015). Furthermore, we show that interest rates and other macroeconomic variables are much less important in explaining changes in net interest margins than the competitiveness of the sector and the market power of individual banks. In the sample period that we analyse, low-for-long interest rates seem to be a far smaller problem for bank profitability than is often claimed.

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TABLES

Table 1

Variable definitions

Variable	Definition	Expected coefficient
Macro-economic variables		
Economic growth	Year-on-year quarterly change in GDP	+
Inflation	Year-on-year quarterly change in CPI	+
Interest rate, one year	One year zero yield German bunds	+
Volatility of the interest rate	Annualised quarterly standard deviation of the interest rate	+
Slope of the yield curve	Difference between the ten year and one year zero yields on German bunds divided by the difference in term	+
Volatility of the slope	Annualised quarterly standard deviation of the slope of the yield curve	+
Herfindahl-Hirschman index	Herfindahl-Hirschman index based on market shares for loans to non-financial sectors	+
Bank specific variables		
Net interest margin	Net interest margin, difference between interest income and expense as a fraction of total banking book assets	Not relevant
Net interest margin excluding income from maturity transformation	As above but excluding income from maturity transformation as calculated in Chaudron (2018)	Not relevant
Duration of equity	Duration of equity in years	+
Lerner index	Index of market power indicated by the margin of price over marginal costs, estimated using Eq. (3) following the method of Coccorese (2014).	+
Market share	Market share in the loan market	+
Capital ratio	TIER-1 capital ratio	+
Leverage ratio	Ratio of total assets and the book value of equity	-
Loan losses	Realised losses on impaired loans as a percentage of banking book assets	+
Credit risk	Capital required for credit risk as calculated for capital requirements over banking book assets	+
Cash ratio	Ratio of cash and deposits at the central bank over total assets	-
Loan to deposit ratio	Ratio of loans from the banking book to deposits	-
Size	Natural logarithm of total assets in the banking book	+/-
Average costs	Average operational (labour and other) costs	+
Marginal costs	Marginal operational costs as estimated using Eq. (6)	+
Other income	Fees and other income divided by total assets	+/-

Table 2

Descriptive statistics

Variable		No. of obs.	Mean	St. dev.	Minimum	Maximum
Macroeconomic variables						
Economic growth		34	0.5294	2.1144	-4.9000	3.2000
Inflation		34	1.6267	0.8838	0.0299	3.0711
Interest rate, one year		34	0.5703	1.1755	-0.6500	4.6000
Volatility of the interest rate		34	1.4766	1.5243	0.1966	5.9916
Slope of the yield curve		34	0.1794	0.0853	0.0133	0.3222
Volatility of the slope		34	0.2247	0.1184	0.0815	0.5844
Herfindahl-Hirschman index		34	0.2528	0.0125	0.2262	0.2763
Bank specific variables						
Net interest margin	overall	1253	1.3311	1.1144	-1.0429	7.1387
	between	43		0.9182	0.1836	4.3164
	within	29.1395		0.6029	-1.2852	7.4624
Net interest margin	overall	1254	1.1390	1.1181	-2.9600	6.6721
excluding	between	43		0.9024	-0.2880	4.2391
	within	29.1628		0.6132	-1.5330	7.7010
Duration of equity	overall	1111	2.7003	2.8699	-8.6199	21.4743
	between	43		1.9628	-0.2969	7.4349
	within	25.8372		2.1931	-12.2467	19.8512
Capital ratio	overall	1243	20.8404	14.8058	4.4068	111.1621
	between	43		12.1646	9.7117	78.2907
	within	28.907		7.8460	-7.9723	85.5490
Leverage ratio	overall	1253	19.0581	16.5952	1.0893	176.0755
	between	43		14.0590	1.1815	57.0575
	within	29.1395		8.8844	-14.4232	147.1178
Loan losses	overall	1253	0.1093	0.6016	-1.2862	14.5562
	between	43		0.1853	-0.1598	0.8009
	within	29.1395		0.5772	-1.6467	13.8645
Credit risk	overall	1243	3.4691	2.2191	0.0386	10.8339
	between	43		2.0763	0.1716	9.7692
	within	28.907		0.6778	-0.0182	10.8249
Cash ratio	overall	1253	5.7645	8.2273	0.0000	69.0811
	between	43		6.0928	0.0034	31.3316
	within	29.1395		6.4740	-17.1934	61.8533
Loan to deposit ratio	overall	1214	2.3113	3.8931	0.7774	41.8763
	between	41		3.3402	0.9898	17.7499
	within	29.6098		1.7606	-8.2216	27.3299
Lerner index	overall	1203	0.2700	0.1394	0.0582	0.9593
	between	41		0.1027	0.0690	0.5372
	within	29.3415		0.0909	-0.2090	0.7932
Size	overall	1253	15.4181	2.3113	9.3083	20.7962
	between	43		2.4509	9.6308	20.6219
	within	29.1395		0.3493	11.9732	17.0433
Market share	overall	1253	2.7135	7.6412	0.0005	43.5888
	between	43		7.3235	0.0007	35.8293
	within	29.1395		0.7284	-5.4809	10.4730
Marginal costs	overall	1245	1.1947	3.3197	0.0086	31.9148
	between	43		3.8959	0.0124	20.1706
	within	28.9535		0.9390	-10.2257	12.9389
Average costs	overall	1253	0.9098	2.8932	-5.9495	30.5340
	between	43		3.5333	0.0067	17.2811
	within	29.1395		0.9944	-8.9906	14.1626
Other income	overall	1253	0.7482	3.2415	-9.0199	44.0115
	between	43		3.2106	-0.8082	18.9060
	within	29.1395		1.5012	-8.4026	29.7338

Table 3

Results from within and LSDVC panel estimation on macroeconomic and bank specific variables

Variable	NIM		NIM excl. income from maturity	
	Standard within (1)	LSDVC (2)	Standard within (3)	LSDVC (4)
Macroeconomic variables				
Economic growth	0.0181	0.0174	0.0280**	0.0274**
	(0.0124)	(0.0131)	(0.0133)	(0.0137)
Inflation	-0.0111	-0.0127	-0.0115	-0.0133
	(0.0215)	(0.0252)	(0.0248)	(0.0265)
One year interest rate	-0.0383	-0.0363	-0.0837**	-0.0813***
	(0.0253)	(0.0271)	(0.0318)	(0.0283)
Volatility of the interest rate	0.0191	0.0184	0.00983	0.00949
	(0.0145)	(0.0155)	(0.0141)	(0.0163)
Slope of the yield curve	-0.232	-0.226	-0.745**	-0.738***
	(0.331)	(0.259)	(0.282)	(0.275)
Volatility of the slope	0.0591	0.0483	0.0681	0.0600
	(0.171)	(0.142)	(0.181)	(0.149)
Herfindahl-Hirschman index	3.694	3.746	6.148***	6.195**
	(2.198)	(2.354)	(2.245)	(2.461)
Bank-specific variables				
Dependent variable$_{(t-1)}$	0.254***	0.299***	0.272***	0.315***
	(0.0765)	(0.0269)	(0.0784)	(0.0266)
Duration of equity	-0.00603	-0.00600	-0.0296***	-0.0285***
	(0.00978)	(0.00679)	(0.00805)	(0.00725)
Tier-1 capital ratio	0.00358	0.00337	0.000539	0.000444
	(0.00277)	(0.00236)	(0.00226)	(0.00248)
Leverage	-0.00312*	-0.00299	-0.00274	-0.00264
	(0.00179)	(0.00197)	(0.00186)	(0.00206)
Loan losses	0.0787**	0.0795***	0.0904***	0.0910***
	(0.0356)	(0.0282)	(0.0324)	(0.0295)
Credit risk	0.0826***	0.0791***	0.0585*	0.0556**
	(0.0303)	(0.0248)	(0.0302)	(0.0258)
Cash ratio	-0.0111***	-0.0113***	-0.00839**	-0.00858***
	(0.00320)	(0.00310)	(0.00374)	(0.00325)
Loan to deposits ratio	-0.0164*	-0.0163	-0.0133	-0.0133
	(0.00878)	(0.0123)	(0.0118)	(0.0129)
Size	-0.266*	-0.248***	-0.284*	-0.271***
	(0.143)	(0.0814)	(0.143)	(0.0852)
Market share	-0.00559	-0.00766	-0.00345	-0.00529
	(0.00884)	(0.0219)	(0.0112)	(0.0229)
Marginal costs	0.102	0.0997*	0.0661	0.0645
	(0.0851)	(0.0522)	(0.0708)	(0.0547)
Other income	-0.0276	-0.0269*	-0.0194	-0.0190
	(0.0282)	(0.0148)	(0.0280)	(0.0155)
Bank fixed effects	Y	Y	Y	Y
Time effects	N	N	N	N
Number of observations	1046	1046	1046	1046
Number of banks	41	41	41	41
R^2 within	0.2147	-	0.2208	-
F-test p-value	0.0000	-	0.0000	-

Note: Standard errors shown in parentheses. Variables are defined in Table 1. Data covers the period 2008Q1-2016Q2.Within indicates within panel estimation using standard OLS and bank fixed effects, LSDVC indicates Nickell bias corrected least squares dummy variable. Standard errors for the LSDVC estimates are calculated using a bootstrap variance-covariance matrix with 100 repetitions. ∗∗∗ Indicates significance at 1% level, ∗∗ at 5% level and ∗ at 10% level.

Table 4

Results from standard within panel estimation on macroeconomic and bank specific variables, alternative specifications

Variable	NIM		NIM excl. income from maturity	
	(1)	(2)	(3)	(4)
Macroeconomic variables				
Economic growth	0.0243*	0.0164	0.0340**	0.0283*
	(0.0139)	(0.0149)	(0.0151)	(0.0156)
Inflation	-0.00647	-0.0182	-0.00423	-0.0225
	(0.0204)	(0.0281)	(0.0229)	(0.0342)
One year interest rate	-0.0435	-0.0535	-0.0864**	-0.118**
	(0.0328)	(0.0352)	(0.0391)	(0.0457)
Interest rate volatility	0.0154	0.0295*	0.00839	0.0175
	(0.0136)	(0.0160)	(0.0132)	(0.0158)
Slope of the yield curve	-0.151	-0.234	-0.583**	-0.946**
	(0.339)	(0.463)	(0.277)	(0.443)
Volatility of the slope	0.0269	0.0933	0.0369	0.0954
	(0.176)	(0.155)	(0.185)	(0.169)
Herfindahl-Hirschman index	4.273*	3.599	6.546**	6.853**
	(2.472)	(2.639)	(2.613)	(2.611)
Bank-specific variables				
Dependent variable$_{(t-1)}$	0.213***	-	0.221***	-
	(0.0674)	-	(0.0666)	-
Dependent variable$_{(t-2)}$	0.122***	-	0.140***	-
	(0.0372)	-	(0.0382)	-
Duration of equity	-0.00835	-0.00611	-0.0326***	-0.0322***
	(0.00972)	(0.0125)	(0.00776)	(0.0106)
Tier-1 capital ratio	0.00291	0.00546	0.000172	0.00187
	(0.00223)	(0.00397)	(0.00197)	(0.00334)
Leverage	-0.00280	-0.00397*	-0.00245	-0.00345
	(0.00196)	(0.00203)	(0.00189)	(0.00219)
Loan losses	0.0821**	0.0775*	0.0927***	0.0903**
	(0.0372)	(0.0405)	(0.0342)	(0.0364)
Credit risk	0.0813**	0.125**	0.0608*	0.0964*
	(0.0310)	(0.0474)	(0.0310)	(0.0501)
Cash ratio	-0.00993***	-0.0133***	-0.00735**	-0.0100*
	(0.00306)	(0.00443)	(0.00353)	(0.00547)
Loan to deposits ratio	-0.0151*	-0.0204*	-0.0135	-0.0159
	(0.00823)	(0.0113)	(0.0113)	(0.0154)
Size	-0.276*	-0.306*	-0.290**	-0.332*
	(0.142)	(0.175)	(0.138)	(0.184)
Market share	0.00422	-0.0125	0.00604	-0.00907
	(0.00893)	(0.0107)	(0.0103)	(0.0135)
Marginal costs	0.0836	0.132	0.0510	0.0919
	(0.0809)	(0.107)	(0.0707)	(0.0912)
Other income	-0.0270	-0.0331	-0.0171	-0.0259
	(0.0295)	(0.0281)	(0.0284)	(0.0295)
Bank fixed effects	Y	Y	Y	Y
Time effects	N	N	N	N
Number of observations	1014	1073	1014	1073
Number of banks	41	41	41	41
R^2 within	0.2206	0.1589	0.2346	0.1483
F-test p-value	0.0000	0.0000	0.0000	0.0000

Note: Standard errors shown in parentheses. Variables are defined in Table 1. Data covers the period 2008Q1-2016Q2. Within panel estimation using standard OLS and bank fixed effects. ∗∗∗ Indicates significance at 1% level, ∗∗ at 5% level and ∗ at 10% level.

Table 5

Results from the WLS estimation on macroeconomic and bank specific variables

Variable	NIM (1)	NIM excl. income from maturity (2)
Macroeconomic variables		
Economic growth	0.0151*	0.00401
	(0.00870)	(0.00558)
Inflation	-0.0392**	-0.0669***
	(0.0180)	(0.0197)
One year interest rate	-0.0447*	-0.0700***
	(0.0228)	(0.0243)
Interest rate volatility	0.0195***	0.0201***
	(0.00510)	(0.00529)
Slope of the yield curve	0.220	-0.724*
	(0.396)	(0.418)
Volatility of the slope	0.264***	0.287***
	(0.0691)	(0.0938)
Herfindahl-Hirschman index	0.0421	2.560
	(1.850)	(2.492)
Bank-specific variables		
Dependent variable$_{(t-1)}$	0.126***	0.185**
	(0.0388)	(0.0746)
Duration of equity	-0.0110	-0.0395***
	(0.0101)	(0.00942)
Tier-1 capital ratio	0.000464	-0.000761
	(0.00102)	(0.00120)
Leverage	-0.00302**	-0.00110
	(0.00147)	(0.00177)
Loan losses	0.118*	0.125
	(0.0681)	(0.0749)
Credit risk	0.119**	0.119**
	(0.0442)	(0.0445)
Cash ratio	-0.00130	0.00681
	(0.00719)	(0.00706)
Loan to deposits ratio	-0.0120**	-0.00999*
	(0.00555)	(0.00577)
Size	-0.299*	-0.524***
	(0.169)	(0.165)
Market share	-0.00663	-0.00611
	(0.00737)	(0.00638)
Marginal costs	0.109	-0.0336
	(0.0878)	(0.0986)
Other income	0.0133	0.0570
	(0.0330)	(0.0357)
Bank fixed effects	Y	Y
Time effects	N	N
Number of observations	1046	1046
Number of banks	41	41
R^2 within	0.2612	0.3834
F-test p-value	0.0000	0.0000

Note: Standard errors shown in parentheses. Variables are defined in Table 1. Data covers the period 2008Q1-2016Q2. Estimates for weighted least squares using normalised average total assets and within panel with fixed effects. $***$ Indicates significance at 1% level, $**$ at 5% level and $*$ at 10% level.

Table 6

Results from the standard within, LSDVC and IV panel estimation on macroeconomic and bank specific variables including the Lerner index

Variable	NIM			NIM excl. income from maturity		
	Standard within	LSDVC	IV	Standard within	LSDVC	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Macroeconomic variables						
Economic growth	0.0110	0.00991	0.00725	0.0202	0.0192	0.0158
	(0.0126)	(0.0140)	(0.0126)	(0.0126)	(0.0142)	(0.0131)
Inflation	0.00679	0.00529	0.0152	0.00465	0.00291	0.0139
	(0.0188)	(0.0239)	(0.0202)	(0.0230)	(0.0242)	(0.0209)
One year interest rate	-0.0207	-0.0198	-0.0131	-0.0697**	-0.0683***	-0.0619***
	(0.0193)	(0.0252)	(0.0224)	(0.0264)	(0.0256)	(0.0233)
Interest rate volatility	0.0327**	0.0323**	0.0355***	0.0229*	0.0229*	0.0256*
	(0.0138)	(0.0133)	(0.0130)	(0.0130)	(0.0134)	(0.0134)
Slope of the yield curve	-0.392	-0.384	-0.483**	-0.969***	-0.960***	-1.097***
	(0.303)	(0.279)	(0.231)	(0.267)	(0.282)	(0.243)
Volatility of the slope	0.127	0.116	0.149	0.137	0.129	0.161
	(0.151)	(0.143)	(0.126)	(0.161)	(0.145)	(0.131)
Herfindahl-Hirschman index	4.887**	4.905**	4.999**	7.464***	7.477***	7.678***
	(2.096)	(2.262)	(2.137)	(2.190)	(2.293)	(2.221)
Bank-specific variables						
Dependent variable$_{(t-1)}$	0.179***	0.217***	0.152***	0.198***	0.234***	0.165***
	(0.0602)	(0.0316)	(0.0292)	(0.0654)	(0.0316)	(0.0293)
Duration of equity	-0.0105	-0.0107	-0.0117*	-0.0358***	-0.0351***	-0.0380***
	(0.00634)	(0.00752)	(0.00653)	(0.00572)	(0.00764)	(0.00680)
Lerner index	2.266***	2.192***	3.141***	2.285***	2.219***	3.322***
	(0.445)	(0.202)	(0.330)	(0.491)	(0.205)	(0.344)
Tier-1 capital ratio	0.00838*	0.00828***	0.0101***	0.00518	0.00519*	0.00718***
	(0.00427)	(0.00303)	(0.00226)	(0.00338)	(0.00306)	(0.00234)
Leverage	-0.00459*	-0.00407	-0.00511***	-0.00432*	-0.00384	-0.00498***
	(0.00230)	(0.00363)	(0.00185)	(0.00215)	(0.00368)	(0.00191)
Loan losses	0.0708***	0.0720***	0.0681***	0.0832***	0.0841***	0.0803***
	(0.0236)	(0.0256)	(0.0237)	(0.0205)	(0.0258)	(0.0246)
Credit risk	0.0934**	0.0906***	0.0940***	0.0665*	0.0641**	0.0660***
	(0.0386)	(0.0254)	(0.0234)	(0.0352)	(0.0257)	(0.0241)
Cash ratio	-0.0118***	-0.0120***	-0.0125***	-0.00887***	-0.00905***	-0.00964***
	(0.00284)	(0.00280)	(0.00255)	(0.00289)	(0.00282)	(0.00263)
Loan to deposits ratio	-0.0170**	-0.0168*	-0.0172*	-0.0137	-0.0135	-0.0138
	(0.00706)	(0.0100)	(0.00944)	(0.0105)	(0.0102)	(0.00977)
Size	-0.288**	-0.261***	-0.306***	-0.316**	-0.293***	-0.341***
	(0.114)	(0.0771)	(0.0702)	(0.121)	(0.0781)	(0.0729)
Market share	-0.00847	-0.0105	-0.00876	-0.00561	-0.00742	-0.00572
	(0.0110)	(0.0237)	(0.0197)	(0.0102)	(0.0240)	(0.0204)
Marginal costs	0.166*	0.164***	0.191***	0.128*	0.126**	0.156***
	(0.0878)	(0.0567)	(0.0466)	(0.0745)	(0.0573)	(0.0482)
Other income	-0.0237	-0.0226	-0.0218	-0.0153	-0.0145	-0.0130
	(0.0237)	(0.0138)	(0.0137)	(0.0236)	(0.0140)	(0.0142)
Bank fixed effects	Y	Y	Y	Y	Y	Y
Time effects	N	N	N	N	N	N
Number of observations	`1039	1039	1034	`1039	1039	1034
Number of banks	41	41	41	41	41	41
R^2 within	0.3327	-	0.3131	0.3335	-	0.3099
F-test p-value	0.0000	-	-	0.0000	-	-
Wald Chi^2 p-value	-	-	0.0000	-	-	0.0000

Note: Standard errors shown in parentheses. Variables are defined in Table 1. Data covers the period 2008Q1-2016Q2.Within indicates within panel estimation using standard OLS and bank fixed effects, LSDVC indicates Nickell bias corrected least squares dummy variable. Standard errors for the LSDVC estimates are calculated using a bootstrap variance-covariance matrix with 100 repetitions. IV indicates instrumental variables. Only Lerner index is treated as endogenous and is instrumented with the other variables as well as first differences of itself. $***$ Indicates significance at 1% level, $**$ at 5% level and $*$ at 10% level.

Table 7

Results from standard within panel estimation on macroeconomic and bank specific variables including interaction terms for the use of derivatives

Variable	NIM (1)	NIM excl. income from maturity (2)
Macroeconomic variables		
Economic growth	0.0203	0.0271^{*}
	(0.0124)	(0.0137)
Inflation	-0.00920	-0.0141
	(0.0221)	(0.0256)
One year interest rate | Deriv=0	-0.0488	-0.104^{*}
	(0.0631)	(0.0584)
One year interest rate | Deriv=1	-0.0398	-0.0815^{**}
	(0.0254)	(0.0337)
Interest rate volatility | Deriv=0	-0.0226	-0.0384^{***}
	(0.0247)	(0.0134)
Interest rate volatility | Deriv=1	0.0270	0.0210
	(0.0164)	(0.0161)
Slope of the yield curve | Deriv=0	0.977	-0.266
	(0.644)	(0.563)
Slope of the yield curve | Deriv=1	-0.427	-0.862^{***}
	(0.345)	(0.296)
Volatility of the slope | Deriv=0	-0.00957	0.0487
	(0.125)	(0.136)
Volatility of the slope | Deriv=1	0.0617	0.0753
	(0.211)	(0.221)
Herfindahl-Hirschman index	3.804^{*}	6.025^{**}
	(2.183)	(2.266)
Bank-specific variables		
Dependent variable$_{(t-1)}$	0.248^{***}	0.267^{***}
	(0.0760)	(0.0791)
Duration of equity | Deriv=0	-0.0114	-0.0176^{**}
	(0.0109)	(0.00680)
Duration of equity | Deriv=1	-0.00554	-0.0340^{***}
	(0.0116)	(0.00914)
Tier-1 capital ratio	0.00352	0.00114
	(0.00263)	(0.00236)
Leverage	-0.00178	-0.000995
	(0.00229)	(0.00218)
Loan losses	0.0773^{**}	0.0911^{***}
	(0.0343)	(0.0327)
Credit risk	0.0834^{***}	0.0592^{*}
	(0.0291)	(0.0311)
Cash ratio	-0.0109^{***}	-0.00903^{**}
	(0.00362)	(0.00389)
Loan to deposits ratio	-0.0155^{*}	-0.0135
	(0.00888)	(0.0122)
Size	-0.259^{*}	-0.304^{**}
	(0.141)	(0.141)
Market share	-0.00710	-0.00630
	(0.00898)	(0.0108)
Marginal costs	0.0945	0.0590
	(0.0833)	(0.0705)
Other income	-0.0315	-0.0203
	(0.0270)	(0.0267)
Bank fixed effects	Y	Y
Time effects	N	N
Number of observations	1046	1046
Number of banks	41	41
R^2 within	0.2234	0.2278

F-test p-value	0.0000	0.0000

Note: Standard errors shown in parentheses. Variables are defined in Table 1. Data covers the period 2008Q1-2016Q2. Within panel estimates using standard OLS and bank fixed effects. ∗∗∗ Indicates significance at 1% level, ∗∗ at 5% level and ∗ at 10% level. Deriv is a dummy variable for which the value 0 indicates the bank does not use derivatives and the value 1 that it does. In order to facilitate comparisons, the table presents the coefficients on the interaction terms for the case when the dummy equals zero, i.e. the bank does not use derivatives and the for when it equals one, when the bank does use derivatives.

FIGURES

Figure 1: Net interest margin including income from maturity transformation

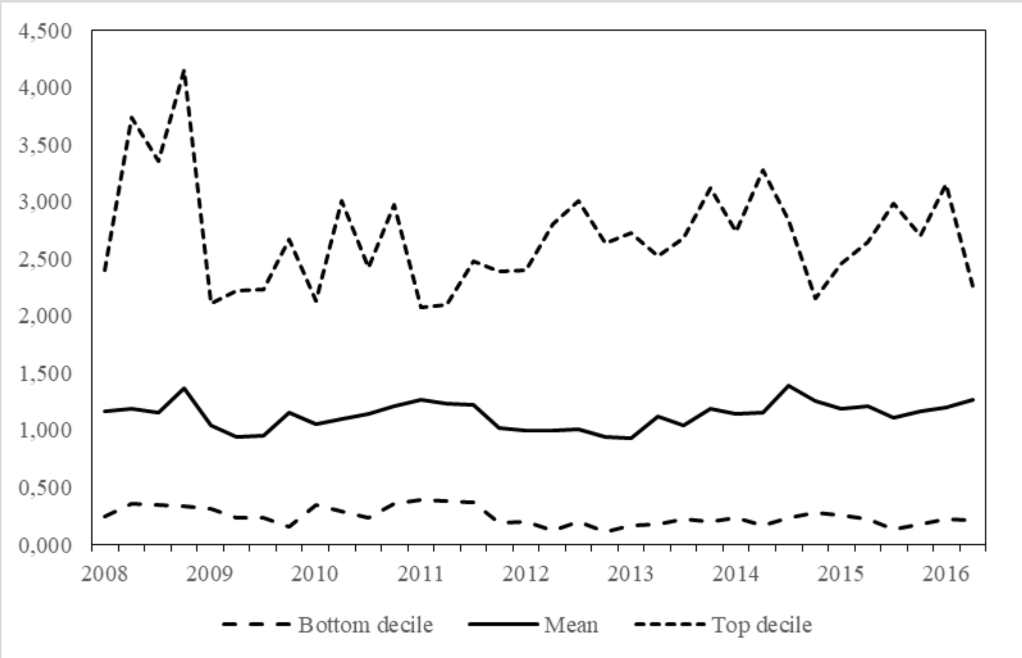


Figure 2: Net interest margin excluding income from maturity transformation

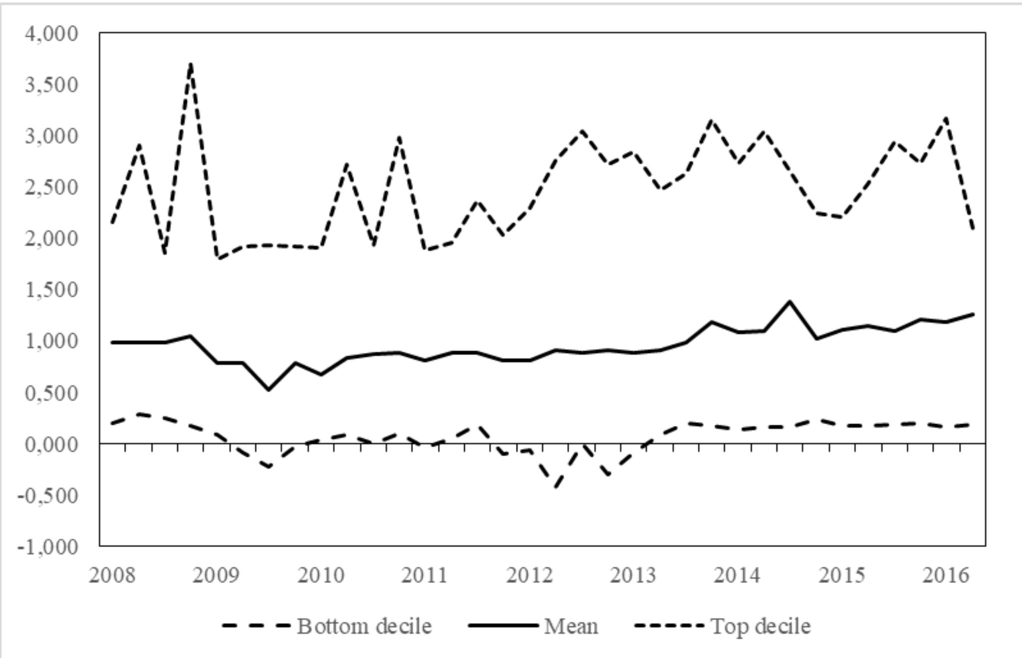


Figure 3: One year interest rate and difference with 10 year rate

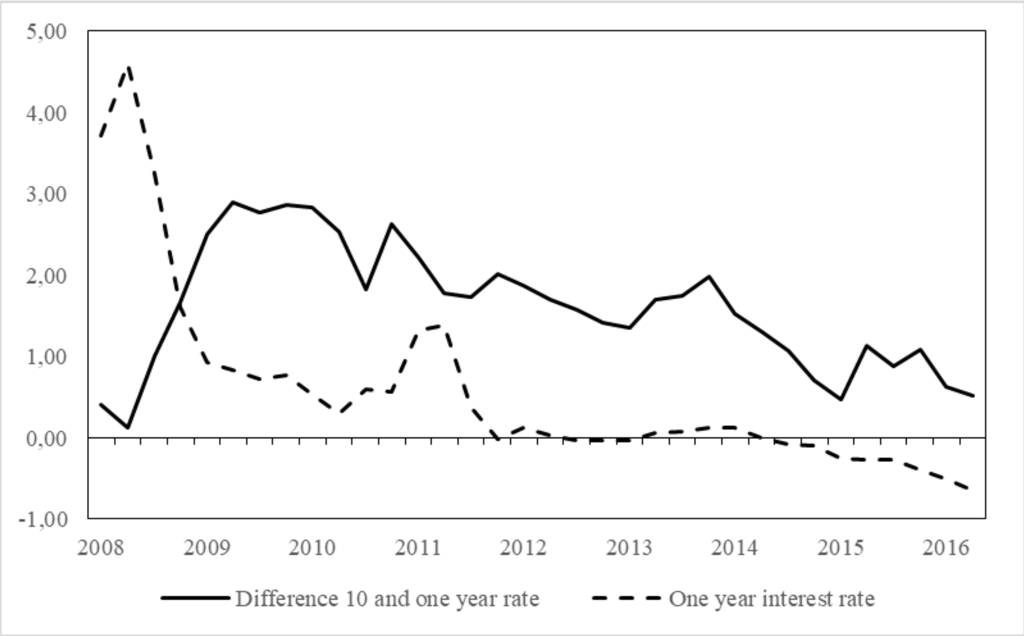


Figure 4: Lerner index

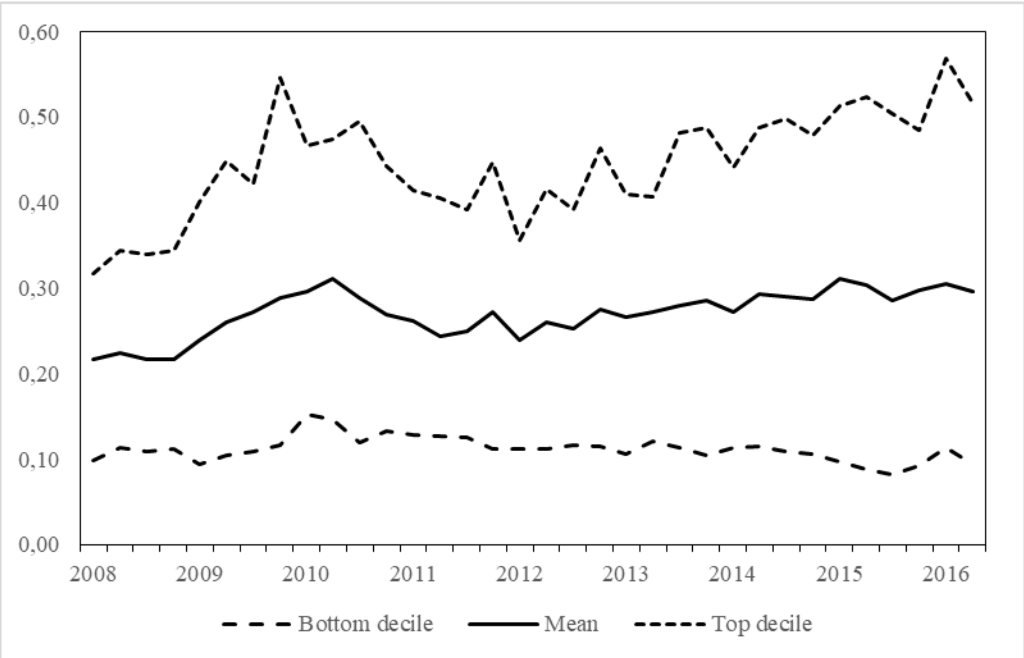


Figure 5: Marginal operational costs

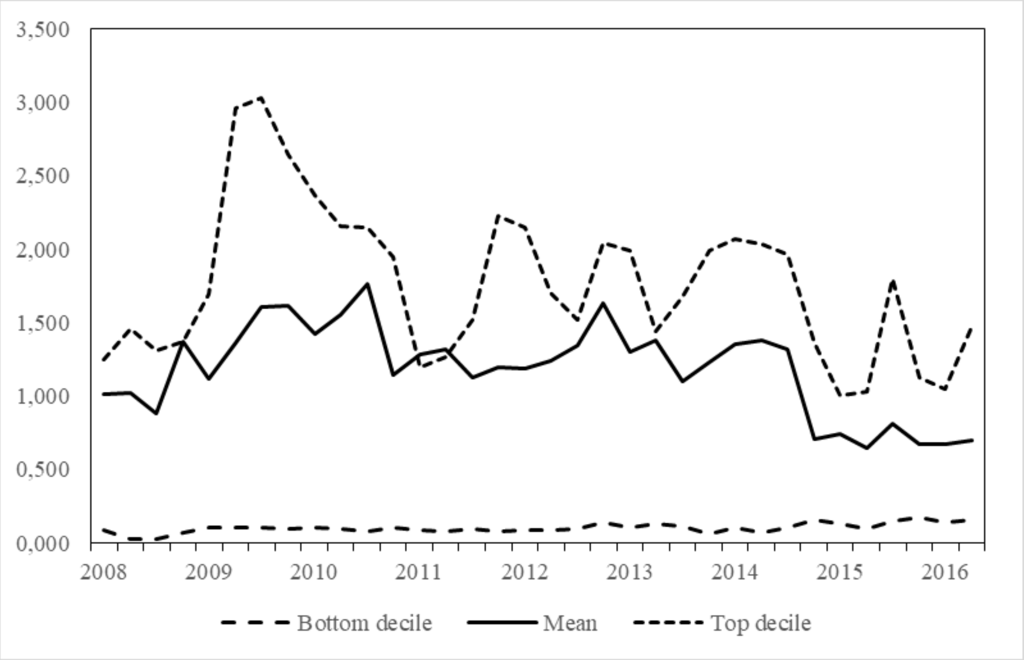
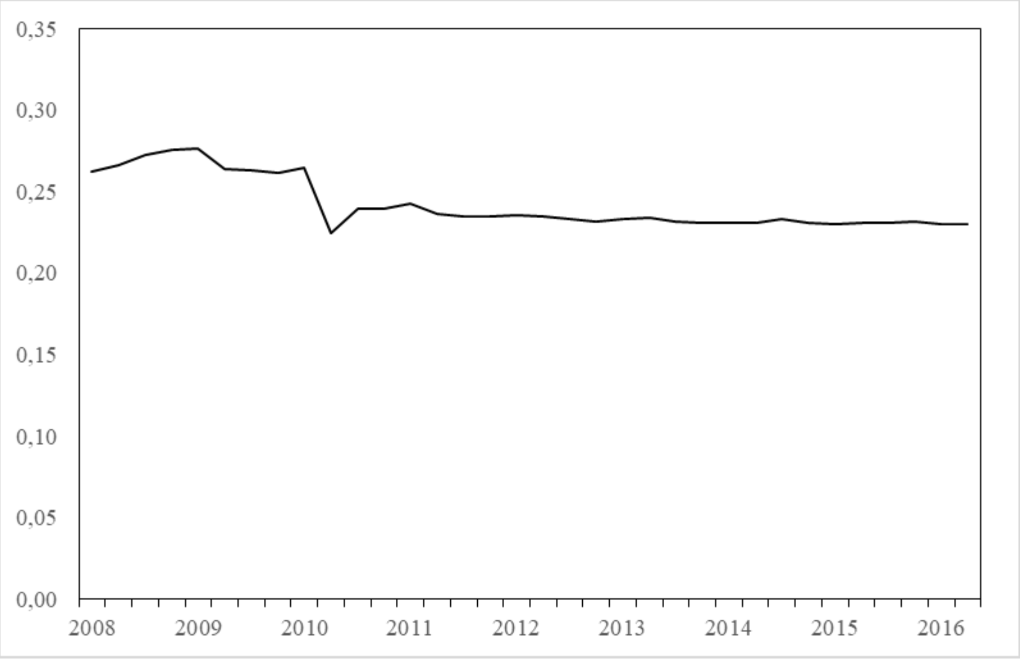


Figure 6: Herfindahl-Hirschman indicator



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