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JEL Classification: C53, E43, E52, G21

Keywords: monetary policy, bank business models, financial crisis

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Bank intermediation activity in a low interest rate environment

Michael Brei, Claudio Borio and Leonardo Gambacorta[1]

Abstract

This paper investigates how the prolonged period of low interest rates affects bank intermediation activity. We use data for 113 large international banks headquartered in 14 major advanced economies during the period 1994–2015. We find that low interest rates induce banks to shift their activities from interest-generating to fee-related and trading activities. This rebalancing is stronger for low capitalised banks. Banks also moderately adjust their funding structure, away from short-term market funding towards deposits. We observe a concomitant decline in the risk-weighted asset ratio and a reduction in loan-loss provisions, which is consistent with signs of evergreening.

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[1] Claudio Borio and Leonardo Gambacorta are with the Bank for International Settlements. Michael Brei is with the University of Lille. The authors wish to thank two anonymous referees, Claudia Buch, Stijn Claessens and Ulf Lewrick for useful comments and suggestions. The opinions expressed in this paper are those of the authors and do not necessarily reflect those of the Bank for International Settlements.

Introduction

Central banks in advanced economies have kept policy rates at, or close to, the effective lower bound ever since the Great Financial Crisis (GFC). The accommodative stance began to reverse only with the Federal Reserve's decision to increase policy rates at the end of 2015. The post-crisis period has also been marked by unconventional monetary policies aimed at restoring confidence in banks and financial markets (Gambacorta et al 2014). In addition, banks have faced tighter regulation, notably with the introduction of the Basel III leverage ratio, capital surcharges on systemically important banks, and anti-money laundering recommendations, to name just a few.

A major concern is that prolonged low interest rates will erode banks' income, by sapping their traditional lending activity. This will also hurt their franchise value. Compressed bank margins and profitability can in turn harm banks' ability to lend by constraining capital accumulation. A second concern is that banks may rebalance their portfolios towards fee-related and trading activities. In the short term, this may offset shrinking profits, but once policy rates reverse, the greater exposure to financial markets could weaken banks' soundness.

By actively managing their business lines, banks are expected to react to the low interest rate environment. The actual response depends on whether or not the environment is perceived to be long-lasting. On the income side, banks see their profit margins shrinking, particularly in the retail segment which generates interest revenue (Borio et al (2017), Claessens et al (2016)). The impact depends on the price elasticity of loan demand and deposit supply. In markets where the elasticities of these two functions are low and loan demand is anaemic,[2] banks will counteract the compressed interest margin by keeping loan rates high and, if there is scope to do so, by reducing deposit rates. In markets where intense competition is also felt from non-bank financial institutions, banks will be more constrained.

Low interest rates tend to boost stock and bond markets (Bernanke and Kuttner (2005)). Searching for yield, banks are expected to rebalance their asset portfolio from the loan to the trading book, which should generate higher yields and fee-based income (Rajan (2005)). Likewise, at low rates, there is greater demand from retail depositors for professional portfolio management services (Albertazzi and Gambacorta (2009)). Bank managers may thus be inclined to shift their business lines towards capital market activities and raise their corresponding exposures.

Banks will also have incentives to rebalance the composition of funding. For a given risk profile, funding costs decline when interest rates are low. This includes the cost of bond issues, if term premia are compressed, and that of retail deposits. Banks may have incentives to rely more on deposits and fixed-rate long-term debt at the expense of short-term variable-rate funding.

Against that backdrop, this paper investigates bank responses to the low interest rate environment, using data on 113 large international banks headquartered in 14 major advanced economies for the period 1994–2015. Our findings indicate that low interest rates encourage banks to rebalance their activities from interest-generating

[2] Such low rates will tend to prevail following banking crises and balance sheet recessions, in which debt overhangs depress the demand for additional borrowing and make it less responsive to declines in interest rates (eg Bech et al (2014), Borio (2014)).

to fee-generating and trading business lines. The impact is economically significant. According to our estimates, the long-term elasticity of fees and commissions with respect to the policy rate is 0.93, which means that for each 1% decline in the policy rate, income from fees and commissions increases by 0.93%. And the longer that low interest rates persist, the more this rebalancing effect is reinforced. On the funding side, banks rely relatively more on deposits and less on short-term funding.

The remainder of the paper is organised as follows. The first section describes the potential transmission mechanisms of low interest rates on bank activities and funding structure. The second describes the data, methodology and results.

1. Low interest rates and banks' intermediation activity

There is widespread agreement that, by responding vigorously to the crisis, central banks were successful in preventing a financial and economic meltdown. However, questions have been raised concerning the net benefits of the prolonged monetary accommodation that followed, notably through its longer-term impact on financial activity and the financial system (eg Dale (2012), Plosser (2012), Praet (2012), Rajan (2013), Bank for International Settlements (2012)). Banks are affected through a number of channels.

Impact on business models and bank risk

Low interest rates affect bank intermediation margins (Borio et al (2017), Claessens et al (2016)). The transmission depends on the sensitivity and adjustment speed of loan and deposit rates to market rates (*re-pricing lag effect*).[3] For a given deposit rate, banks would tend to pass on lower interest rates to lending rates, particularly to customers with other financing options. All else equal, this compresses interest margins.[4] Finally, since deposit rates are priced as a markdown on market rates, reductions in this markdown will squeeze the bank interest margin (*retail deposit endowment effect*).

Lower interest rates also affect any profits generated in the non-retail segment (Borio et al (2017)). Bank profits on security portfolios are expected to increase in low interest environments through higher stock and bond valuations (Bernanke and Kuttner (2005)); this, of course, is just a one-off effect unless banks increase their exposure and trading activities. Bank fees and commissions, linked to lending and deposit activities (eg credit lines, transaction services) or investment banking-type activities (eg securities brokerage, trading, market making), may increase in low

[3] Among the market factors that affect the responsiveness of bank deposit rates are the direction of the change in market rates (Hannan and Berger (1991), Gambacorta and Iannotti (2007)), whether the bank interest rate is above or below a target rate (Hutchison (1995); Neumark and Sharpe (1992)), and the degree of market concentration in the deposit market (Hannan and Berger (1991)). For a review of the main institutional factors that influence the response of bank lending rates to policy rate changes, see, among others, Borio and Fritz (1995).

[4] Empirical studies tend to support the negative impact of persistently very low interest rates on banks' net interest margins (Claessens et al (2016), Borio et al (2017) and CGFS (2018)). In environments where the demand for loans is elastic, interest margins might even increase because the positive quantity effect of lower rates on lending will dominate the negative price effect on loan rates. But this is unlikely to happen in low interest rate environments following banking crises and balance sheet recessions, to the extent that debt overhang depresses the demand for additional borrowing and makes it less responsive to declines in interest rates (eg Bech et al (2014), Borio (2014)).

interest environments if there is more demand for such services. For a given level of risk, banks would have incentives to shift activities away from the loan segment to other businesses (eg securities underwriting, trading, or insurance). Banks may also reduce their lending activity and expand to other higher-yielding activities so as to meet the minimum profit constraints of shareholders if they privilege market share over profits (Baumol (1959)).

For given macroeconomic conditions, lower interest rates should go hand in hand with lower loan losses. True, low rates may induce more risk-taking on new loans through the risk-taking channel (Borio and Zhu (2012)). But lower interest rates reduce the default probability of variable-rate loans, by decreasing debt servicing burdens. Since the stock of variable-rate loans is bound to be considerably larger than the flow of new loans, and the results of risk-taking are likely to take a long time to emerge, the overall impact of low interest rates on loan losses should be positive. Moreover, loan losses can also be lower because banks "evergreen" or "extend and pretend" (Barseghyan (2010)).[5]

Impact on funding structure

Banks may also adjust their funding structure in low interest rate environments. Funding spreads should decline and so will deposit rates. Banks may then have incentives to rely more on deposits and fixed-rate long-term debt (bonds and CDs), than on short-term funds at variable rates. Supporting that preference, deposits can become more attractive at very low market rates, when the spread between market and deposit rates vanishes. Shrinking profitability associated with low interest rates will also make it more difficult for banks to accumulate capital through retained earnings (Gambacorta and Shin (2018)). All else equal, banks would thus rely more on external sources of funds unless they are constrained by prudential regulation.

Low interest rates can also have an impact on off-balance sheet activities. When funding costs are low and liquidity is abundant, banks have less incentive to seek liquidity and funding through securitisation (Pescatori and Sole (2016)). In addition, to the extent that interest rate uncertainty and volatility are lower, there may be less demand for insurance and scope for making profits by taking positions. And to the extent that low rates are associated with abundant central bank liquidity, the demand for loan commitments, credit lines and other forms of liquidity insurance may also be lower.

2. Empirical analysis

Data

This study uses annual bank-level data from Fitch Connect. We consider consolidated financial statements, in line with the view that an internationally active bank takes strategic decisions on its worldwide consolidated assets and liabilities. All major international banks are included. The sample covers 22 years from 1994 to 2015, a period spanning different business cycles, a wave of consolidation, and the GFC.

[5] There is considerable evidence for this mechanism, some of it going back to Japan's post-bubble experience during the 1990s (eg Caballero et al (2008)) and some relating to the post-crisis experience in Europe (eg Albertazzi and Marchetti (2010), Enria (2013), Bank of England (2010)).

We adjust the sample in a number of ways. First, we control for 184 mergers and acquisitions by constructing pro-forma entities at the bank holding company level. This procedure helps us remove discontinuities in the series but also limits the number of banks in the sample. To ensure consistently broad coverage, we select banks by country in descending order of size so as to cover at least 80% of the domestic banking systems in the G10 countries (Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the United Kingdom and the United States) plus Austria, Australia and Spain. The merger-adjusted sample comprises 113 pro forma banks, including the acquisitions in each bank's merger history based on 297 banks in total. The sample covers assets worth a total USD 53 trillion at end-2015. For each country, Table 1 shows the number of banks headquartered there, along with their combined asset size.

Second, we take into account the international nature of the banks in our sample. Many of them operate internationally through a network of branches and subsidiaries (Goodhart and Schoenmaker (2009); McCauley et al (2012)) and operate in different markets. The columns on the "location of the ultimate borrower"[6] in Table 1 show, unsurprisingly, that banks headquartered in different countries also differ in the level of international activity and exposure. While the activities of Italian, Japanese and US banks are focused mainly on their home market, with close to 20% of claims on borrowers abroad, Swedish and British banks invest heavily abroad. It is thus important to adjust the macroeconomic indicators for the location of bank assets. Doing so requires the calculation of a weighted average of the country-specific indicators in which banks operate.[7]

We approximate funding costs by forming our best estimate of the funding composition by currency, weighing the corresponding amount by the monetary policy indicators – ie the policy rate, the long-term rate and therefore also the yield curve slope.[8] The weighting scheme can make a large difference. For example, while US banks are funded mainly in US dollars, over half of Swiss bank liabilities are in that currency – less than one quarter is in Swiss francs.[9] As a result of this weighting scheme, each bank in our sample faces different monetary conditions, as captured by the weighted policy rate and slope of the yield curve. And this translates into different monetary conditions for the individual countries' banking sectors as a whole. The average of the weighted level of the short-term rates in the individual jurisdictions ranges from 0.64 (Japan) to 4.84% (Australia), while the average yield curve slope varies from 0.52 (Australia) to 2.08% (Spain).

[6] The concept of "ultimate borrower" is based on the country where the ultimate risk or obligor resides, after taking into account risk transfers.

[7] Ideally, we could control for these factors based on bank-level information. Unfortunately, such detailed information is not included in the database. As a result, we approximate it with information from the BIS international banking statistics, which have similar data but at the aggregate level of internationally active banks from the sample countries, based on the location of banks' ultimate borrower. The broad coverage of the statistics and the concentration of international operations in a few large banks tend to mitigate measurement errors.

[8] Of course, the long-term rate captures factors that go beyond monetary policy.

[9] It is important to note that we cannot take into account funding via FX swaps, which can create debt-like obligations (Borio, McCauley and McGuire (2017)). This also means that we cannot capture the funding costs that result from hedging strategies and the failure of covered interest rate parity (Sushko et al (2016)).

Graph 2 shows the average weighted short- and long-term interest rates and the corresponding yield spread across all banks. The chart reveals that short- and long-term interest rates have been trending down over the sample period, reaching negative levels in the euro area, Sweden and Switzerland in 2015, the last observation in our sample period. The yield spread (yield curve slope) fluctuated between 0 and 2% until 2009, when it rose above 2% before falling back in 2012. The persistently low rates have reflected unusually accommodative monetary conditions for a substantial part of the sample.

A common bank strategy for coping with the low interest environment and the erosion of interest margins is to focus more on trading and fee-based businesses. Consistent with this, Graph 3 indicates that low market interest rates go hand-in-hand with lower profitability (measured by the return on assets) and a shift from interest-earning revenues to other income sources, such as investment banking, trading and brokerage. This pattern may reflect the negative effect of low interest rates on the returns from maturity transformation (Borio et al (2017)). In combination with the positive impact of low interest rates on securities' valuations, banks have offset the compression in the net interest margin through increased trading and fee-based revenues.

Graph 4 shows that the evolution of various indicators on the asset, funding and off-balance sheet structure of banks appears to be broadly consistent with our priors. Banks have responded by paring down their loan portfolios. The somewhat sluggish response is presumably due to the stock of loans outstanding, the effect of quantitative easing policies on loan demand, and the lending incentive programmes implemented in various countries in the wake of the GFC. Banks have also relied more on deposit funding. Finally, off-balance sheet activities have also contracted.

Econometric framework

Indexing individual banks with *k*, countries where banks are headquartered with *j* and years with *t*, we carry out the econometric analysis using the following benchmark model:

$$Y_{k,j,t} = \delta Y_{k,j,t-1} + \alpha_0 r_{j,t} + \alpha_1 r_{j,t}^2 + \Phi' C_{k,j,t} + \Psi' X_{k,j,t-1} + \vartheta_k + \varepsilon_{k,j,t} \quad (1)$$

where Y are various income and balance sheet indicators. Our approach to investigating the transmission of low interest rates to banks' business activity and performance is to use information on the composition of bank profits, both on- and off-balance sheet. Overall, we use 12 indicators in separate regressions on: (i) income diversification, (ii) fees and commissions, (iii) net interest income, (iv) trading profit, (v) lending, (vi) liquid asset holdings, (vii) asset diversification, (viii) deposit funding, (ix) short-term funding, (x) off-balance sheet activity, (xi) density function (risk-weighted assets over total assets), and (xii) loan loss provisions.[10]

We decided to focus on this set of bank variables because they allow us to examine changes in both the investment and funding strategies of banks, along with their relative profitability. For instance, modifications in banks' lending and deposit-taking activity are reflected on the balance sheet, with the interest margin being recorded in the income statement. Other activities are harder to measure, because they cannot be matched with the corresponding balance sheet positions or with the

[10] Table 2 includes the precise definition of the variables.

resources employed. This is particularly relevant for the resources invested in fee-for-service activities, as they involve in many cases contingent off-balance sheet positions or intangible assets, such as human capital, or non-financial assets, such as information technology (Stiroh (2006)). Finally, to broaden our analysis to explore the possibility of the risk-taking channel operating, we include the density function and loan loss provisions as a potentially forward-looking risk indicator.

The monetary policy indicator is the three-month interbank rate (r). It enters the regression in levels and in quadratic form. The coefficients α_0 and α_1 measure the sensitivity of the various bank variables to the monetary policy stance, after controlling for the macroeconomic, regulatory and bank-specific environment. The quadratic term allows us to test for non-linear relationships. For example, if the coefficients are significant and if $\alpha_0 < 0$ and $\alpha_1 > 0$, then there is evidence of a u-shaped, convex relationship between the interest rate and the financial indicator, whereas if α_1 is not significant, the relationship is linear.

We use several control variables. The macroeconomic indicators in vector C include the growth rates of real GDP, consumer price index, residential property prices, and central bank assets. In addition, we include the level of the slope of the yield curve, measured by the difference between the 10-year government bond yield and the short-term interest rate r. Central bank assets and the yield curve slope allow us to control for the effects of unconventional monetary policies adopted during the GFC. We also include a dummy variable to identify financial crises based on Borio and Drehmann (2009), Laeven and Valencia (2012) and Reinhart and Rogoff (2009). Following Bech et al (2014), the dummy takes the value of one in the crisis year and in all the subsequent years when real GDP contracts.

In order to take into account bank characteristics, we include a set of bank-fixed effects (ϑ_k) and a vector of time-varying bank-specific indicators (X). Our strategy relies on the hypothesis that certain bank-specific characteristics (eg the cost-to-income ratio or capitalisation) only influence banks' pricing and activity decisions, not shifts in the demand schedule. Broadly speaking, this approach assumes that banks differ in their ability to shield themselves from shocks. For instance, it assumes that they differ in the extent to which, following monetary policy changes, they can switch their activities from lending to trading. In particular, less efficient and less capitalised banks, which are penalised by markets (ie are more subject to a variety of "informational frictions"), face a higher cost in raising non-secured deposits and may therefore react to monetary policy changes more strongly. Similarly, banks that face capital constraints have less room to adjust their balance sheet in response to changes in market rates.

Taking into account the above considerations, our vector X contains (i) the cost-to-income ratio, (ii) the unweighted leverage ratio (equity-to-total assets ratio (Kishan and Opiela (2000); Adrian and Shin (2010)); (iii) a dummy for banks with regulatory liquidity constraints (ie those with a net stable funding ratio (NSFR) of less than 95% in the period 2011–15); and (iv) a dummy for banks that were recapitalised by the authorities during the crisis (Brei et al (2013)).[11] The NSFR ratio has been

[11] We also include a dummy variable $IFRS_{k,j,t}$ that takes the value of one once a bank has adopted International Financial Reporting Standards (IFRS) and zero otherwise. It controls for changes in the measurement of certain balance sheet items and other differences in accounting due to the introduction of the new IFRS standards, notably the rules concerning the offsetting of derivatives on the asset and liability side.

reconstructed historically using the methodology described in Dietrich et al (2014). Because the NSFR ratio was included in the Basel III agreement in December 2010, we identified banks with regulatory liquidity constraints only over the period 2011–15. As for cost-efficient and well capitalised banks, and those with a more stable maturity composition, we expect that they should be in a better position to shield themselves from unexpected shocks and changes in the regulatory environment.

One possible identification problem is endogeneity. Bank decisions could have an impact on the financial indicators listed above as well as on monetary policy decisions. We address this potential problem in two ways. First, we lag all bank-specific characteristics by one period. Second, we use the dynamic System Generalised Method of Moments (S-GMM) panel methodology, which should yield consistent and unbiased estimates in our dynamic panel setting with a short time series and a large cross section. This methodology reduces endogeneity bias and takes into account the data heterogeneity caused by unobservable factors affecting individual banks. We use the instruments suggested in Blundell and Bond (1998): exogenous variables, in first differences, are instrumented by themselves; endogenous variables (also in first differences), by their lags in levels.[12]

In addition, other considerations suggest that the endogeneity problem may not be as serious owing to the characteristics of our sample. While aggregate banking conditions could influence monetary policy, the response of any given bank is less likely to affect central bank decisions. In addition, the fact that banks operate in several jurisdictions, and need not be that large in several of them, reduces this risk further. For example, we can presume that the conditions of the Swiss banking industry are important for macroeconomic conditions in Switzerland but that they do not influence the US economy in the same way.

The baseline model is augmented to take into account the existence of regulatory constraints on specific banks. Banks might have incentives to increase capital buffers when they are close to the regulatory minimum to avoid costly recapitalisations in times of distress, while unconstrained banks tend to maintain their levels of capital and focus on profitability (Heid et al (2004); Gropp and Heider (2010)). The responses of banks to the short-term interest rate might thus be asymmetrical and depend on whether a bank is capital constrained.

Thus, we further enrich the model by including interactions between the short-term interest rate and a dummy variable for banks that are capital-constrained. Specifically, we estimate the following model:

$$Y_{k,j,t} = \delta Y_{k,j,t-1} + (\alpha_0 + \alpha_0^* \cdot LowCap_{k,j,t}) r_{j,t} + (\alpha_1 + \alpha_1^* \cdot LowCap_{k,j,t}) r_{j,t}^2 \qquad (2)$$
$$+ \Phi' C_{k,j,t} + \Psi' X_{k,j,t-1} + \vartheta_k + \varepsilon_{k,j,t}$$

where $LowCap$ takes the value of one if a bank's regulatory capital buffer, the difference between the regulatory capital ratio and the regulatory minimum, is in the

[12] This approach is commonly applied to deal with possible endogeneity biases. For instance, Blundell and Bond (1998) use it to estimate a labour demand model while Beck et al (2000) apply it to investigate the relationship between financial development and economic growth. For an application to the analysis of the bank lending channel, see Altunbas et al (2009).

lowest decile of the distribution.[13] The coefficients α_0^* and α_1^* indicate whether the responses of low capitalised banks differ from the rest.

In parallel, we investigate a separate model to better understand the transmission of persistently low interest rates. In our sample, Japanese banks operated up to 15 years in a low interest rate environment (with a three-month interbank rate below 1.25%), while in most other countries the environment prevailed for seven years starting in 2009. It is not clear how banks will respond to low interest rates as they persist. Valuation gains should vanish while higher profitability in the trading book may not continue indefinitely. The same might be true of the interest income generated in the loan book if risk-taking boosts losses in the future.

To assess the possible non-linear effects of persistently low interest rates, we include interaction terms between the short-term interest rate and a variable that counts the years during which the interest rate was below 1.25 in a given country. We thus estimate the following model:

$$Y_{k,j,t} = \delta Y_{k,j,t-1} + (\alpha_0 + \alpha_0^* \cdot LowYears_{j,t}) r_{j,t} + (\alpha_1 + \alpha_1^* \cdot LowYears_{j,t}) r_{j,t}^2 \quad (3)$$
$$+ \Phi' C_{k,j,t} + \Psi' X_{k,j,t-1} + \vartheta_k + \varepsilon_{k,j,t}$$

where $LowYears$ is our measure for the duration of the low interest rate environment. For example, if the coefficients α_0^* and α_1^* are significant, then the change in the bank indicators in response to interest rates depends on the number of low interest rate years, i.e. $\frac{\partial Y}{\partial r} = \alpha_0 + 2\alpha_1 r + (\alpha_0^* + 2\alpha_1^* r) \cdot LowYears$.

Results

We next consider the main findings regarding the impact of short-term interest rates on our business model indicators. Table 3 provides summary statistics of the regression variables and Tables 4, 5 and 6 present the regression results for the baseline and augmented models, respectively.[14] More generally, Graph 5 gives a graphical interpretation of the estimated relationship between the short-term interest rate and banks' income and balance sheet indicators, evaluated at the mean values of the other regression variables. Graphs 6 and 7 provide similar graphical representations for the augmented models.

Impact on the composition of bank income

In a low interest rate environment, banks' non-interest income tends to increase after controlling for the other potential determinants in the regressions (column I, Table 4). For example, when the interest rate falls from 3% to 0%, the diversification ratio (non-interest income divided by total income) increases from 21.9% to 23.6% of income in the short term (evaluated at the regression average, see panel (I) Graph 5). This pattern is accounted for by increases in fee and commission income (column II, panel

[13] We consider a bank as capital-constrained when the distance of a bank's capital ratio from the regulatory minimum is lower than the 10th percentile of the distribution of distances, taking into account regulatory differences across countries. While all countries have minimum requirements for risk-weighted capital ratios (for Basel I and II: Tier 1/RWA > 4%, total capital/RWA >8%), additional limits were imposed on banks' leverage ratios in Canada and the United States (Barth et al (2013)). Constrained banks have, on average, a Basel III leverage ratio of 3.4% and a Tier 1/RWA of 7.2%, while for unconstrained banks the ratios are, respectively, 4.6% and 10.7%.

[14] The complete specification for Table 4 is reported in the Annex.

II) and trading revenues (column IV, panel IV). If the interest rate decreases from 3 to 0%, fee income increases in the short term from 14.2% to 15.2% of total income whereas trading profits increase from 2.5% to 3.2% of income. The long-term effects, which take into account the dynamic nature of the regressions are larger. This is especially the case for fees and commissions, which are highly persistent. For example, while the implied short-term elasticity of fees and commissions with respect to the interest rate is 0.05, the corresponding long-term one is 0.93.[15]

The results suggest that banks respond to the low interest rate environment by shifting resources to fee-based activities and the non-retail segment (Borio et al (2017)). The higher revenues generated by trading activities are presumably linked to profits stemming from investments into stock and bond markets, or market-making activities. Moreover, it appears that banks rely more on income generated by fees and commissions. Unfortunately, the database does not allow us to decompose this income in more detail. Even so, it is likely that banks offset lower interest margins through higher fees on both traditional and non-traditional types of service. There might also be a demand effect for financial services and advice on the part of bank depositors.

The increase in non-interest income offsets in part the negative effect of low interest rates on banks' net interest margin (measured by net interest income divided by total exposure), see column (III) and panel (III). The latter finding is in line with Borio et al (2017) and Claessens et al (2016). The repricing of variable rate loans and downward pressure on loan rates cannot be fully offset by lower deposit rates, as for many types of deposit, banks are reluctant to lower deposit rates, especially below zero (Claessens et al (2016)). Our estimates suggest that, if the interest rate falls from 3% to 0%, in the short term the net interest margin declines from 1.42% to 1.31% of total exposure. As with fee income, the long-term effect is many times larger owing to the high autocorrelation of the net interest margin. Evaluated at the average interest rate of 2.54, the implied short-run elasticity is 0.04 while the long-run one is 0.21. Apart from the linear effect on fees and commissions, the other effects of the interest rate are non-linear, becoming stronger at very low rates.

Impact on the composition of bank balance sheets

Liquid asset holdings increase in a low interest rate environment across all banks, which is presumably due to the absorption of central bank liquidity (column VI, panel VI), whereas the reduction in the traditional intermediation activity (measured by the loan ratio, ie loans divided by total exposure) is only statistically significant for capital-constrained banks (column V, Table 5, panels (I) and (II), Graph 6). The results hold when controlling for banks that are liquidity-constrained (NSFR below 95% during 2011–15). More specifically, a reduction in the interest rate from 3% to 0% coincides with an increase in the liquidity ratio from 9.1% to 10.6% of total exposure in the short run. The statistically insignificant effect of the interest rate on the loan ratio for banks with sufficient regulatory capital could be an indication that these banks were seeking to support their clients, extending new loans when old ones fall due. The opposite is true for capital-constrained banks, in that they cut lending when interest rates fall. It

[15] The implied short-term elasticity between a dependent variable Y and determinant X is calculated by $\varepsilon_X^Y = \frac{\partial Y/\bar{Y}}{\partial X/\bar{X}} = \beta \frac{\bar{X}}{\bar{Y}}$, whereas the long-term elasticity is $\varepsilon_X^Y/(1-\delta)$ with δ being the autoregressive coefficient of the regression and β the coefficient of variable X.

could be that banks seek to restore their regulatory capital ratios by shifting their exposure from loans with high risk weights to investments that carry a lower risk weight. It might also simply reflect deleveraging. Auxiliary regressions (not reported here) for a subset of observations showed that corporate loans are more sensitive to the interest rate environment than are mortgages and consumer loans.

Overall, we detect a higher diversification in the composition of assets (the Herfindahl-Hirschman index decreases).[16] The results seem to be driven by low capitalised banks (column VII, Tables 4 and 5). A more dispersed asset portfolio across our four asset categories (loans, interbank lending, securities and a residual category) is another indication of banks' portfolio reallocation. The result for capital-constrained banks is presumably linked to stronger portfolio rebalancing towards activities with lower risk weights, such as government bonds or highly rated corporate bonds.

On the funding side, banks tend to increase the share of deposits (column VIII) and reduce that of short-term and money market funding (column IX). The estimated impact, however, is only sizeable in the case of deposit funding. To be more precise, a reduction in the interest rate from 3% to 0% is associated with an increase in deposits from 48.9% to 51.5% of funding, whereas short-term and money market funding declines from 10.5% to 10.3%. Banks thus move towards more stable funding sources.

Off-balance sheet activity also declines (column X). Our results suggest that, if interest rates fall from 3% to 0%, off-balance sheet exposures fall from 19.2% to 14.6% of total exposure. Auxiliary regressions on the compositional effects suggested that this result is mainly driven by a reduction in guarantees (which represent 4% of total exposure) and not by credit commitments, the largest component of banks' off-balance sheet activities.

Impact on bank risks

Low interest rates also exert significant effects on banks' risk profile. In particular, we observe a drop in the risk density function (risk-weighted assets divided by total exposure), in line with the risk-taking channel hypothesis (column XI). Loan loss provisions also decline, possibly a sign of evergreening (column XII). If the interest rate drops from 3% to 0%, risk-weighted assets decline from 48.6% to 42.4% of total exposure, while loan-loss provisions drop from 0.7% to 0.4% of total loans. The result is stronger for capital-constrained banks, which have more incentives to restore prudential capital ratios by adjusting their portfolio towards assets with lower risk weights. For a given balance sheet size, this would result in lower risk estimates. Lower riskiness and loan loss provisions could also be an indication of a reallocation of the lending business to safer firms (flight to quality) or reflect lower estimated default probabilities linked to the lower interest burden on borrowers. It could, however, also reflect evergreening (or zombie lending; see Peek and Rosengren (2005)), in which less-capitalised banks may delay recognising losses on their credit portfolio by rolling over loans to high-risk borrowers to shore up reported capital and profitability.

[16] The HHI index has been calculated by $HHI_{k,j,t} = 1 - \sum_{n=1}^{4} \left(\frac{A^n_{k,j,t}}{TA_{k,j,t}}\right)^2$, where A^n is the amount invested in loans, interbank lending, securities and other assets, respectively, while TA denotes total assets.

Impact of the persistence of the low interest environment

For some bank indicators, the duration of the low interest environment adds to the direct effect of interest rates, whereas for others it either dampens the effect or results in one that is not statistically significant. There are two main results.

First, the effect on bank income generated in the non-interest segment is stronger. That is, prolonged low interest rates are associated with higher non-interest income (column (I), Table 7). This result is accounted for mainly by higher income from fees and commissions. For example, while the short-term implied elasticity is 0.12 at a duration of one year, it rises to 0.37 if low interest rates persist for seven years.

Second, after an initial deterioration, the interest margin appears to improve. There is also a concomitant increase in bank lending associated with higher estimated risks. This could point to the positive effects that low interest rates may have on borrowers and the economy in general, besides those associated with valuation gains on securities in the short term.

Conclusion

This paper analyses how banks adjust their business activities in a low interest rate environment. Our findings indicate that low interest rates induce banks to rebalance their activities from interest-generating to fee-generating and trading activities. In other words, banks seek to offset the reduced interest margin by expanding other income-generating activities. This rebalancing is stronger for capital constrained banks. On the funding side, banks rely more on deposits and less on short-term market funding. There is also some evidence of a decline in the risk-weighted asset ratio and a reduction in loan-loss provisions.

These results shed further light on previous work, pointing to a number of policy conclusions. They confirm previous work indicating that persistent low interest rates tend to reduce bank profits, mainly by depressing interest margins. They indicate that banks adjust their activities in an effort to offset that reduction, at least partially. They suggest that supervisors reinforce these shifts. And they reveal that funding tends to shift form short-term market funding towards deposits. At the same time, they suggest that supervisors should remain alert to the possibility of evergreening.

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Table 1: Characteristics of the database (1994–2015)

Country where bank is headquartered	Total assets, USD billion, end-2015	Short-term interest rate	Slope of the yield curve	CPI inflation	Non-interest income/ total income	Total loans/ total assets	Total equity/ total assets	Location of the ultimate borrower		No. of banks	No. of rescued banks	No. of M&A	No. of crisis years
								Domestic	Other				
Austria	510	2.05	1.44	1.85	20.77	47.28	6.26	52.3	47.7	6	4	4	5
Australia	2042	4.84	0.52	2.59	17.67	69.20	6.23	75.0	25.0	7	0	4	0
Belgium	543	2.17	1.69	1.91	5.54	44.28	3.33	57.5	42.5	5	3	5	5
Canada	3165	2.82	1.41	1.97	30.99	46.01	4.49	57.1	42.9	6	0	3	0
Switzerland	2012	1.79	1.29	1.17	30.79	48.04	5.28	53.5	46.5	5	1	4	5
Germany	4159	2.19	1.18	1.56	10.86	41.64	3.43	71.3	28.7	15	4	10	5
Spain	3579	2.18	2.08	2.14	18.35	59.16	5.92	54.6	45.4	14	10	37	5
France	7121	2.20	1.37	1.52	22.73	29.06	3.66	58.5	41.5	6	5	16	5
Italy	2538	2.54	1.88	1.96	24.09	53.81	7.87	77.9	22.1	14	7	36	5
Japan	6012	0.64	0.95	0.40	20.25	43.69	4.50	78.3	21.7	7	1	7	5
Netherlands	2234	2.10	1.34	1.85	12.82	64.46	3.98	54.3	45.7	5	3	1	5
Sweden	1553	3.00	1.11	1.23	20.85	48.12	4.39	47.9	52.1	4	1	5	7
UK	7404	3.27	0.88	2.01	23.86	53.06	4.79	45.4	54.6	6	2	15	6
USA	10007	2.45	1.42	2.09	40.31	42.85	9.25	78.4	21.6	13	11	37	6
Average/sum*	52879*	2.45	1.33	1.73	21.42	49.33	5.24	61.57	38.43	113*	52*	184*	64*

Note: Unweighted averages across banks per country. "Average/sum*" indicates unweighted averages or sums (*) over countries. Location of the ultimate borrower is estimated by merging Fitch Connect information with data from the BIS international banking statistics. No. of M&A indicates the number of mergers and acquisitions that have been taken into account in the construction of pro forma banks. No. of crisis years counts the number of years in which a financial crisis occurred and in all the subsequent years of falling real GDP, based on Borio and Drehmann (2009), Laeven and Valencia (2012) and Reinhart and Rogoff (2009).

Sources: Fitch Connect; BIS consolidated banking statistics by ultimate borrower.

Table 2: Variable definitions

Variable	*Definition*
	Dependent variables
Diversification ratio	Total non-interest (NI) operating income/(interest income+ NI operating income)
Fee ratio	Net fees and commissions/(interest income+ NI operating income)
NII ratio	Net interest income/total exposure
Trading profit ratio	Net gains on trading and derivatives/(interest income + NI operating income)
Loan ratio	Total loans/total exposure
Liquid asset ratio	AVS securities + cash and due from banks/total exposure
HHI assets	Herfindahl-Hirschman index (loans, securities, interbank, and other)
Deposit-funding ratio	Total deposits/total funding
ST-MM funding ratio	Short-term and money market funding/total funding
OBS exposures	Off-balance sheet exposures/total exposure
RWA ratio	Risk-weighted assets/total exposure
Provisions ratio	Loan impairment charge/total loans
	Independent variables
Short-term rate	Three-month interbank rate, weighted
Constrained	Indicator if a bank is close to the regulatory minimum of capital
Real GDP growth	Real GDP growth, weighted
Inflation	CPI inflation, weighted
House price growth	House price growth, weighted
Central bank assets growth	Growth in central bank assets over GDP, weighted
Slope	Yield on 10-year government bonds – three-month interbank rate, weighted
Cost-debt ratio	Total interest expense/total funding
Leverage	Total equity/assets
Dummy, NSFR	Indicator if a bank's NSFR is below 95% during 2011–15
Dummy, recapitalisation	Indicator if a bank has been rescued by a government
Dummy, banking crisis	Indicator if country experienced a banking crisis
Dummy, IFRS	Indicator if a bank has changed accounting standards

Table 3: Summary statistics of the regression variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Dependent variables					
Diversification ratio	1733	22.40	14.64	-69.28	79.85
Fee ratio	1733	14.44	9.95	-3.73	56.72
NII ratio	1733	1.43	0.76	-0.19	6.38
Trading profit ratio	1238	2.74	4.90	-15.01	23.61
Loan ratio	1733	49.64	17.06	3.10	91.18
Liquid asset ratio	1733	9.69	8.49	0.01	54.87
HHI assets	1733	47.68	9.95	26.76	83.56
Deposit-funding ratio	1733	49.59	18.00	19.13	81.36
ST-MM funding ratio	1733	10.68	11.27	-42.41	52.73
OBS exposures	1733	18.71	27.11	0.00	355.19
RWA ratio	1518	46.60	17.12	9.49	95.96
Provisions ratio	1687	0.63	0.95	-1.55	15.61
Independent variables					
Short-term rate	1733	2.54	1.96	-0.46	9.61
Constrained	1733	0.12	0.33	0.00	1.00
Real GDP growth	1733	1.63	1.98	-5.32	5.46
Inflation	1733	1.83	1.03	-1.14	4.82
House price growth	1733	3.37	5.26	-13.51	17.80
Central bank assets growth	1733	9.41	32.11	-56.83	221.99
Slope	1733	1.38	1.10	-1.23	4.48
Cost-debt ratio	1733	3.03	1.86	0.11	16.51
Leverage	1733	5.66	2.81	-6.07	16.85
Dummy, NSFR	1733	0.16	0.37	0.00	1.00
Dummy, recapitalisation	1733	0.43	0.50	0.00	1.00
Dummy, banking crisis	1733	0.27	0.46	0.00	1.00
Dummy, IFRS	1733	0.47	0.50	0.00	1.00

Notes: The variable definitions are provided in Table 2.

Table 4: Results for the baseline model

	Dependent variables:					
	(I)	(II)	(III)	(IV)	(V)	(VI)
	Diversification ratio	Fee ratio	NII ratio	Trading profit ratio	Loan ratio	Liquid asset ratio
Lagged dependent variable	0.580***	0.945***	0.826***	0.221***	0.876***	0.721***
	(0.079)	(0.035)	(0.027)	(0.051)	(0.050)	(0.074)
Short-term rate	**–1.168****	**–0.292***	**0.051*****	**–0.542****	–0.142	**–0.705****
	(0.542)	**(0.155)**	**(0.016)**	**(0.232)**	(0.276)	**(0.325)**
Short-term rate^2	**0.193*****	–0.006	**–0.006****	**0.099*****	0.014	**0.065****
	(0.047)	(0.016)	**(0.002)**	**(0.031)**	(0.029)	**(0.031)**
Bank-specific controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of banks and observations	113/1,733	113/1,733	113/1,733	108/1,238	113/1,733	113/1,733
Serial correlation test (1)	0.826	0.001	0.327	0.143	0.661	0.184
Hansen test (2)	0.173	0.209	0.200	0.284	0.116	0.314
	Dependent variables, continued:					
	(VII)	(VIII)	(IX)	(X)	(XI)	(XII)
	HHI assets	Deposit-funding ratio	ST-MM funding ratio	OBS exposures	RWA ratio	Provisions ratio
Lagged dependent variable	0.899***	0.937***	0.774***	0.680***	0.647***	0.211***
	(0.039)	(0.041)	(0.046)	(0.042)	(0.102)	(0.077)
Short-term rate	**0.242***	**-1.160*****	-0.203	0.936	**2.752*****	**0.143*****
	(0.126)	**(0.329)**	(0.380)	(0.840)	**(0.857)**	**(0.039)**
Short-term rate^2	**-0.030****	**0.092***	**0.087***	**0.193***	**-0.236*****	**-0.009****
	(0.013)	**(0.048)**	**(0.051)**	**(0.106)**	**(0.073)**	**(0.004)**
Bank-specific controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of banks and observations	113/1,733	113/1,733	113/1,733	113/1,733	111/1,446	113/1,687
Serial correlation test (1)	0.823	0.118	0.527	0.759	0.174	0.236
Hansen test (2)	0.530	0.485	0.386	0.130	0.596	0.185

Note: The sample goes from 1994 to 2015. All estimations are based on the Arellano and Bover (1995) System GMM estimator. Robust standard errors are reported in brackets. (***, **, *) indicate significance at the 1%, 5%, 10% level. Significant coefficients are in bold. (1) Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second-order serial correlation. (2) Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals.

Table 5: Results for the augmented model

	Dependent variables:					
	(I)	(II)	(III)	(IV)	(V)	(VI)
	Diversification ratio	Fee ratio	NII ratio	Trading profit ratio	Loan ratio	Liquid asset ratio
Lagged dependent variable	0.584***	0.946***	0.860***	0.210***	0.874***	0.734***
	(0.064)	(0.033)	(0.025)	(0.050)	(0.050)	(0.072)
Short-term rate	**–1.200****	**–0.288***	**0.048*****	–0.314	–0.244	**–0.680****
	(0.527)	**(0.173)**	**(0.015)**	(0.242)	(0.276)	**(0.294)**
Short-term rate^2	**0.201*****	–0.007	**–0.006****	**0.063***	0.032	**0.059****
	(0.055)	(0.017)	**(0.002)**	**(0.034)**	(0.030)	**(0.027)**
Short-term rate*Constrained	**–0.975****	–0.230	–0.006	**–0.884*****	**0.916***	–0.449
	(0.441)	(0.245)	(0.024)	**(0.322)**	**(0.513)**	(0.481)
Short-term rate^2*Constrained	**0.183***	0.057	0.001	0.109	**–0.186***	0.128
	(0.096)	(0.056)	(0.006)	(0.073)	**(0.107)**	(0.098)
Bank-specific controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of banks and observations	113/1,733	113/1,733	113/1,733	108/1,238	113/1,733	113/1,733
Serial correlation test (1)	0.822	0.001	0.333	0.092	0.714	0.180
Hansen test (2)	0.907	0.201	0.687	0.326	0.150	0.379
	Dependent variables (continued):					
	(VII)	(VIII)	(IX)	(X)	(XI)	(XII)
	HHI assets	Deposit-funding ratio	ST-MM funding ratio	OBS exposures	RWA ratio	Provisions ratio
Lagged dependent variable	0.879***	0.939***	0.784***	0.698***	0.640***	0.206***
	(0.038)	(0.037)	(0.032)	(0.045)	(0.095)	(0.079)
Short-term rate	0.204	**–1.075*****	–0.302	–0.365	**2.440*****	**0.124*****
	(0.166)	**(0.338)**	(0.443)	(0.710)	**(0.699)**	**(0.034)**
Short-term rate^2	–0.021	**0.088***	**0.132****	**0.234***	**–0.180*****	–0.006
	(0.024)	**(0.050)**	**(0.067)**	**(0.130)**	**(0.058)**	(0.004)
Short-term rate*Constrained	**0.629****	–0.579	0.309	0.882	**2.936****	**0.231****
	(0.247)	(0.440)	(0.566)	(2.500)	**(1.408)**	**(0.104)**
Short-term rate^2*Constrained	**–0.118****	0.131	–0.061	0.521	**–0.597***	**–0.046****
	(0.053)	(0.091)	(0.116)	(0.618)	**(0.308)**	**(0.021)**
Bank-specific controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of banks and observations	113/1,733	113/1,733	113/1,733	113/1,733	111/1,446	113/1,687
Serial correlation test (1)	0.935	0.133	0.424	0.714	0.179	0.300
Hansen test (2)	0.456	0.940	0.336	0.996	0.499	0.197

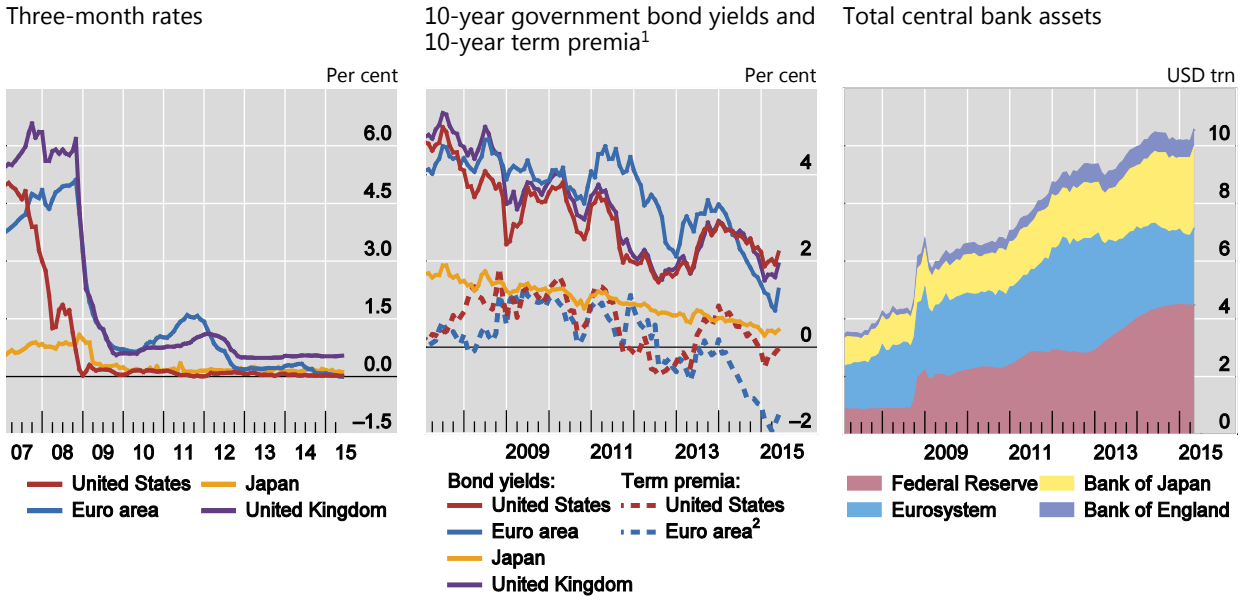
Note: The sample goes from 1994 to 2015. All estimations are based on the Arellano and Bover (1995) System GMM estimator. Robust standard errors are reported in brackets. (***, **, *) indicate significance at the 1%, 5%, 10% level. Significant coefficients are in bold. (1) Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second-order serial correlation. (2) Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals.

Table 6: Results for the model with duration of low interest rates

	Dependent variables:					
	(I)	(II)	(III)	(IV)	(V)	(VI)
	Diversification ratio	Fee ratio	NII ratio	Trading profit ratio	Loan ratio	Liquid asset ratio
Lagged dependent variable	0.562***	0.945***	0.819***	0.220***	0.878***	0.715***
	(0.090)	(0.036)	(0.028)	(0.051)	(0.049)	(0.076)
Short-term rate	**–1.461*** **	**–0.414** **	**0.046*** **	**–0.426***	–0.265	**–0.559***
	(0.440)	**(0.168)**	**(0.016)**	**(0.255)**	(0.277)	**(0.287)**
Short-term rate^2	**0.198*** **	0.002	**–0.005** **	**0.086*** **	0.019	**0.052***
	(0.048)	(0.017)	**(0.002)**	**(0.031)**	(0.028)	**(0.028)**
Short-term rate*years in low	**–1.082***	**–0.244*** **	**–0.018*** **	0.195	**–0.308** **	0.351
	(0.614)	**(0.089)**	**(0.007)**	(0.207)	**(0.136)**	(0.247)
Short-term rate^2*years in low	0.020	0.047	0.003	–0.132	0.067	–0.147
	(0.158)	(0.050)	(0.003)	(0.158)	(0.069)	(0.108)
Bank-specific controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of banks and observations	113/1,733	113/1,733	113/1,733	108/1,238	113/1,733	113/1,733
Serial correlation test (1)	0.786	0.001	0.313	0.152	0.656	0.179
Hansen test (2)	0.198	0.190	0.229	0.295	0.118	0.348
	Dependent variables (continued):					
	(VII)	(VIII)	(IX)	(X)	(XI)	(XII)
	HHI assets	Deposit-funding ratio	ST-MM funding ratio	OBS exposures	RWA ratio	Provisions ratio
Lagged dependent variable	0.893***	0.949***	0.762***	0.680***	0.647***	0.206***
	(0.045)	(0.041)	(0.042)	(0.042)	(0.100)	(0.077)
Short-term rate	**0.257***	**–1.243*** **	–0.304	0.874	**2.833*** **	**0.151*** **
	(0.138)	**(0.354)**	(0.373)	(0.843)	**(0.811)**	**(0.044)**
Short-term rate^2	**–0.029** **	**0.094***	**0.125** **	**0.197***	**–0.251*** **	**–0.011** **
	(0.014)	**(0.050)**	**(0.056)**	**(0.103)**	**(0.070)**	**(0.004)**
Short-term rate*years in low	–0.011	–0.288	0.109	–0.176	0.001	–0.003
	(0.115)	(0.178)	(0.161)	(0.378)	(0.158)	(0.026)
Short-term rate^2*years in low	–0.042	0.042	–0.097	0.072	**–0.209** **	–0.026
	(0.079)	(0.062)	(0.071)	(0.235)	**(0.099)**	(0.020)
Bank-specific controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of banks and observations	113/1,733	113/1,733	113/1,733	113/1,733	111/1,446	113/1,687
Serial correlation test (1)	0.760	0.116	0.527	0.759	0.171	0.291
Hansen test (2)	0.288	0.870	0.641	0.134	0.580	0.176

Note: The sample goes from 1994 to 2015. All estimations are based on the Arellano and Bover (1995) System GMM estimator. Robust standard errors are reported in brackets. (***, **, *) indicate significance at the 1%, 5%, 10% level. Significant coefficients are in bold. (1) Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second-order serial correlation. (2) Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals.

Graph 1: Interest rates and central bank assets in major advanced economies

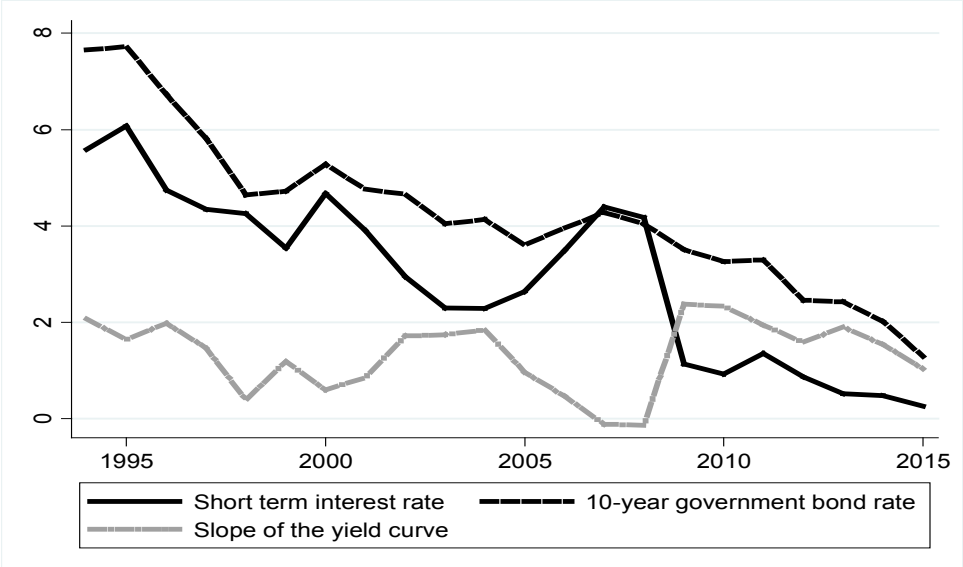


[1] Estimated based on the model of Hördahl and Tristani (2014). [2] Estimated using a basket of French government bonds.

Sources: Bloomberg; Datastream; national data; BIS estimations.

Graph 2: Interest rates and slope of the yield curve

In per cent



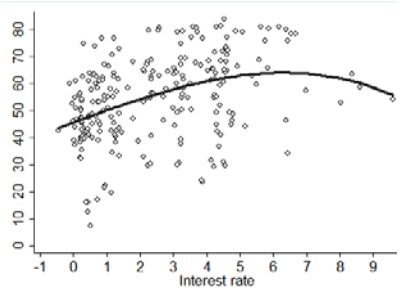
Note: Simple average across the banks in the sample of the weighted indicators. As banks operate in different jurisdictions, we construct bank-specific monetary policy indicators by weighting the interest rates of the individual countries based on the international exposure of each individual bank.

Sources: Bloomberg; Datastream; national data; BIS calculations.

Graph 3: Interest rates and bank income structure

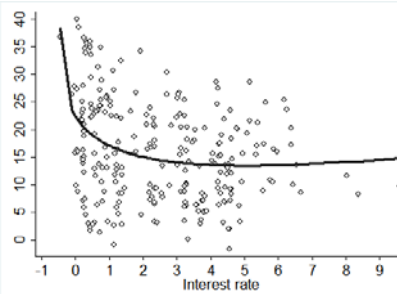
Interest income

Per cent



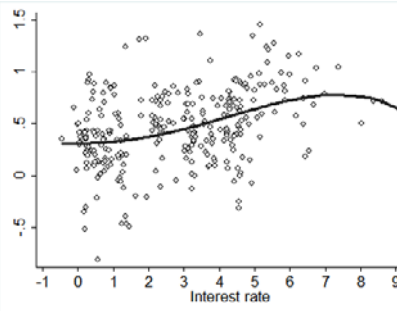
Fee and trading income

Per cent



Return on assets

Per cent



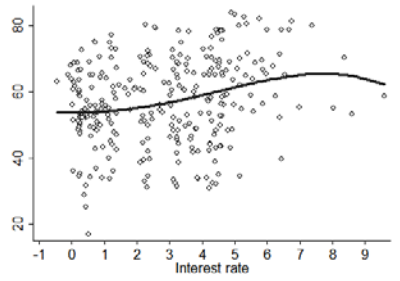
Note: The scatter plots show annual country averages of bank-level indicators. Fee and trading income is defined as net fees and commissions and net gains on trading and derivatives as a percentage of total income. Interest income is interest income on loans excluding dividend income as a percentage of total income. Return on assets is net income divided by total assets.

Sources: Fitch Connect, Fitch Connect. Authors' calculations.

Graph 4: Interest rates and balance sheets

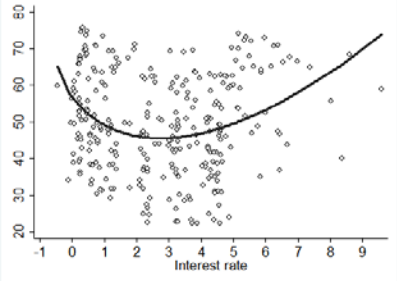
Total loans

Per cent



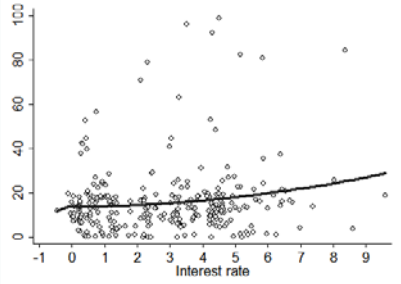
Customer deposits

Per cent



Off-balance sheet items

Per cent

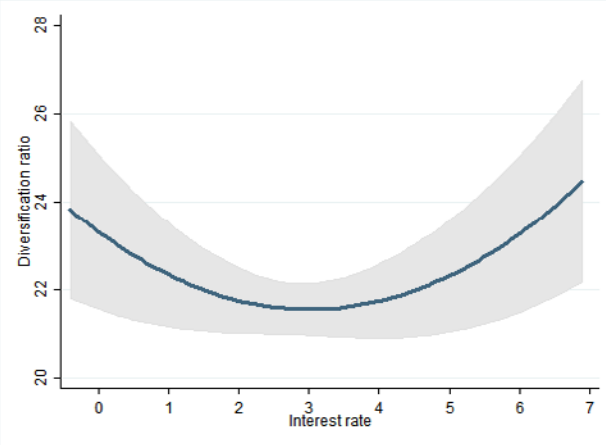


Note: The scatter plots show annual country averages of bank-level indicators. Off-balance sheet items include securitised assets, guarantees, acceptances and credit lines expressed as a percentage of total exposure. Customer deposits are expressed as a percentage of total funding. Total loans is expressed as a percentage of total earning assets.

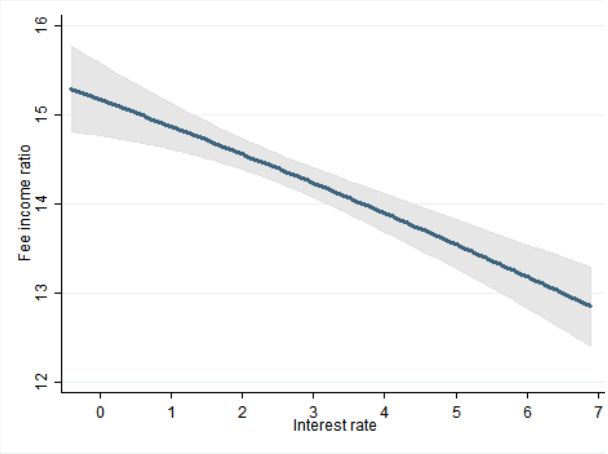
Sources: Fitch Connect, Fitch Connect. Authors' calculations.

Graph 5 (a): Effect of the short-term interest rate on bank intermediation activity

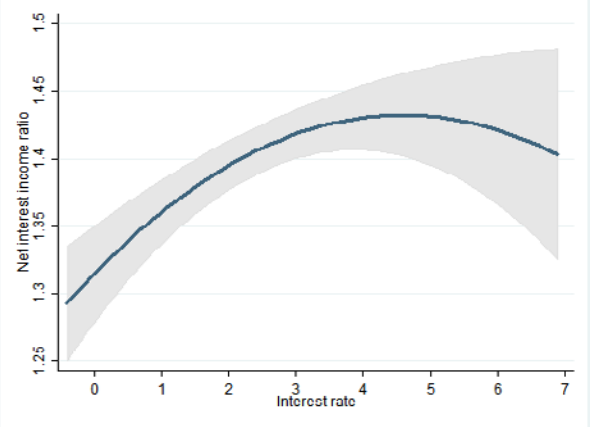
(I) Impact on diversification ratio



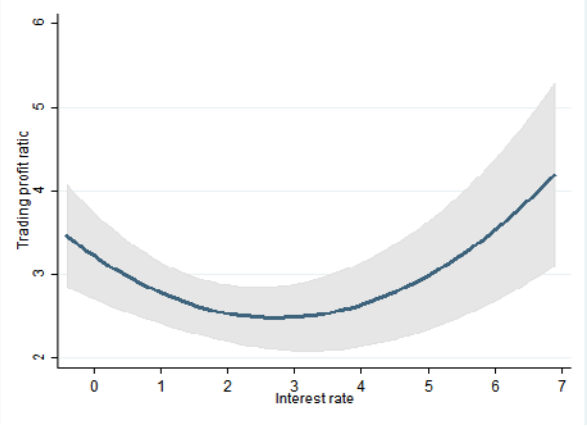
(II) Impact on fees and commissions ratio



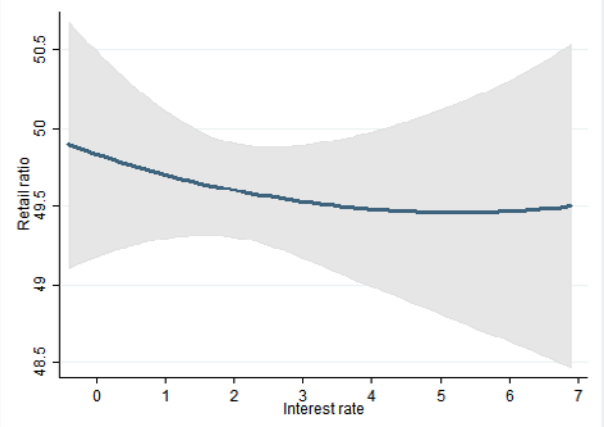
(III) Impact on net interest income ratio



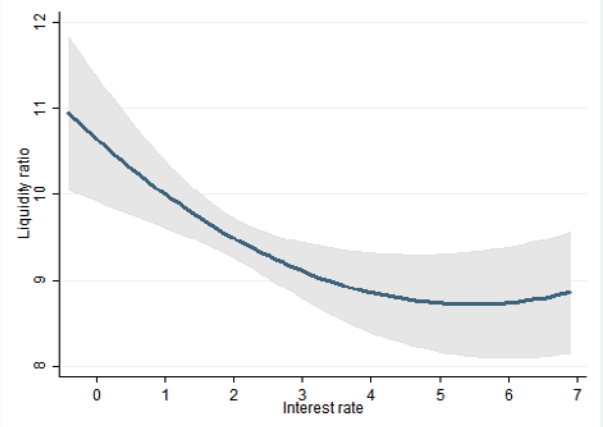
(IV) Impact on trading profit ratio



(V) Impact on loan ratio



(VI) Impact on liquidity ratio

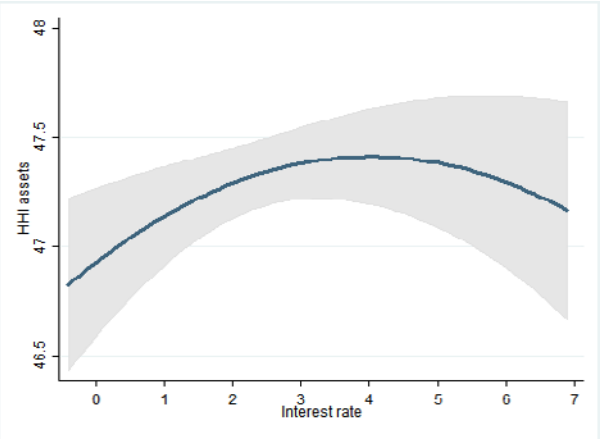


Note: The horizontal axis shows the nominal level of the money market rate. The vertical axis shows the level of each bank intermediation indicator as a function of the short-term rate, in percentage points. The shaded area indicates 95% confidence bands. The marginal effects have been calculated using the results shown in Table 4.

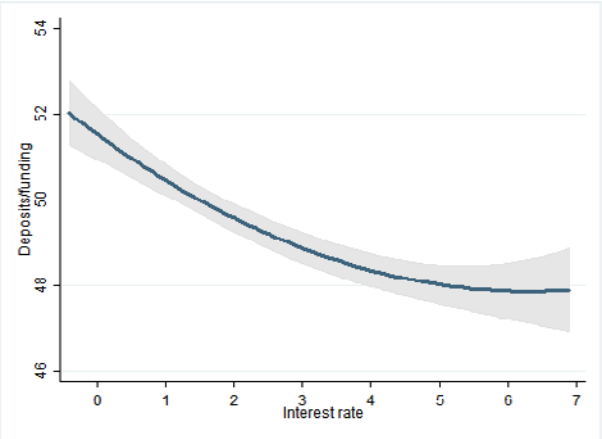
Source: Authors' calculations.

Graph 5 (b): Effect of the short-term interest rate on bank intermediation activity

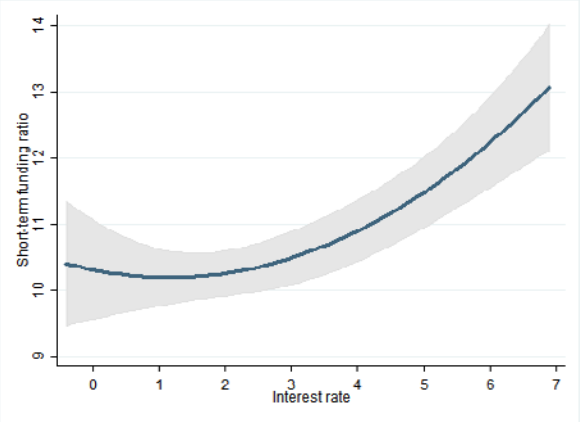
(VII) Impact on HHI asset ratio



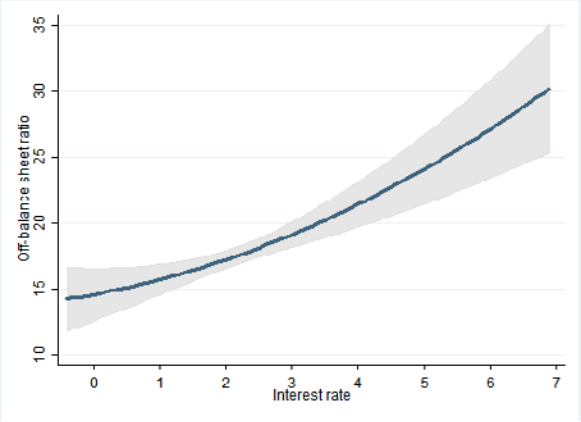
(VIII) Impact on deposit funding ratio



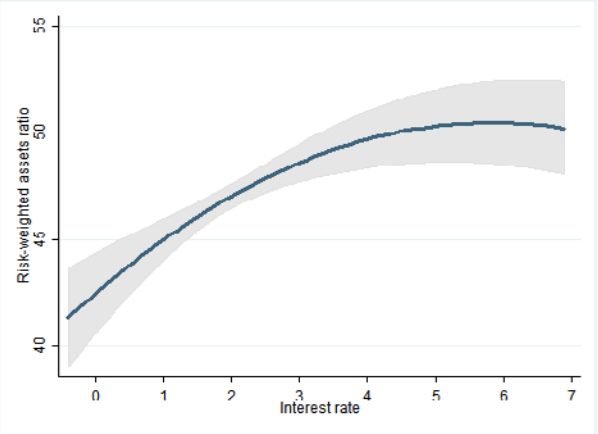
(IX) Impact on short term funding ratio



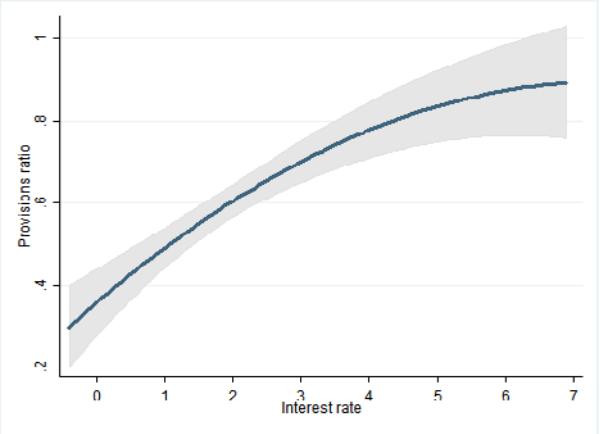
(X) Impact on off-balance sheet ratio



(XI) Impact on risk-weighted asset ratio



(XII) Impact on provision ratio

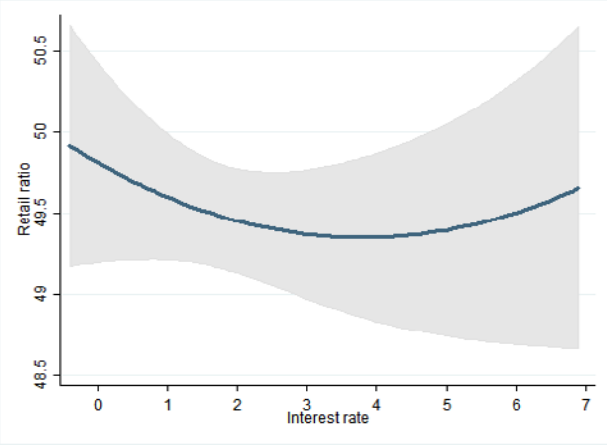


Note: The horizontal axis shows the nominal level of the money market rate. The vertical axis shows the level of each bank intermediation indicator as a function of the short-term rate, in percentage points. The shaded area indicates 95% confidence bands. The marginal effects have been calculated using the results shown in Table 4.

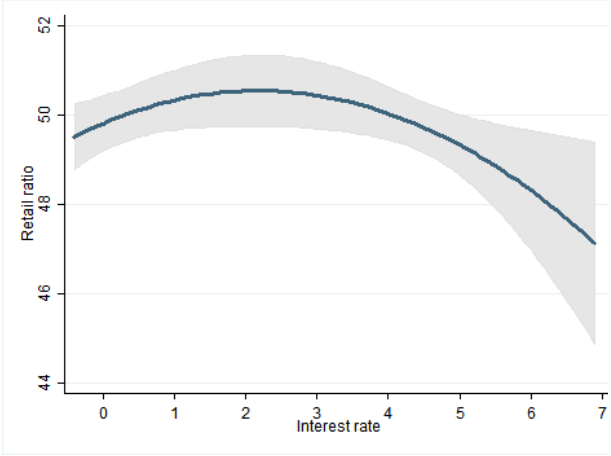
Source: Authors' calculations.

Graph 6: Effect of the short-term interest rate for capital-constrained banks

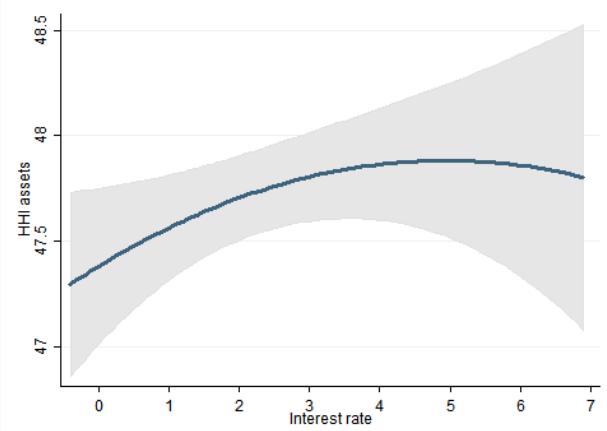
(I) Impact on loan ratio, unconstrained banks



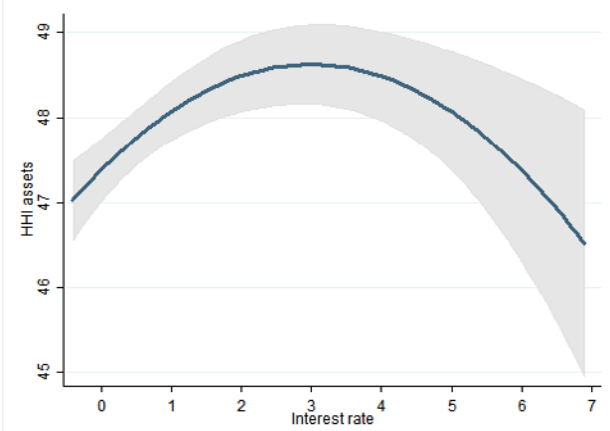
(II) Impact on loan ratio, constrained banks



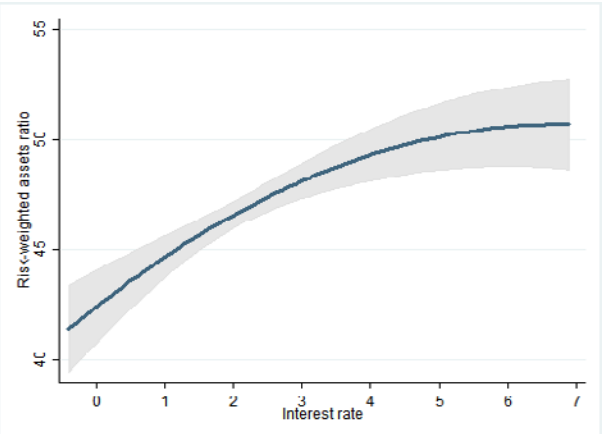
(III) Impact on HHI asset ratio, unconstrained banks



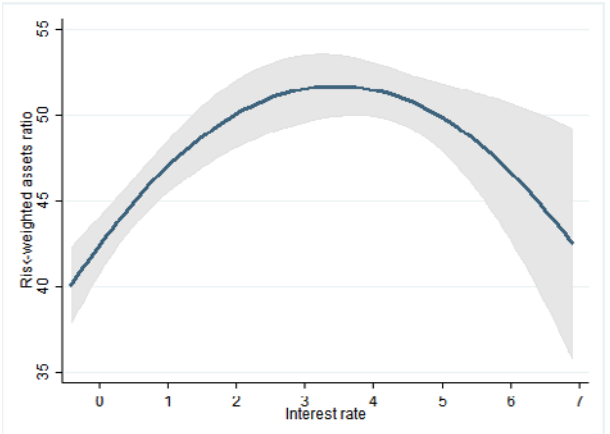
(IV) Impact on HHI asset ratio, constrained banks



(V) Impact on RWA ratio, unconstrained banks



(VI) Impact on RWA ratio, constrained banks



Note: The horizontal axis shows the nominal level of the money market rate. The vertical axis shows the level of each bank intermediation indicator as a function of the short-term rate, in percentage points. The shaded area indicates 95% confidence bands. The marginal effects have been calculated using the results shown in Table 5.

Source: Authors' calculations.

Annex

Table 4: Results for the baseline model, detailed

	Dependent variables:					
	(I) Diversification ratio	(II) Fee ratio	(III) NII ratio	(IV) Trading profit ratio	(V) Retail ratio	(VI) Liquid asset ratio
Lagged dependent variable	0.580***	0.945***	0.826***	0.221***	0.876***	0.721***
	(0.079)	(0.035)	(0.027)	(0.051)	(0.050)	(0.074)
Short-term rate	**–1.168****	**–0.292***	**0.051*****	**–0.542****	–0.142	**–0.705****
	(0.542)	**(0.155)**	**(0.016)**	**(0.232)**	(0.276)	**(0.325)**
Short-term rate^2	**0.193*****	–0.006	**–0.006****	**0.099*****	0.014	**0.065****
	(0.047)	(0.016)	**(0.002)**	**(0.031)**	(0.029)	**(0.031)**
Real GDP growth	–0.755***	0.060	–0.012***	–0.178**	–0.069	0.154
	(0.154)	(0.047)	(0.003)	(0.076)	(0.087)	(0.094)
Inflation	–1.644***	–0.392***	–0.015	–0.626***	0.021	–0.150
	(0.388)	(0.113)	(0.010)	(0.230)	(0.146)	(0.127)
House price growth	0.232***	–0.016	0.000	0.062*	0.086**	–0.073**
	(0.084)	(0.0254)	(0.002)	(0.036)	(0.036)	(0.033)
Central bank assets growth	–0.0178***	0.000	–0.000	–0.006	–0.006*	–0.001
	(0.006)	(0.002)	(0.0001)	(0.007)	(0.004)	(0.004)
Slope	1.059***	0.195**	–0.005	0.247	–0.320*	–0.085
	(0.374)	(0.088)	(0.011)	(0.167)	(0.180)	(0.194)
Cost-debt ratio, t-1	–1.246***	0.201	–0.012*	–0.426***	0.053	–0.251**
	(0.354)	(0.123)	(0.007)	(0.115)	(0.102)	(0.098)
Leverage, t-1	0.203	0.064	0.016***	–0.229***	0.212*	0.037
	(0.146)	(0.044)	(0.006)	(0.067)	(0.125)	(0.064)
Dummy, NSFR	–1.565**	–0.577**	0.027	–0.298	–1.208**	–0.584**
	(0.753)	(0.242)	(0.019)	(0.350)	(0.493)	(0.298)
Dummy, recapitalisation	0.924	0.368*	0.031	–0.312	–0.661	0.656*
	(0.942)	(0.212)	(0.020)	(0.475)	(0.560)	(0.377)
Dummy, IFRS	–2.453***	–0.327	0.002	–0.589	2.387***	1.714***
	(0.752)	(0.383)	(0.025)	(0.457)	(0.809)	(0.490)
Dummy, banking crisis	–0.624	–0.0753	0.004	0.204	–0.740*	–0.663*
	(0.568)	(0.204)	(0.020)	(0.513)	(0.408)	(0.377)
Constant	16.750***	1.507*	0.113***	6.348***	4.844***	4.160***
	(2.640)	(0.818)	(0.042)	(0.977)	(1.859)	(1.366)
No. of banks and observations	113/1,733	113/1,733	113/1,733	108/1,238	113/1,733	113/1,733
Serial correlation test (1)	0.826	0.001	0.327	0.143	0.661	0.184
Hansen test (2)	0.173	0.209	0.200	0.284	0.116	0.314

Note: The sample goes from 1994 to 2015. All estimations are based on the Arellano and Bover (1995) System GMM estimator. Robust standard errors are reported in brackets. (***, **, *) indicate significance at the 1%, 5%, 10% level. (1) Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second-order serial correlation. (2) Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals.

Table 4 (continued): Results for the baseline model, detailed

	Dependent variables:					
	(VII) HHI assets	(VIII) Deposit-funding ratio	(IX) ST-MM funding ratio	(X) OBS exposures	(XI) RWA ratio	(XII) Provisions ratio
Lagged dependent variable	0.899***	0.937***	0.774***	0.680***	0.647***	0.211***
	(0.039)	(0.041)	(0.046)	(0.042)	(0.102)	(0.077)
Short-term rate	**0.242***	**–1.160*****	–0.203	0.936	**2.752*****	**0.143*****
	(0.126)	**(0.329)**	(0.380)	(0.840)	**(0.857)**	**(0.039)**
Short-term rate^2	**–0.030****	**0.0918***	**0.087***	**0.193***	**–0.236*****	**–0.009****
	(0.013)	**(0.048)**	**(0.051)**	**(0.106)**	**(0.073)**	**(0.004)**
Real GDP growth	–0.024	–0.254***	0.237**	–0.044	–0.053	–0.058***
	(0.050)	(0.077)	(0.115)	(0.238)	(0.129)	(0.011)
Inflation	–0.061	0.117	–0.176	–2.197**	–0.651**	–0.032
	(0.129)	(0.164)	(0.233)	(1.037)	(0.283)	(0.020)
House price growth	0.063***	–0.069**	0.015	0.057	0.029	–0.036***
	(0.021)	(0.034)	(0.043)	(0.098)	(0.052)	(0.008)
Central bank assets growth	–0.005*	–0.013***	–0.003	–0.056**	–0.001	0.001
	(0.003)	(0.004)	(0.006)	(0.028)	(0.004)	(0.001)
Slope	–0.192**	–0.501***	0.166	0.398	0.706**	0.156***
	(0.090)	(0.166)	(0.196)	(0.552)	(0.348)	(0.055)
Cost-debt ratio, t-1	–0.030	–0.021	–0.041	–0.346	–0.278	–0.000
	(0.062)	(0.123)	(0.120)	(0.294)	(0.223)	(0.013)
Leverage, t-1	0.059	0.043	–0.161	0.038	1.130***	0.036***
	(0.057)	(0.099)	(0.100)	(0.248)	(0.336)	(0.014)
Dummy, NSFR	–0.480*	–0.812	1.708***	4.637***	–0.600	0.262**
	(0.283)	(0.509)	(0.586)	(1.423)	(0.690)	(0.116)
Dummy, recapitalisation	0.036	0.248	–0.497	1.993*	0.548	0.172***
	(0.214)	(0.289)	(0.493)	(1.202)	(0.832)	(0.059)
Dummy, IFRS	0.644***	–0.845	–0.134	–7.475***	0.278	–0.054
	(0.220)	(0.515)	(0.447)	(1.875)	(0.934)	(0.052)
Dummy, banking crisis	0.137	–0.971***	1.085**	5.879*	–1.267***	0.130**
	(0.328)	(0.310)	(0.522)	(3.052)	(0.435)	(0.064)
Constant	4.301**	6.999***	2.585***	6.891***	6.214**	–0.058
	(1.672)	(2.402)	(0.964)	(2.662)	(2.460)	(0.143)
No. of banks and observations	113/1,733	113/1,733	113/1,733	113/1,733	111/1,446	113/1,687
Serial correlation test (1)	0.823	0.118	0.527	0.759	0.174	0.236
Hansen test (2)	0.530	0.485	0.386	0.130	0.596	0.185

Note: The sample goes from 1994 to 2015. All estimations are based on the Arellano and Bover (1995) System GMM estimator. Robust standard errors are reported in brackets. (***, **, *) indicate significance at the 1%, 5%, 10% level. (1) Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second-order serial correlation. (2) Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals.