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Interest Rates and Net Interest Margins: The Impact of Monetary Policy

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2.1 Introduction

Several central banks have adopted an expansionary monetary policy in recent years so as to combat the impact of the last financial crisis on the economy. In addition to the low monetary policy interest rates (Fig. 2.1) resulting from the measures adopted (both conventional and unconventional), there is also a fall in the long-run natural rate of interest[1]: This derives from an excess of savings in relation to investment due to demographic factors (such as the ageing of the population and the

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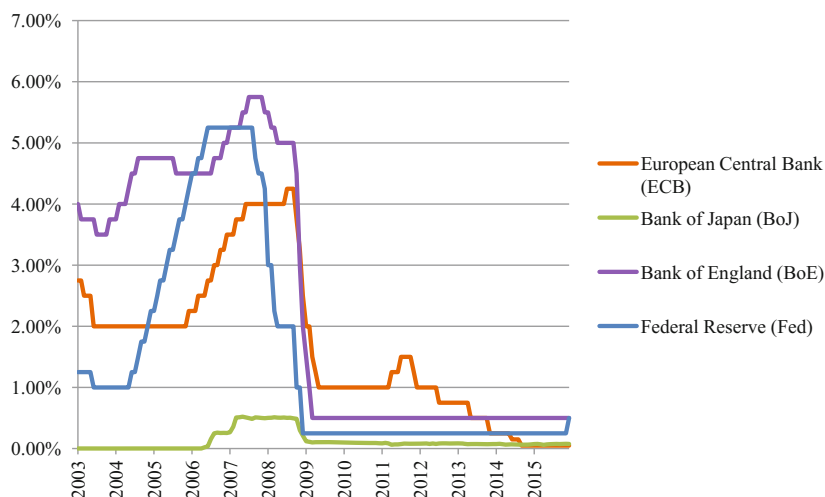Instituto Valenciano de Investigaciones Económicas, Valencia, Spain

Fig. 2.1 Intervention interest rates by the main Central Banks. *Source: Bank of Spain.*

depression in consumption which this entails), a lower rate of techno-logical progress (with the consequent secular stagnation of economies), low prices of raw materials, particularly oil, and increased demand for safe assets (pushing prices upward and decreasing yields), etc. What all of this leads to is a scenario of very low (or even negative) interest rates. In fact, a high percentage of debt in many countries has negative interest rates.

According to a recent analysis by the International Monetary Fund (2016), the expansionary monetary policies adopted by some central banks have eased the access to finance (by reducing the cost of funding and increasing the availability of credit), thus stimulating aggregate demand. However, a prolonged period of reduced interest rates can impair bank intermediation margins (and therefore profitability), given the existence of a floor in deposit interest rates, since it is difficult for banks to pass on the drop in interest rates to the deposits interest rates, at least in the case of households.[2] For this reason, the net interest margin is seen to be most affected in those banks with a greater proportion of financing via deposits. Likewise, the greater the proportion of variable interest rate loans in a bank, the greater the deterioration of its

profitability, as a result of the fall in financial revenues due to the reduction of the money market interest rates.

The European Central Bank (2016), on the other hand, highlights in its Annual Report that the expansionary measures adopted have a positive impact. The positive impact is driven by the fact that the drop in interest rates has led to an improvement in the quality of bank assets (since less risky projects are financed), an increase in lending activity and a drop in non-performing loans as a result of economic recovery.

Other papers, such as Rostagno et al. (2016), also provide empirical evidence of the increase in credit growth due to the policy of negative rates, showing that loans to companies have increased in the Eurozone with the current expansionary policy.

Taking the above mentioned into account, it is important to differentiate between the impact that falling interest rates have had up until now and the impact of these extremely low, or even negative, rates persisting for a prolonged period. To date, the effect has not been negative, as stated by the IMF and the ECB. However, the IMF warns that if this scenario persists for much longer, it will have an adverse effect on the net interest margin and therefore on bank profitability, primarily due to the floor in interest rates on deposits, as well as a flattening of the yield curve which has taken place with the falling interest rates.

In this context, the objective of this study is to analyse the impact of the variation of interest rates on the net interest margin and the possible existence of a non-linear relationship which would explain why the impact of monetary policy differs depending on the level of interest rates. Thus, if the relationship is quadratic, a fall in interest rates could be harmful for bank margins if the level of rates is low, while the same drop in rates can have beneficial effects with high rates (as a result of the reactivation of the demand for credit, reducing non-performing loans, etc.).

Since there are very few works to date which have empirically analysed the effect of a prolonged period of low-interest rates on banking net interest margins (and therefore on profitability), further evidence is needed on this subject. But given the current context of such low rates, this issue has attracted attention as shown by the recent works by Borio et al. (2015) and by Claessens et al. (2016). Using samples of banks from various countries, both papers provide evidence demonstrating the

existence of a non-linear relationship between interest rates and the net interest margin. In addition to these two works, are those by Genay and Podjasek (2014) which analyse the effects of expansionary monetary policy on the bank margin in the USA, and Busch and Memmel (2015) for German banks.

Our work provides further empirical evidence for a sample of 32 countries from around the world for the period 2003–2014, a period that includes years of expansion in which accommodative monetary policies were adopted and the subsequent years of crisis in which expansionary monetary policy measures were implemented, both conventional (such as a decrease in intervention rates), as well as unconventional (QE, negative rates which penalise excess bank reserves, etc.). The work is focused on quantifying the impact of short-term interest rates on bank interest margins, testing the hypothesis of whether the relationship between interest rates and the margin is indeed quadratic. However, we also consider the impact of other variables as determinants of net interest margins, which capture the characteristics of each bank (market power, credit risk, risk aversion, operating costs, etc.), along with other control variables (market risk, etc.). We have taken variables used as determinants in the model by Ho and Saunders (1981) and some of their additions together with the reference framework by Borio et al. (2015).

The results obtained indicate that the impact of interest rates on the intermediation margin is quadratic rather than linear. Accordingly, taking into account this concave relationship and the current low rates, a normalisation in monetary policy would have a significant effect on margin recovery. Similarly, this result also shows that if this situation persists for much longer (and even worse, if the negative rates which penalise excess bank reserves in some countries are increased), it could have a negative impact on financial stability as a result of the fall in bank profitability, which is already at an extremely low level (and below the cost of raising capital) at least in European banking.

In addition to this introduction, our paper is structured as follows. Section 2.2 examines the theoretical framework on the determinants of bank intermediation margins and presents the testable hypothesis. Section 2.3 describes the sample used, defines the variables of the model and the empirical approach, and explains the methodology used.

Section 2.4 shows the results obtained and Sect. 2.5 checks the robustness of the results. Finally, Sect. 2.6 presents the conclusions and the economic policy implications.

2.2 Theoretical Framework and Testable Hypothesis

2.2.1 Theoretical Framework

There are various theoretical frameworks in which the behaviour of net interest margins is modelled (see, for example, Zarruk 1989; or Wong 1997). However, most of the works in the literature take the model developed by Ho and Saunders (1981) as a starting point. Allen (1988) extended this model by incorporating different types of loans and deposits. In this extension, the author showed that the margins can be reduced when one considers the cross elasticity of demand between banking products. Angbazo (1997), on the other hand, expanded the original model by taking into account credit risk as well as interest rate risk. Maudos and Fernández de Guevara (2004) extended the model to include operating costs. In addition, their analysis of net interest margins in the main sectors of European banking uses a direct measure of the degree of market power, such as the Lerner index. Carbó and Rodríguez (2007) included non-interest income as a determinant of the margin.

In all these models, the bank is considered as an (risk averse) intermediary, maximising the expected utility of its wealth $EU(\bar{W})$, between suppliers and demanders of loans in a static framework over a single period. In the model, the banks set interest rates (r_L and r_D) on their loans (L) and deposits (D), setting markups a and b on the money market interest rate (r). Banking activity is subject to two types of risks: (1) the uncertain profitability of their loans associated with default risk; and (2) the risk that banks take because of their position in the money market to which they call on when they need to grant new loans or to place excess liquidity. Both risks are introduced by assuming that interest rates on loans and the money market have a probability function with variance

α_L^2 y α_C^2, respectively. In addition, both risks are related (with covariance σ_{LC}). For each additional loan or deposit, banks must assume operating costs $Exp(Q_L)$ or $Exp(Q_D)$, respectively. Finally, the loans and deposits reach banks according to Poisson processes which depend on the spreads that banks set on the interbank interest rate. These processes include the parameters that determine the market power (α/β) of banks in their markets.

In an application for the case of German banking, Entrop et al. (2015) include the cost of the maturity transformation, defining the equation that describes the determinants of the intermediation margin (s) in the following way:

$$s = \frac{1}{2}\frac{\alpha}{\beta} + \frac{1}{2}\left(\frac{Exp(Q_L)}{Q_L(1+r)} + \frac{Exp(Q_D)}{Q_D(1+r)}\right) - \frac{1}{2}\frac{r_L - r_D}{(1+r)}$$
$$+ \frac{1}{4}\frac{U''(\bar{W})}{U'(\bar{W})}\frac{\left((Q_L + 2L_0)(\sigma_L^2 + 2\sigma_{LC} + \sigma_C^2)\right) - 2(\sigma_{LD} + \sigma_{CD})(D_0 + L_0) + \sigma_D^2(2D_0 + Q_D)}{(1+r)}$$

With these additions to the original model by Ho and Saunders (1981), the determinants of the net interest margin are the level of interest rates (r, r_L and r_D), the degree of competition (α/β), risk (credit risk, as well as market risk, and their interaction- σ_L^2, σ_C^2 and σ_{LC} -), bank risk aversion, $-1/2U''(\bar{W})/U'(\bar{W})$, the overheads, the volume of the initial credit portfolio L_0 and of deposits D_0, and the average size of operations Q_L and Q_D.

Other group of papers (see Gerali et al. 2010) use a dynamic stochastic general equilibrium model with an imperfect competition. These authors postulate a linear relationship between bank margin and the level of interest rates. Alesandri and Nelson (2015) consider a simple version of former model in partial equilibrium with the same conclusion.

More recently, Borio et al. (2015) used the Monti-Klein model for the case where oligopolistic competition exists between N banks, incorporating the cost of maturity transformation, the capital requirements coefficient and an equation for provisions for possible loans losses. The determinants of the net interest margin included in the empirical application are the three-month interbank interest rate, the slope of the yield curve and the interest rate risk, in addition to macroeconomic

indicators and variables that approximate the characteristics of each bank (bank size, risk aversion, liquidity and efficiency). This paper focuses on the influence of monetary policy on the intermediation margin both through the impact of the short-term interest rates and the slope of the yield curve. These authors find that the level of interest rates, which is the key variable in our work, has a positive non-linear relationship with the net interest margin, depending on the curvature of the value of elasticity of demand for loans and deposits and on capital requirements.

In the same vein, Claessens et al. (2016) provide empirical evidence on the negative effect of the drop in interest rates on net interest margin, with the impact being greater when interest rates started at a low level, obtaining a quadratic relationship between the money market interest rates and the net interest margin.

2.2.2 Testable Hypothesis

In this context, our work takes into account all previous contributions in so far as we analyse the determinants of the net interest margin by including the various explanatory variables put forward, but with emphasis on the effect of interest rates and hence the impact of monetary policy.

Our testable hypothesis is the following: controlling for bank characteristics and macroeconomic variables, an increase in interest rates has a positive effect on net interest margin, the impact being greater when interest rates are low. In other words, we expect a positive and concave relationship between net interest income and the level of interest rates.

2.3 Data, Definition of Variables and Methodology

2.3.1 Data

The data used for the empirical analysis come from the BankScope database (Bureau Van Dijk), which contains information on the balance

and the income statement of a representative sample of banks from around the world. To control the influence of other macroeconomic variables which affect the intermediation margin, the World Bank database is used, while the money market interest rates come from the OECD database.

The sample used includes financial institutions (banks, savings banks, credit unions and other types of banks) from 32 OECD[3] countries.

The period examined is from 2003 to 2014. Excluded from the sample are those banks that do not provide the necessary data with which to calculate any of the variables required for econometric specification and those whose input prices, necessary for estimating the Lerner index of market power, are outside the range of the 2.5 standard deviations on either side of the mean calculated for each year. With these filters, the panel of data finally used is made up of 54,540 observations.

Variables

In order to carry out the empirical contrast, we used variables put forward by Ho and Saunders (1981) and their subsequent extensions, adding the level of interest rate and its square, as do Borio et al. (2015). Therefore, the following variables are needed for econometric specification: the level of short-term interest rates, market power, the degree of bank risk aversion, money market volatility (interest rate risk), credit risk, the interaction between both types of risk, the volume of credit, liquidity reserves and average production costs. Each of these variables is approximated as indicated below:

Level of Interest Rates

We use the three-month interbank market interest rate (*Short-term interest rate*) to approximate the level of short-term interest rates. The expected sign of this variable on the net interest margin is positive.

To capture a possible non-linear relationship between the level of interest rates and the intermediation margin, the square of the level of interest rates is included as an explanatory variable.

Market Power

As an approximation of market power, two alternative measures are used. The first is the *Lerner index* of market power, which is estimated at bank level using the approach commonly taken in other works, such as Berg and Kim (1994) or Maudos and Fernández de Guevara (2004).

The Lerner index measures the ability of companies to set a price above the marginal cost and is defined as the price-cost margin in relation to the price:

$$\text{Lerner index}_i = \frac{P_i - \text{MC}_i}{P_i}$$

where P_i is the average price of banking products, which is approximated by the total assets and is measured as a ratio between total income and total assets, and MC_i is the marginal cost of production, which is calculated based on the following translog cost function:

$$
\begin{aligned}
\ln C_i = {} & \alpha_0 + \alpha_1 \ln \text{TA}_i + \frac{1}{2}\alpha_k (\ln \text{TA}_i)^2 + \sum_{j=1}^{3} \beta_j \ln w_{ji} \\
& + \frac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3} \beta_{jk}\ln w_{ji}\ln w_{ki} + \frac{1}{2}\sum_{j=1}^{3} \gamma_j \ln \text{TA}_i \ln w_{ji} + \mu_1 \text{Trend} \\
& + \mu_2 \frac{1}{2}\text{Trend}^2 + \mu_3 \text{Trend}\,\ln\text{TA}_i + \sum_{j=1}^{3} \delta_j \text{Trend}\,\ln w_{ji} + \ln u_i
\end{aligned}
$$

where C_i is the total costs of the bank (financial and operating costs) and TA_i is total assets. The definition of the price of production factors is the following:

w_1: Price of labour = Staff costs/total assets[4].
w_2: Price of capital = Operating costs (except staff costs)/fixed assets.
w_3: Price of deposits = Financial costs/deposits.

The cost function estimate is carried out by using a data panel consisting of all the banks in the analysis. So as to capture the influence of

specific variables for each bank, fixed effects are introduced in the cost function estimate. Finally, a trend variable was also introduced (*Trend*) to show the effect of technological change, resulting in displacement of the cost function over time. As is a common practice, the estimate was made by imposing the restrictions of symmetry and grade one homogeneity in *input* prices.

The second indicator of market power is the Herfindahl index which approximates the structure or concentration of the market. Although it is common to use market concentration measures as indicators of competition, such measures have significant limitations for two reasons. Firstly, the theory shows that when judging competition, it is not always the number of competitors (or the concentration) that is relevant, but the rivalry that exists between them. And secondly, indicators of concentration do not show variations between banks in the same country.

Therefore, since the Lerner index is a measure of market power that is theoretically better grounded than the Herfindahl index, as well as presenting variations at bank level, it will be the preference in the estimate. However, the sensitivity of the results will be analysed using the Herfindahl index.

The expected sign of the variables (both the Lerner index and Herfindahl index) is positive, since banks with greater market power can set higher margins.

Bank Size

The logarithm of loan volumes (*log-loans*) is included as a proxy for bank size, since for a given credit risk, the potential losses will be proportional to the loan volume, and consequently the risk premium applicable to the margin. Alternatively, as in Borio et al. (2015), the logarithm for total assets (*log-assets*) is also included to verify the robustness of the estimate. In both cases, the expected sign is positive.

Risk Aversion

The degree of bank risk aversion (*Risk aversion*) follows the approach used by McShane and Sharpe (1985) and is approximated by the following ratio:

$$\text{RISKAVER} = \frac{\text{Equity}}{\text{Total Assets}}$$

The expected sign of this variable is positive, since banks with greater risk aversion will set a higher margin.[5]

Credit Risk

Given the possibility of non-payment or default on loans, banks include a risk premium, which is implicit in the interest rates charged on such transactions. Credit risk is approximated by the ratio between the provision for insolvencies and the volume of credit granted (*Prov/loans*), since the greater the likelihood of insolvency and non-performing loans, the more provisions banks will provide. The expected sign of this variable is positive.

Interest Rate Risk

Money market uncertainty is approximated by using the coefficient of variation calculated with monthly data on the three-month interbank interest rate (*Interest rate risk*). The expected sign is positive since, *ceteris paribus*, greater volatility means higher risk and thus a greater intermediation margin is needed to offset this risk.

Interaction Between Credit Risk and Market Risk (*Risk Covariance*)

Interaction between credit risk and market risk (*Risk covariance*) is proxied by the product of the measurement of credit risk and the interest rate risk. The expected sign of this variable is positive, since given a higher correlation between both types of risk, banks require a greater intermediation margin.

Average Cost of Transactions (*Average Cost*)

This is defined as the ratio between total operating costs divided by total assets. As demonstrated by Maudos and Fernández de Guevara (2004), the expected sign is positive, since the intermediation margin should cover at least the operating costs.

Liquid Reserves (*Reserves*)

A high volume of liquid reserves has a positive effect on the bank intermediation margin to the extent that they mean an opportunity cost by banks forgoing investment of these reserves in profitable assets. As a result, banks have to set a higher intermediation margin to offset lower interest income. This variable is approximated using the ratio between liquid reserves and total assets.

It is common practice in some studies to add other control variables. In particular, also included are implicit interest payments and an indicator of management quality. In addition, GDP growth is included to capture the possible influence of the economic cycle in determining the net interest margin.

Implicit Interest Payments

Following Ho and Saunders (1981), Angbazo (1997) and Saunders and Schumacher (2000), among others, an indicator of implicit interest

payments is included. As an approximation to these payments, we use the variable operating expenses net of non-interest revenues as a percentage of total assets (*Implicit interest rates*). The expected sign of this variable is positive since higher implicit payments mean increased transaction costs which demand wider margins to compensate banks for the costs this entails (instead of fees being charged explicitly, they are implicit in the form of a greater margin).

Efficiency

Efficient management involves choosing the most profitable assets and the lowest cost deposits. Management quality is therefore approximated by the ratio between operating costs and the operating income (cost to income ratio, *Efficiency*). The expected sign of this variable is negative, since the higher the ratio, the greater the operating inefficiency and thus the smaller the margin.

GDP Growth

As is common practice in studies which analyse banking margins, the estimate of the annual GDP growth rate (*GDP growth*) is included to control for the possible influence of the economic cycle on the net interest margin.

Net Interest Margin

Finally, the dependent variable to account for, i.e. the net interest margin per unit of assets (NII), is defined as the difference between revenue and financial costs in relation to total assets.

Table 2.1 shows the weighted average of each of the variables concerned in our study for the countries analysed.

Table 2.1 Descriptive statistics (2003–2014 averages)

	Net interest margin/ total assets (%)	Short-term interest rate (%)	Implicit interest payments (%)	Efficiency	Lerner index	Herfindahl index	Volatility of market interest rates (%)	Credit risk (prov/loans) (%)
Australia	1.83	4.70	0.87	45.95	0.26	0.08	7.11	0.18
Austria	2.04	2.15	0.99	68.17	0.27	0.06	17.64	1.09
Belgium	1.63	2.01	0.70	69.40	0.27	0.11	17.85	0.09
Canada	1.88	2.52	0.91	73.06	0.28	0.15	8.31	0.22
Chile	3.67	4.33	1.28	58.55	0.36	0.07	20.52	1.01
Colombia	4.79	5.88	1.29	63.48	0.39	0.06	8.23	7.41
Czech Republic	1.88	1.87	1.12	72.94	0.33	0.10	11.37	0.46
Denmark	3.22	2.27	1.57	67.50	0.36	0.18	14.30	1.45
Finland	1.42	1.30	0.63	68.85	0.37	0.25	25.78	0.17
France	2.06	2.09	0.77	78.80	0.30	0.05	18.31	0.02
Germany	2.39	2.22	1.38	70.28	0.25	0.03	16.50	3.01
Greece	2.21	2.21	0.71	60.96	0.32	0.11	17.34	1.74
Hungary	3.70	6.36	2.18	97.47	0.31	0.09	14.68	2.72
Iceland	3.31	8.49	−0.01	39.08	0.30	0.92	10.10	2.23
Ireland	0.84	2.02	−0.22	31.56	0.38	0.26	18.38	0.27
Israel	2.14	3.07	1.23	73.30	0.27	0.20	19.10	0.49
Italy	2.58	2.52	1.38	71.71	0.30	0.06	15.82	0.79
Japan	1.69	0.30	1.18	100.02	0.29	0.18	15.21	0.64
Korea, Rep.	2.15	3.66	0.59	61.91	0.32	0.05	6.12	2.01
Latvia	2.22	4.53	0.63	71.66	0.40	0.07	26.43	1.73
Luxembourg	0.96	1.56	−0.22	58.39	0.38	0.04	18.48	−0.19
Mexico	8.31	4.91	4.91	67.89	0.34	47.10	5.31	4.71

Table 2.1 (continued)

	Net interest margin/ total assets (%)	Short-term interest rate (%)	Implicit interest payments (%)	Efficiency	Lerner index	Herfindahl index	Volatility of market interest rates (%)	Credit risk (prov/loans) (%)
Netherlands	1.42	1.87	−0.08	48.78	0.39	0.23	20.06	0.64
New Zealand	2.01	4.68	0.73	54.10	0.31	0.12	6.22	0.22
Norway	2.13	3.00	1.01	61.76	0.32	0.13	11.30	0.22
Poland	3.04	4.53	1.13	63.23	0.34	0.06	8.22	1.11
Portugal	2.28	1.11	1.21	68.50	0.29	0.08	28.60	1.01
Russian Federati	5.31	7.71	2.66	80.44	0.37	0.06	20.57	−1.45
Slovak Republic	2.83	2.19	1.25	65.12	0.36	0.10	22.47	1.13
Slovenia	2.16	2.34	0.77	53.67	0.28	0.11	22.14	3.05
South Africa	3.82	7.00	1.19	68.57	0.36	0.08	5.91	1.60
Spain	1.87	2.30	0.75	67.58	0.30	0.07	16.74	2.61
Sweden	3.03	1.86	1.47	62.24	0.4	0.1344	27.15	0.3
Switzerland	1.38	0.78	0.48	67.97	0.32	0.1101	49.25	1.32
UK	1.61	2.79	0.85	65.41	0.72	0.0804	12.38	0.86
USA	3.12	2.01	1.59	69.87	0.35	0.0387	20.52	0.58

	Loans (log)	Total assets (log)	Risk aversion (%)	Operating costs (% total assets)	Reserves (% total assets)	GDP growth (%)	Number of obs.
Australia	14.98	15.53	7.27	1.83	4.12	2.86	322
Austria	12.48	13.17	8.36	2.58	1.55	1.68	1983
Belgium	13.23	14.74	9.04	2.06	1.19	1.63	449

(continued)

Table 2.1 (continued)

	Loans (log)	Total assets (log)	Risk aversion (%)	Operating costs (% total assets)	Reserves (% total assets)	GDP growth (%)	Number of obs.
Canada	14.29	14.91	8.46	2.14	2.37	2.41	490
Chile	13.99	14.56	14.35	3.02	6.53	4.77	79
Colombia	12.71	13.67	18.08	5.45	6.12	4.85	401
Czech Republic	13.76	14.53	10.02	3.21	2.75	2.76	232
Denmark	12.57	13.18	13.27	3.14	3.82	0.52	842
Finland	13.55	14.23	8.79	2.02	2.35	0.49	195
France	14.10	14.95	9.87	2.65	1.7	1.65	2474
Germany	12.99	13.63	7.05	2.49	2.24	1.34	12923
Greece	14.67	15.23	11.17	1.97	2.79	0.05	120
Hungary	12.97	13.89	10.88	4.72	6.15	2.16	70
Iceland	11.45	11.98	15.14	3.48	5.81	3.58	105
Ireland	14.13	15.76	14.12	1.62	2.08	3.18	129
Israel	15.38	15.86	6.41	2.45	11.32	3.36	80
Italy	13.05	13.61	11.05	2.55	1.24	0.81	2969
Japan	14.32	14.97	5.41	1.33	2.27	1.64	3265
Korea, Rep.	15.18	16.28	10.59	2.46	5.08	4.21	242
Latvia	12.02	13.24	10.35	2.64	7.59	3.54	202
Luxembourg	12.64	14.68	9.50	1.45	2.95	3.05	585
Mexico	13.87	14.89	14.03	7.70	4.96	3.24	27
Netherlands	13.80	15.17	11.20	1.35	7.26	1.48	167
New Zealand	14.52	14.91	8.98	1.42	4.3	2.65	95
Norway	12.83	13.04	9.86	1.54	2.66	1.7	1211

Table 2.1 (continued)

	Loans (log)	Total assets (log)	Risk aversion (%)	Operating costs (% total assets)	Reserves (% total assets)	GDP growth (%)	Number of obs.
Poland	14.02	14.62	12.02	2.77	4.18	4.24	277
Portugal	12.32	13.06	11.22	2.13	1.34	−0.19	500
Russian Federati	10.51	11.25	20.43	19.40	6.4	3.62	7012
Slovak Republic	13.51	14.16	15.57	2.53	5.97	3.74	132
Slovenia	13.71	14.33	8.81	1.92	3.61	1.44	158
South Africa	13.50	14.52	11.64	4.90	15.26	3.2	166
Spain	14.29	15.02	8.58	1.60	1.39	2.03	778
Sweden	12.26	12.68	13.75	3.08	0.71	1.98	993
Switzerland	12.55	13.07	8.23	2.09	4.21	2.08	4473
UK	12.66	13.79	11.07	1.99	4.64	1.62	1369
USA	13.98	14.5	10.67	2.88	3.8	2.66	9786

Source: BankScope and authors' calculations

2.3.2   Methodology

With all the variables described, the following equation is estimated:

$$\text{NII}_t = f(\text{NII}_{t-1}, \text{Short-term interest rate}_t, \text{Short-term interest rate}_t^2,$$
$$\text{Implicit interest payments}_t, \text{Efficiency}_t, \text{Lerner index}_t, \text{Interest rate risk}_t,$$
$$\text{Credit risk}_t, \text{Risk covariance}_t, \text{Size}_t, \text{Risk aversion}_t,$$
$$\text{Average cost}_t, \text{Reserves}_t, \text{GDP growth}_t)$$

The analysis of the net interest margin determinants is based on an estimation of a dynamic panel data model using the Generalized Method of Moments based on Arellano and Bond (1991) and Blundell and Bond (1998). In addition to including the net interest margin with its time lag as an explanatory variable to capture the inertia in its evolution, possible endogeneity problems are corrected by estimating the model in differences and using the lagged variables as instruments. Time effects are included in the estimation to show the impact of specific variables in each year.

2.4   Results

2.4.1   Base Scenario

Before commenting on the results obtained from the econometric estimation, it is important to analyse how the main variable in our study has evolved: short-term interest rates. As shown in Fig. 2.2, short-term interest rates (approximated by the three-month interbank interest rate) suffered a sharp increase during the years prior to the recent financial crisis, due to the accommodative monetary policy adopted by the main central banks. When the crisis hit in 2007, interest rates dropped sharply as a result of the expansionary monetary policies implemented to combat the effects of the crisis and have generally remained at levels close to zero since 2010.
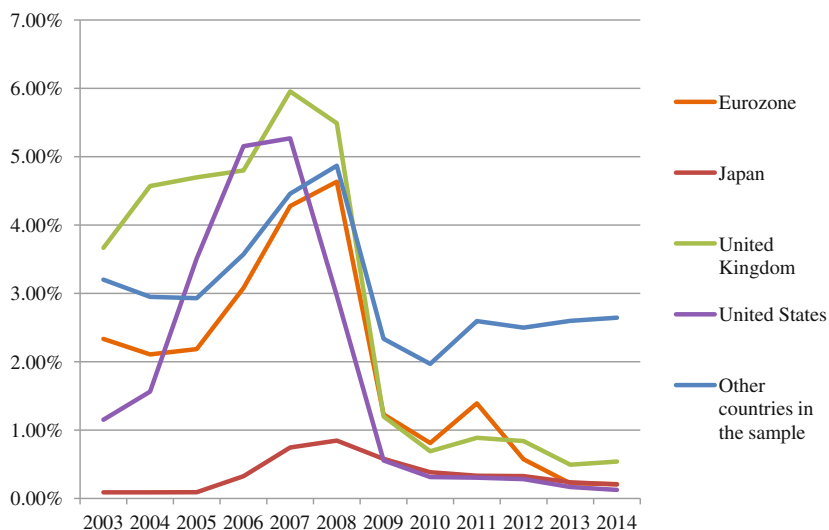
Fig. 2.2 Three-month interbank rates evolution. *Source* OECD and authors' calculations

Furthermore, it is also worth observing the evolution of the net interest margin, as it is the dependent variable in our study. As can be seen in Fig. 2.3, there are significant differences in the level of net interest margins between countries/geographical areas throughout the period analysed. The UK, Japan and the Eurozone have lower margins, while they are much higher in the USA and the group called "other countries".

We can also observe that the margin has fallen in the USA, the Eurozone and Japan, but increased in the group "other countries" and remained more or less stable in the UK.

Table 2.2 presents the results of the estimation of the equation which explains the net interest margin. The first column estimates the determinants of the intermediation margin, assuming a linear relationship between the margin and short-term interest rates. As can be seen, the effect of the level of interest rates is not statistically significant, thus discarding a linear relationship between the intermediation margin and the level of interest rates. The second column also includes the square of short-term interest rates, obtaining a positive and significant impact on
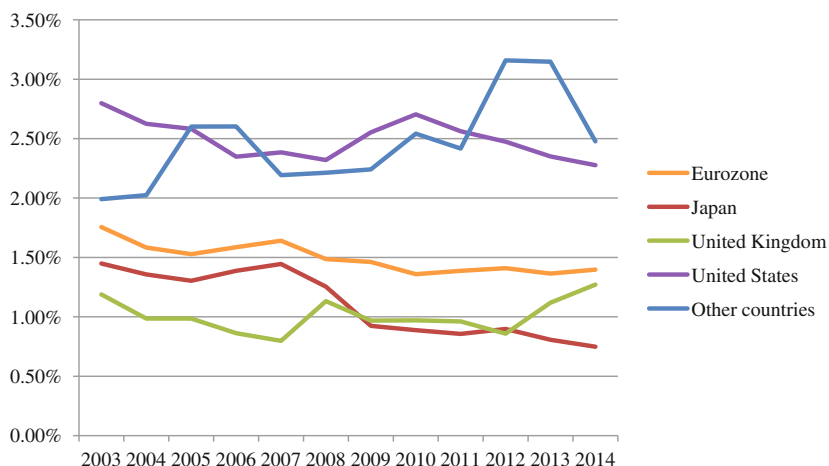
Fig. 2.3 Net interest income evolution (% total assets). *Source: BankScope and authors' calculations*

the level but negative for the square, which shows a quadratic rather than linear relationship. Consequently, a change in interest rates has a greater impact on the net interest margin the lower the level of interest rates. Table 2.2 also shows that the maximum in the relationship between interest rates and the margin is observed at 0.085 (8.5%).

Of the remaining variables, i.e. implicit interest payments, operating efficiency, bank size, risk aversion and GDP growth, they are significant and have the expected sign. Thus, higher implicit payments, lower efficiency, larger banks, greater risk aversion, and a positive GDP growth increase net interest margins.

Robustness of the Results

The third and fourth column analyses the robustness of the results to changes in the empirical approach to some of the determinants of the net interest margin. As shown in column 3, the results are maintained when the size is approximated by the total asset logarithm. Likewise, the results do not vary when market power is approximated by the Herfindahl index (column 4).

Table 2.2 Determinants of net interest income: 2003–2014

	[1]	[2]	[3]	[4]
NIM-1	0.278***	0.295***	0.281***	0.225***
	(0.056)	(0.052)	(0.052)	(0.081)
Short-term interest rate	0.090	0.451**	0.408**	1.350**
	(0.080)	(0.183)	(0.181)	(0.568)
Short-term interest rate^2		−2.663**	−2.510**	−9.775**
		(1.240)	(1.236)	(3.827)
Implicit interest payments	0.463***	0.426***	0.476***	0.501**
	(0.144)	(0.134)	(0.131)	(0.232)
Efficiency	−0.008**	−0.008**	−0.008**	0.006
	(0.004)	(0.004)	(0.004)	(0.010)
Lerner index	0.035	0.360	0.282	
	(0.746)	(0.704)	(0.702)	
Herfindahl index				0.042
				(0.038)
Interest rate risk	0.004	0.012	0.013	0.019
	(0.007)	(0.008)	(0.008)	(0.012)
Credit risk (provisions/loans)	0.000	0.005	0.001	0.051
	(0.010)	(0.009)	(0.009)	(0.045)
Risk covariance	−0.023	−0.020	−0.022	−0.063*
	(0.026)	(0.024)	(0.024)	(0.034)
Log (loans)	0.278***	0.313***		1.392**
	(0.099)	(0.093)		(0.567)
Log (total assets)			0.325***	
			(0.112)	
Risk aversión	0.092***	0.091***	0.096***	0.234**
	(0.031)	(0.029)	(0.030)	(0.108)
Average cost	−0.004	−0.022	−0.021	−0.064**
	(0.013)	(0.014)	(0.014)	(0.031)
Reserves	0.055	0.036	0.035	0.232**
	(0.041)	(0.038)	(0.038)	(0.096)
GDP growth	0.191***	0.204***	0.218***	0.445***
	(0.056)	(0.052)	(0.055)	(0.128)
Constant	−0.038**	−0.053***	−0.056***	−0.255**
	(0.016)	(0.016)	(0.020)	(0.109)
Max. short-term interest rate		0.085	0.081	0.069
Number observations	38,835	38,835	38,835	38,835
Arellano-Bond test for AR(1) in first differences [p-valour]	−2.37 [0.018]	−2.34 [0.019]	−2.35 [0.019]	−0.76 [0.450]

(continued)

Table 2.2 (continued)

	[1]	[2]	[3]	[4]
Arellano-Bond test for AR(2) in first differences [p-valour]	−0.32 [0.748]	−0.58 [0.559]	−0.64 [0.524]	−0.90 [0.370]
Sargan test of overid. Restrictions [p-valour]	23.26 [0.445]	22.77 [0.415]	25.84 [0.259]	4.09 [0.664]

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Estimations are done using the generalised method of moments (GMM) based on Arellano and Bond (1991) and Blundell and Bond (1998), where Lerner index is instrumented with Herfindahl index, and NIM and other endogenous variables are instrumented with their own first and second differences. All estimations include fixed and time effects. Format of the data in the table: Coef. (Robust Std. Error)

Source: Authors' calculations

2.5 Economic Impact of the Determinants of Net Interest Margin

To be able to assess how the variation of each explanatory variable affects the net interest margin it is not enough to simply compare the magnitude of the estimated coefficient, but rather, the intra-sample variation of each variable must be taken into account in order to know the economic impact. Figure 2.4 therefore quantifies the impact of an interquartile variation in each of the explanatory variables (a change from percentile 25 to 75 of the distribution), taking the estimated parameters in column 2 as references. The variables are ordered from highest to lowest impact, and the bars in the figure in a more subdued colour represent variables which are not statistically significant.

As can be seen in the figure, the most important determinants of the net interest margin for the period analysed are the level of interest rates (due to the large increase caused by accommodative monetary policy during the years before the crisis, as well as the sharp fall in rates as a result of aggressive monetary policy followed by the major central banks to combat the financial crisis), bank size, the degree of risk aversion, the economic cycle and operating efficiency. Thus, a variation in short-term interest rates which means going from percentile 25 to 75 of the distribution entails an increase in the intermediation margin of 119 basis points. In the case of bank size, growth in net interest income would be
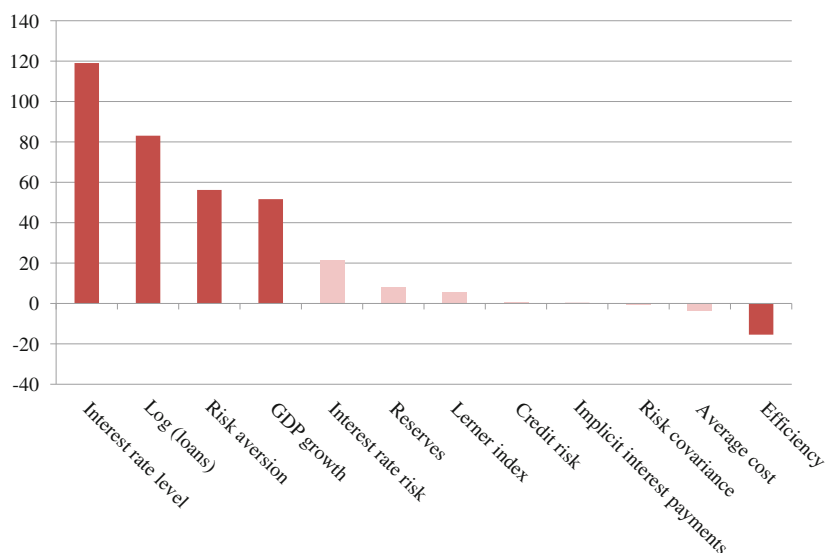
Fig. 2.4 Economic impact of the net interest margin determinants (bp). The graph shows the effect on net interest income of a variation of 25–75 percentile of the distribution in each of the explanatory variables. The bars that have a more subdued colour correspond to variables whose effect is not statistically significant. The variables are sorted from highest to lowest impact on net interest income. The equation [2] of the Table 2.2 was used for the analysis. *Source: Authors' calculations*

83 pb to an equivalent variation of the variable. This variation in the case of banks' risk aversion implies an increase in the intermediation margin of 56 pb; being 51 pb in the case of GDP growth. Finally, a variation in the operating efficiency of percentile 25 and 75 entails a drop of 15 pb in the intermediation margin.

Focusing on the impact of interest rates, if instead of using the interquartile variation range we use the variation which has taken place in the period analysed, as seen in Table 2.3 and Fig. 2.5 from 2003 to 2007 (subperiod of expansion), the increase in the intermediation margin explained by the increase in interest rates is 98 bp in the Eurozone, 231 bp in the USA, 117 bp in the UK, 31 bp in Japan and 61 bp in the group "other countries". During the subperiod of the crisis 2008–2014, interest rates fell primarily as a result of the expansionary monetary policy

Table 2.3 Observed changes in interest rate and yield slope curve and predicted changes in net interest margin (bp)

	Change in three-month interest rate 2003–2007	Predicted change in net interest margin 2003–2007	Change in three-month interest rate 2008–2014	Predicted change in net interest margin 2008–2014	Change in three-month interest rate 2003–2014	Predicted change in net interest margin 2003–2014
Eurozone	194	98	−442	−147	−212	−84
USA	412	231	−284	−107	−103	−43
UK	229	117	−495	−158	−313	−115
Japan	66	31	−64	−28	12	5
Other countries in the sample	126	61	−222	−87	−56	−24

Source: Authors' calculation

Fig. 2.5 Observed changes in interest rates and predicted changes in the net interest margin (bp). *Source: Authors' calculations*

measures taken, which led to a fall in the net interest margin of 147 bp in the Eurozone, 107 bp in the USA, 158 bp in the UK, 28 bp in Japan and 87 bp in the group "other countries". For the entire period analysed, the total effect of the variation in interest rates on the intermediation margin was a fall of 84 bp in the Eurozone, 43 bp in the USA, 115 bp in the UK, 24 bp in the group "other countries", and an increase of 5 bp in Japan.

2.6   Conclusions

A cause for concern today is the impact that unconventional monetary policy measures adopted by several central banks to combat the crisis could have on bank interest margins and thus on the profitability. Although the effect has been positive so far, the prolonged low level of interest rates in some countries (as is the case with those belonging to the Eurozone) might end up negatively affecting the intermediation margin, given the existence of a floor in the level of interest rates on bank deposits. The quadratic, rather than linear, relationship between net

interest margin and interest rates mean that a further drop in rates will damage profitability.

In this context, the results obtained in this study for a large sample of banks in OECD countries for the period 2003–2014 confirm that the above-mentioned quadratic relationship does indeed exist. This indicates that the impact of a variation in interest rates is higher for low levels than for high values. Consequently, if this current scenario of very low-interest rates persists over time (and even worse, if there is a further drop), banking margins could be adversely affected and therefore, profitability.

This result is in line with the evidence obtained recently by Borio et al. (2015) and Claessens et al. (2016), who also obtained a positive quadratic relationship between net interest margin and the level of short-term interest rates.

An important implication of economic policy regarding the results obtained is that there is a trade-off between economic growth and financial stability associated with the impact of expansionary monetary policy when the level of interest rates is very low. Thus, while on the one hand expansionary measures are adopted to combat the crisis (increasing the rate of inflation and encouraging economic growth), the negative impact on the net interest margin also negatively affects the profitability of banks, thus increasing the likelihood of a systemic crisis.

In this context, of particular concern is the case of the banks in the Eurozone, which currently have a problem with low profitability as a consequence of the regulatory pressure and the high amount of non-performing assets. The fact that the inflation rate is well below the ECB target of 2% justifies the expansionary measures taken (such as the expanded asset purchase programme (APP) and the penalty of up to −0.4% of excess of reserve requirements and deposit facility). But taking into account the results obtained in this paper, these same measures can have a negative impact on bank profitability. This explains the IMF's recent warning (2016) not to further increase the negative interest rates on marginal deposit facility and excess reserves. Until now the expansionary monetary policy has stimulated the volume and quality of bank lending and, by this way, profitability. But now that interest rates are so low (even negative), monetary policy is holding back banks' profitability.

Notes

1. See Laubach and Williams (2015).
2. In the same vein, the recent study by Borio and Zabbai (2016) analyses both the negative and the positive effects of unconventional monetary policy measures that are being adopted. The authors conclude that although there is evidence that these measures are successful in improving financial conditions, over time they could have a negative impact on bank profitability.
3. Australia, Austria, Belgium, Canada, Colombia, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Rep. Korea, Latvia, Netherlands, New Zealand, Norway, Poland, Portugal, Russian Federation, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, UK and USA.
4. The price of labour is approximated by the ratio of Staff costs/total assets.
5. The ratio own resources/assets is a capitalisation measurement with limitations, due to the influence of regulation on own resources, as a measure of risk aversion. Therefore, the results should be interpreted with caution.

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