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Bank interest rate setting in the euro area during the Great Recession

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Abstract

This paper sheds light on how recent financial tensions in the euro area were ultimately reflected in bank interest rate setting. We make two new contributions. First, we develop a theoretical model capturing banks financing and the rate setting choices. Banks in the model can finance themselves through deposits, on the money market and/or by issuing bonds. Second, we assemble a novel database and put our model to test. Our model extends that of Gambacorta (2004), as we formalise banks' decision to issue debt endogenously. Gambacorta's analysis was conducted for Italian banks and did not include the recent financial crisis. Instead, we focus our analysis on the Great Recession period (July 2007 to October 2014) and euro area banks. From a monetary policy perspective, both our theoretical model and the empirical results provide useful information on the impact of some of the measures introduced by the ECB during the financial crisis. First, the ECB introduced specific measures to alleviate tensions in money markets. To the extent that these measures fostered stability in money markets, and reduced the volatility of money market rates, this paper shows that they were also channelled to bank rates. Second, the ECB also introduced measures to address tensions in bond markets. Our results also show that having access to debt financing has important implications for bank rate setting.

JEL classification: C32, E43,E52, E58, G01
Keywords: Bank interest rate setting, bank financing, non-standard monetary policy and euro area crisis.

NON-TECHNICAL SUMMARY

Despite the richness of research on the global financial crisis, and the euro area crisis in particular, there is still a lot to learn about the role of banks and how they set interest rates throughout such a prolonged crisis. The goal of this paper is to shed light on how financial tensions in the euro area during the Great Recession period were ultimately reflected in banks' interest rate setting.

Our original contribution is twofold. First, we present a theoretical model capturing banks financing and the rate setting choices more realistically. Banks in the model can finance themselves through deposits, on the money market, or issuing bonds. Each funding choice has different costs and is subject to different tensions. In particular, if the bank gets financing in the form of debt, it will be less inclined to compete for deposits (to cover for the future arrival of loans) by offering higher deposit rates. Debt financing should also have an impact on bank lending rate setting, because debt offers an insurance against the risks associated with financing in the money market, i.e. the volatility of money market rates. Second, we assemble a novel database and put our theoretical model to test. The dataset captures banks effective funding and pricing policies, and their exposure to a variety of risks and uncertainties. We gather bank level data for 55 euro area banks. Bank lending and deposit rates are collected from the harmonised Individual MFI interest rate statistics of the ECB. We retrieve quotes from Bloomberg to assemble bank level time series of bond yields. We also use ECB internal data to identify those banks that were more reliant on ECB financing and tap less regularly the interbank money market in search for financing.

Our empirical analysis broadly supports four of the five theoretical implications of our model. First, both the deposit rate and the bank lending rate respond to money market uncertainty, and banks widen the spread between lending rates and deposit rates to compensate for the higher refinancing risks in money markets. Second, higher risk of default on the loan leads to higher bank lending rates. Third, those banks with access to money markets, and thus banks that relied less on ECB financing, offered lower deposit rates and lower bank lending rates during the Great Recession period. Fourth, banks that chose to finance via debt offered both lower deposit rates and lower lending rates.

The fifth theoretical implication of our model is, however, not immediately validated by our empirical results. In contrast with what was to be expected from our model, our regression results suggest that floating lending rates are more sensitive to bank's refinancing risks, than fixed lending rates. This is somehow puzzling, and we do not have a complete explanation for this finding. One very tentative explanation is that banks, as part of their marketing strategy, favour smoothing fixed rates more than floating rates, because fixed rates are likely to be more heavily demanded by customers that are more risk averse. This is, however, an issue that we leave for future research.

All in all, these innovations - in the model and the dataset - yield a more accurate picture about how financing tensions are reflected in banks interest rate setting. From a monetary policy perspective, both our theoretical model and the empirical results provide information on the impact of some of the measures introduced by the ECB during the financial crisis. First, the ECB introduced specific measures to alleviate tensions in money markets, e.g. fixed rate full allotment in main refinancing operations, extensions of maturity of liquidity providing monetary operations, and broadening of the collateral pool for conducting operations with the ECB. To the extent that these measures fostered stability in money markets, and reduced the volatility of money market rates, this paper shows that they were also channelled to bank rates. Second, the ECB also introduced measures to address tensions in covered bond markets, e.g. Covered Bond Purchases Programmes. These measures have reactivated activity in both the primary and secondary segments of these markets. Our results show indeed that having access to debt financing has implications for bank rate setting.

1 Introduction

Despite the richness of research on the global financial crisis, and the euro area crisis in particular, there is still a lot to learn about the role of banks and how they set interest rates throughout such a prolonged crisis. The consensus view is that stressed banks, with less market power and facing higher funding costs, resided in euro area countries under financial stress. The temptation would then be to organise the analysis along national lines. The motivation for this paper stems instead from the observations that in fact this was not always the case. If we look at 'granular data' we see the existence of not stressed banks in stressed euro area countries, and vice-versa.

Bank lending rates were already relatively heterogeneous across euro area banks in early 2007, but heterogeneity of bank lending rates to small and medium enterprises (SMEs) became ever more apparent as the crisis unfolded, see Figure 1. Rather interestingly, even in euro area countries not under financial stress the disparities in bank lending rates to SMEs across banks were very large. The degree of heterogeneity across bank rates for SMEs may to a certain extent have reflected compensation for different credit risk exposures. It should also have equally reflected large disparities in the cost of financing of banks, as illustrated in Figure 2 which shows the increasing heterogeneity in the cost of financing via debt instruments. Once more, even banks in euro area countries subject to less financial stress experienced increasing costs of financing. This suggests that there might be merit in studying bank rate setting behaviour using bank level data.

Open market operations are commonly used by central banks to steer short-term money market interest rates, which in turn affect various commercial rates, including bank lending and deposit rates. This is the so called interest rate channel of monetary policy. Prior to the crisis the European Central Bank (ECB) intervened by simply steering short-term money market rates, the so called 'standard' way of implementing monetary policy. During the crisis a number of non-standard monetary policy measures were introduced with a view to address financing tensions in some market segments that were compromising the functioning of the interest rate channel.

The goal of this paper is to shed light on how these financial tensions were ultimately reflected in banks' interest rate setting. For this purpose a new model was needed, and our original contribution is now twofold. First, we present a theoretical model capturing banks financing and the rate setting choices more realistically. Banks in the model can finance themselves through deposits, on the money market, or issuing bonds. Each funding choice has different costs and is subject to different tensions. In particular, if the bank gets financing in the form of debt, it will be less inclined to compete for deposits (to cover for the future arrival of loans) by offering higher deposit rates. Debt financing should also have an impact on bank lending rate setting, because debt offers an insurance against the risks associated with financing in the money market, i.e. the volatility of money market rates. Second, we assemble a novel database and put our theoretical model to test. The dataset captures banks effective funding and pricing policies, and their exposure to a variety of risks and uncertainties. We gather bank level data for 55 euro area banks. Bank lending and deposit rates are collected from the harmonised Individual MFI interest rate statistics of the ECB. We retrieve quotes from Bloomberg to assemble bank level time series of bond yields. We also use ECB internal data to identify those banks that were more reliant on ECB financing and tap less regularly the interbank money market in search for financing.

All in all, these innovations - in the model and the dataset - yield a more accurate picture about how financing tensions are reflected in banks interest rate setting. From a monetary policy perspective, both our theoretical model and the empirical results provide information on the impact of some of the measures introduced by the ECB during the financial crisis. First, the ECB introduced specific measures to alleviate tensions in money markets, e.g. fixed rate full allotment in main refinancing operations, extensions of maturity of liquidity providing monetary operations, and broadening of the collateral pool for conducting operations with the ECB. To the extent that these measures fostered stability in money markets, this paper shows that they were also channelled to bank rates. Second, the ECB also introduced measures to address tensions in covered bond markets, e.g. Covered Bond Purchases Programmes. These measures have reactivated activity in both the primary and secondary segments of these markets. Our results show indeed that having access to debt financing has implications for bank rate setting.

The paper is organised as follows. Section 2 presents the theoretical model. Section 3 describes our strategy for the empirical analysis. Section 4 describes our main dataset. Section 5 provides our regressions results. Finally, section 6 provides some concluding remarks.

2 Modelling bank interest rate setting

2.1 General considerations

A widely used theoretical framework to show how banks set bank lending rates is that of Ho and Saunders (1981). Their model was further extended by Angbazo (1997) and Gambacorta (2004).[1] In this extended framework, which we will refer to as HS-AG, the optimal mark-up – bank's profit margins – for deposit and loan services depends on five key factors: (a) the degree of bank's management risk aversion; (b) the market structure in which the bank operates; (c) the average size of bank transactions; (d) the volatility of money market rates, which account for the refinancing risks the bank faces; and (e) the risk of default on the loan.

In this paper we extend the HS-AG theoretical framework by adding the endogenous issuance of corporate debt as a source of financing. The approach followed in both our theoretical and empirical analyses is close to that of Gambacorta (2004). However, while his framework acknowledges the role of funding via debt instruments, debt is set exogenously. In contrast, in our analysis, banks may substitute debt-financing for alternative forms of financing (e.g. interbank money) if they deemed that debt-financing is too expensive. Gambacorta's analysis was conducted for Italian banks and did not include the recent financial crisis. Instead, we extend the data sets to more countries and embrace the crisis.

The impact of banks' funding costs on bank rate setting has also been recently studied in Illes et al. (2015) and Holton and d'Acri (2015). Once more, and as in Gambacorta (2004), funding costs were treated as exogenous to banks' decisions. Illes et al. (2015) constructed a weighted average cost of liabilities as an alternative benchmark for bank funding costs. The weights used were based on the structure of the liabilities of the banks, while the individual costs were based on new market transactions. The approach followed by Holton and d'Acri (2015) relied on using a range of individual bank characteristics that are expected to influence banks' funding costs. Among these individual bank characteristics they employed, i) the sum of the credit borrowed from the ECB (for both short and long-term maturity borrowing); and ii) the CDS spread of the bank to capture bank's perceived market risk.

[1] Maudos and Fernandez de Guevara (2004) provide an extension of the Angbazo (1997) framework in which loans and deposits are processed at a cost. As in HS-AG, in this paper, we assume that deposits and loans are processed at zero cost.

2.2 A bank model for setting bank margins and issuing debt

The model is a one-period decision model where banks maximize the expected utility of their wealth. At time 0, the wealth of the bank, W_0, is measured as the difference between the loan assets and deposit liabilities plus net cash holdings. For simplicity, we assume that the initial wealth of banks is zero, $W_0 = 0$. The initial loan and deposit portfolios are also assumed to be zero. Banks can finance themselves via deposits, the interbank money market, or by issuing debt. There are differences though. When financing in the money market, the cost of financing is subject to uncertainty (due to market volatility or changing liquidity conditions). Instead, financing by issuing debt is likely to be more expensive but we assume that its cost is known to the bank a priori. After raising debt financing, banks can either grant loans, or place any excess liquidity in the money market. Once more, the investment in the money market is subject to uncertainty. We further assume that banks can invest on a debt instrument providing a return similar to the cost at which they can finance themselves issuing debt. That is, the bank can choose to either borrow or lend in the form of debt. Yet loans are expected to be more profitable than investing in money and debt instruments: however they bear a risk of default.

At time 0 the bank needs to decide on: (i) the interest rate charged for loans, r_L; (ii) the interest rate offered for deposits, r_D; and (iii) the amount to borrow or lend in the form of debt, B. It is assumed that the cost of debt financing or the return of the debt investment (with any extra-funds) is r_B. The deposits and lending opportunities may arrive at different period of times. Were a new loan request to arrive that was not matched by the arrival of new deposits, then the bank would have to finance that loan by borrowing money in the interbank money market. In line with HS-AG, and without loss of generality, it is assumed that at most one loan and/or deposit may arrive, and that these are of equal size which we denote below by Q.

The cost of financing in the interbank market is not fully known, the bank will have to pay $r + Z_r$, where r is the expected interbank rate, and Z_r a normally distributed random shock with mean zero and variance σ_r^2. The random shock Z_r reflects the uncertainty of financing in the money market. The bank can, however, insure itself against such uncertainty by borrowing in the form of debt, B; as the interest rate charged to the bank for borrowing in debt, r_B, is known at time 0. In this manner, in the event of the arrival of a new loan request not matched by deposits arrival, the bank may have some funds – those collected by issuing bonds – to grant the new loan. For simplicity, we assume that the bank lending rate and the bank deposit rate are set with reference to the expected interbank rate. That is:

$$r_D = r + a$$
$$r_L = r + b$$

where a and b are margins to be set by the bank. The return on the loan granted by the bank is subject to uncertainties, it is assumed that the bank will receive in return from a loan $(1 + r_L + Z_L)$, where Z_L is a normal random shock with mean zero and variance σ_L^2. By manipulating the margins a and b, banks understand how they can influence the arrival of deposits and demand for loans, i.e. they hold a certain monopolistic power that they can exploit. This is modelled, for simplicity and as in HS-AG, by assuming that the probability of granting a new loan (λ_L) and the probability of obtaining a new deposit (λ_D) are symmetric and linear functions of the margin applied by the bank, i.e.

$$\lambda_L = \alpha - \beta b$$
$$\lambda_D = \alpha + \beta a$$

It is further assumed that the random shocks, Z_r and Z_L as well as the random event of the arrival of a new deposit or a new loan are all independent. The bank needs to make a decision on the margins, a and b, and on the amount of borrowing or lending in debt instruments, B. If the bank chooses to invest in debt, i.e. hold B in its portfolio and be paid at a rate r_B, it will have to finance that investment borrowing in the interbank money market (in the absence of a new deposit arrival). The value of the wealth will depend on those decisions as follows:

$$W - W_0 = \Delta W_B + R_D \Delta W_D + R_L \Delta W_L$$

where ΔW_B is the increase in net wealth not resulting from the arrival of a new deposit or loan, ΔW_D is the net increase in wealth resulting from the arrival of a new deposit, and ΔW_L is the net increase in wealth resulting from granting a new loan. R_D and R_L are independent Bernoulli random variable with respective probabilities λ_D and λ_L. R_D $(R_D\ )$ take the value of 1 when a new deposit (loan) arrives and a value of zero otherwise. The evolution of bank's wealth is given by:

$$\Delta W_B = B(1 + r_B) - B(1 + r + Z_r)$$
$$= Bs_B - BZ_r$$

$$\Delta W_D = -Q(1 + r_D) + Q(1 + r + Z_r)$$
$$= -Qa + QZ_r$$

$$\Delta W_L = -Q(1 + r + Z_r) + Q(1 + r_L + Z_L)$$
$$= -QZ_r + Qb + QZ_L$$

and where we have used $s_B = r_B - r$ to denote the bond spread. ΔW_B suggests that the amount borrowed in B could be placed in the money market to help servicing part of the interest on the debt in the event of no arrival of a loan request. If B was an investment, i.e. $B > 0$, the financing would come from borrowing in the money market. Were a new deposit to arrive, that amount could be placed in the money market to pay back part of the cost associated with remunerating the deposit. If a request for a new loan arrives, the financing could either go via deposits, if any, or borrowed debt, if any.

The banks expected utility function is then approximated using a Taylor expansion around wealth at time 0, namely:

$$U^e(W) = U(W_0) + U'(W_0)E(W - W_0) + \frac{1}{2}U''(W_0)E(W - W_0)^2$$

Following HS-AG it is further assumed that the terms involving the square terms of the loan and deposit margins in the expected utility expressions above are negligible and can be safely ignored. We follow this same rationale and also assume that the cross product between the loan and deposit margin with the spread s_B are also negligible. We then show in the appendix that the expected increase in wealth, and the square of the expected increase in wealth are respectively given by:

$$E\left(W - W_0\right) = Bs_B - \lambda_D Qa + \lambda_L Qb$$
$$E\left(W - W_0\right)^2 = \sigma_r^2 \left[B^2 + \lambda_D Q^2 + \lambda_L Q^2 + 2BQ\left(\lambda_L - \lambda_D\right)\right] + \sigma_L^2 Q^2 \lambda_L$$

The objective of the bank is to maximize the expected utility of wealth, $U^e(W)$ by setting the margins a and b, and by either borrowing or lending in the form of debt B. Tedious but simple algebra gives us the following three first order conditions:

$$a = -\frac{1}{2}\frac{\alpha}{\beta} - \frac{1}{4}\rho Q\sigma_r^2 + \frac{1}{2}\rho B\sigma_r^2 \tag{1}$$

$$b = \frac{1}{2}\frac{\alpha}{\beta} + \frac{1}{4}\rho Q\sigma_r^2 + \frac{1}{4}\rho Q\sigma_L^2 + \frac{1}{2}\rho B\sigma_r^2 \tag{2}$$

$$B = \frac{s_B}{\rho\sigma_r^2} - Q\left(\lambda_L - \lambda_D\right) \tag{3}$$

where we have used the definition of the coefficient of relative risk aversion, ρ, as:

$$\rho = -\frac{U''\left(W_0\right)}{U'\left(W_0\right)} \tag{4}$$

In this setting we once more reach some familiar result. Namely that the spread between the deposit and loan lending rates and the money market rate reflects a certain market power for setting bank rates, and compensation for funding risks and credit risk. The price for such compensation is in turn also related, as in previous models, to the risk aversion coefficient. Yet, in contrast with HS-OG papers, the endogenous debt issuance has an impact on deposits' remuneration and lending rates. The impact of debt becomes now apparent. If the bank borrows in the form of debt, it will be less inclined to compete for deposits by offering higher deposit rates. The need for deposits for granting new loans is partly covered by the debt. On the lending rate there is also an impact, in particular, the fact that debt offers an insurance against financing in the money market, allows to lower the spread charged when granting loans.

The equation for B is also new. Decisions on debt issuance or investing in debt, are dependent on the spread s_B. But this cost is in relative terms with the risks associated with financing in the money market. Also, the higher the probability of a loan arrival and the lower the probability of a deposit arrival, the more inclined the bank will be to borrow in the form of debt.

Thus, the model formalises the intuition that financial integration and deepening matter. All in all, if banks operate in an environment of well-functioning debt markets, it is to be expected that they will operate with both lower deposit and lower loan rates than banks in an environment of less developed debt financing markets or fragmented markets as we discuss below. The model thus equally provides a theoretical rationale for justifying the measures introduced by the ECB during the recent crisis to address malfunctioning and fragmentation in euro area covered bond markets.

2.3 Setting bank margins with floating rates

In the previous section we assumed that banks offer 'fixed' rate loans. This is in line with the literature on bank rate setting. However, banks usually offer two types of loans to their clients: fixed rate loans and floating rate loans. In the latter, the loan rate charged is time-varying and usually linked to the fluctuations of the money market rate. Under this pricing strategy, banks pass the cost of the refinancing risks to their borrowers. Deposits are also sometimes linked to the money market rate. In order to take this into account, we assume that the deposit and loan rate of a bank offering floating rates to customers are as follows:

$$r_D = r + a_f + Z_r$$
$$r_L = r + b_f + Z_r$$

where we now denote the bank margins on the rates by a_f and b_f to distinguish them from the fixed rate case. Then, it follows that the net change in wealth following the arrival of a new deposit and the net change in wealth following the arrival of a new loan would be respectively:

$$W_D = -Qa_f + QZ_r$$

$$W_L = Qb_f + QZ_L$$

and W_B would remain the same. Proceeding as above for the case of fixed rates, it follows that the optimal choice for B and the margins a and b would be:

$$a_f = -\frac{1}{2}\frac{\alpha_f}{\beta_f} \tag{5}$$

$$b_f = \frac{1}{2}\frac{\alpha_f}{\beta_f} + \frac{1}{4}\rho Q\sigma_L^2 \tag{6}$$

$$B_f = \frac{s_B}{\rho\sigma_r^2} \tag{7}$$

and where we have also adopted the notation α_f and β_f to distinguish these parameters from the fixed rate case, as it is to be expected that the attractiveness of floating loans for a similar margin $b > 0$ should be lower than for fixed rate loans; and similarly for deposits. Now a_f and b_f are set without reference to money market risks or refinancing risks, as these risks are passed to the borrower and the deposit holder. Also, the cost of the deposit is linked with the potential return from placing banks' excess liquidity in money markets in the event of a deposit arrival not matched by a new loan request. For the same levels of risk (refinancing and default risks on the loan) it is to be expected that the price of a floating loan is lower than the price of a fixed loan. The response in terms of B is also intuitive. For a bank that passes the refinancing risk to the customers, the use of B is only in the form of an alternative investment strategy whenever the $r_b > r$. How much the bank is prepared to invest is of course dependent on the risks of financing that investment in the money markets. Under floating rates refinancing risks are passed to the borrower and thus B does not serve the purpose of insuring against those risks.

2.4 The money market rate

In the model, central banks steer r, the short term money market rate. It is via this rate that the central bank actions have a pass-through to the bank lending rates set by the banks. Open market operations are commonly used by central banks to steer short-term money market interest rates, manage the liquidity conditions in money markets and signal the stance of monetary policy. In the euro area the main refinancing operations (MRO) of the ECB play a pivotal role in pursuing these aims.

Prior to the financial crisis, the amount of liquidity injected by the ECB via the main refinancing operations was just enough for banks to fulfil their reserve requirements without the need for them to make use of either the ECB marginal lending facility (if liquidity injected had been scarce), or the ECB deposit facility (if the liquidity injected had been abundant). By acting in this manner, the EONIA, the effective overnight reference rate for euro area banks, remained always very close to the ECB MRO rate. However, during the financial crisis euro area money markets stopped functioning properly. Banks with a liquidity surplus were reluctant to lend to banks with a liquidity deficit which were perceived as weak. Under these circumstances, the ECB had to step-in with a sequence of non-standard measures that included: the lengthening of the maximum maturity of refinancing operations, the extension of the list of eligible collateral for refinancing operations, the provision of liquidity in foreign currencies, and, above all, the decision to satisfy at a fixed rate (and against collateral) the entire banks' demand for liquidity in the refinancing operations. The ECB implemented this fixed-rate full allotment procedure (FRFA) - for both MROs and long-term refinancing operations (LTRO). The aim was to reassure market participants about their unlimited access to liquidity.

In contrast with conditions prior to the crisis, this new environment generated excess liquidity in money markets, as banks financing from the ECB exceeded the needs justified by the fulfilment of the reserve requirements. This excess liquidity was held to avoid the potential risk of facing difficulties to raise financing in the money markets. As a result of this excess liquidity, the overnight money market rate (EONIA) fell below the MRO rate at which financing from the ECB could be obtained. At the peak of excess liquidity, ECB's refinancing operations were conducted at a rate of 70bp above the EONIA.

This implied that the cost of short-term (money) financing for those banks without access to the money market was aligned with the ECB MRO rate, while banks with access to the money market could finance at the discount rate δ with respect to the MRO rate. That is, if we employ a dummy variable h_i that takes the value of 1 if bank i has access to financing in the money market, and a value of 0 otherwise, then the short-term rate r in our model should be replaced by:

$$r_i = r_{MRO} - \delta h_i$$

3 Empirical Strategy

3.1 A two step estimation strategy

We can use equations (1) and (2) into (3) and solve for B. After tedious algebra, this gives:

$$B = \left(\frac{s_B}{\rho \sigma_r^2} + \frac{1}{4} \beta \rho Q^2 \sigma_L^2 \right) \frac{1}{1 - Q \beta \rho \sigma_r^2} \tag{8}$$

The equations for the margins (1) and (2) provide us with the equations for setting loan and deposit rates, namely:

$$r_D = r_{MRO} - \delta - \frac{1}{2} \frac{\alpha}{\beta} - \frac{1}{4} \rho Q \sigma_r^2 + \frac{1}{2} \rho B \sigma_r^2 \tag{9}$$

$$r_L = r_{MRO} - \delta + \frac{1}{2} \frac{\alpha}{\beta} + \frac{1}{4} \rho Q \sigma_r^2 + \frac{1}{4} \rho Q \sigma_L^2 + \frac{1}{2} \rho B \sigma_r^2 \tag{10}$$

Our objective for the empirical analysis will be to estimate the behavioural equations (8), (9) and (10). In doing so, we will employ a two-step approach. First, we estimate our behavioural equation for debt issuance in (8). Second, we replace the fitted value of B in the first step into the equations of bank rate setting (9) and (10). Note that in doing so, this empirical strategy avoids the problems associated with the endogeneity of B in the model.

3.2 Step 1: bank debt issuance

Equation (8) suggests that issuance (or investing) decisions by the bank depend on the cost of financing s_B in a non-linear manner. It is not the absolute cost of financing, s_B, that matters, it is this cost relative to the magnitude of the risks of financing in the money market that matters. Also, it is not exclusively the risks associated with granting a loan (and for which debt financing is sought), but the risk of this loan relative to the risks of refinancing that loan in the money market that matters. These relationships are not linear. This is clearly illustrated when assessing the implications of the impact of refinancing risks. The sign in equation (8) depends on the magnitude of σ_r^2. The larger the refinancing risks the more inclined a bank is to issue debt to avoid the risks of refinancing in the money markets if a new loan is to arrive. However, the higher σ_r^2 the more uncertain is the return from placing the volume of debt raised temporarily in the money market awaiting the arrival of a potential loan request. This equally suggests that the sign and magnitude of the marginal effects associated with σ_r^2, σ_L^2 and s_B are a priori unknown.

For the empirical analysis we will employ a Taylor series approximation to estimate (8). Furthermore, in effect, debt issuance by banks is not conducted in continuous time due to the fixed preparatory costs associated with these operations. Rather than modelling the volume of debt issuance, we chose then to model bank's decision of whether or not to issue debt, that is we are interested in modelling the $Prob\,(B_{it} < 0)$. This we will do by means of estimating a random effects Probit model.[2] In the definition of s_B we need to take into account that some banks may not have access to money market financing but may only get short term financing at a premium from the ECB (as discussed above). To this purpose, we will use the dummy variable h_{it}^{mm} to identify those banks that have access to money market financing at time t, and hence do not solely depend on the financing of the ECB. Then we further define:

$$(s_B)_{it} = (r_B)_{it} - (r_{MRO})_{it} - (\delta_t) * h_{it}^{mm}$$

In our empirical analysis, our final specification will be adjusted to account for a number of additional factors. First, in our model, issuance decisions were also dependent on the parameters α and β which are associated with market power, and market power may differ across banks and especially so across countries. Second, the theoretical framework also assumes that the structure of the supply of deposits, and the ability of a bank to raise deposits, remains constant. However, recent evidence during the financial crisis suggests that it became more difficult for banks to keep the deposits of their customers without increasing the deposit rate. As the likelihood of banks going bust increased, deposit holders became more anxious about their money and, either they took the deposits away from the banks or demanded a higher return for their deposits. This should equally affect the need for pre-financing via debt. Third, some of the non-standard monetary policies of the ECB

[2]Modelling simultaneously both the decision of whether to issue or not and the decision on how much debt to issue would require the use of the two-part modelling techniques proposed in Camba-Mendez et al. (2014).

were aimed at addressing the tensions in financial markets. Non-standard monetary policy measures in the form of the covered bond purchase programme (CBPP) introduced by the ECB to address malfunctioning and fragmentation in these crucial financial market segments is likely to contain and partly revert divergence in the cost of debt-financing by banks. To account for these issues our model for estimating (8) will be as follows:

$$Prob\,(B_{it} < 0) = \beta_0 + \nu_i + \psi_c + +\beta_1 \left(s_B\right)_{it} + \beta_2 \left(\sigma_r^2\right)_t + \beta_3 \left(\sigma_L^2\right)_t + \beta_4 \left(s_B * \sigma_r^2\right)_{it} + \\ + \beta_5 \left(s_B * \sigma_L^2\right)_{it} + \beta_6 \left(\sigma_r^2 * \sigma_L\right)_t + \beta_7 BEDF_{tc} + \beta_8 CBPP_t + \varepsilon_{it} \qquad (11)$$

where the subindexes i, t and c stand respectively for bank, month and country. In this specification we have included a proxy variable to account for the impact of the CBPP, and also a proxy for the expected default frequency of banks in a given country c at time t, $BEDF_{tc}$. We further include a bank specific random effect, ν_i, which may proxy among other things for disparities in operating costs and, a country specific random effects, ψ_c, to account for disparities in the market power of banks across countries. The fitted probability values obtained from the probit estimation will be defined as $\mathcal{B}_{it} = \widehat{Prob\,(B_{it}} < 0)$.

3.3 Step 2: interest rate setting

Our benchmark model to study the interest rate pass-through from the monetary policy rate, r, to the bank deposit and lending rates is derived from equations (9) and (10) using the estimated $\mathcal{B}$ in place of B. Our empirical specification will incorporate some minor adjustments. First, the theoretical model specifies a complete pass-through of movements in the money market rate to the bank rates. That is, the coefficient of r in the equations for r_L and r_D appear with a coefficient of one. However, in reality, the pass-through might be incomplete due, for instance, to the varying speed and magnitude of changes in the monetary policy stance. Second, and as noted before, the ability to raise deposits was subject to strong fluctuations during the crisis periods. This suggests once more the use of $BEDF_{tc}$ as a regressor. We thus take the following econometric specification:

$$(r_L)_{it} = \beta_0 + \nu_i + \psi_c + \beta_1 (r_{MRO})_t + \beta_2 (\delta_t) * h_{it}^{mm} + \beta_3 \left(\sigma_r^2\right)_t + \beta_4 \left(\sigma_L^2\right)_t + \\ \beta_5 \left(\sigma_r^2 * \mathcal{B}\right)_{it} + \beta_6 BEDF_{tc} + \varepsilon_{it} \qquad (12)$$

The coefficient on r is not fixed to one, and should thus measure the pass-through from the short term rate to the bank lending rate. Once more, the model has bank specific random effects, ν_i, which may proxy among other things for disparities in operating costs and, country specific random effects, ψ_c, to account for disparities in the market power of banks across countries. This model will be estimated for both floating and fixed rate lending rates. From our theoretical discussions above, it is clear that certain variables, e.g. σ_r^2, may not be significant for explaining floating rates. We nonetheless include this variable in the model specification, and check for their significance as a test on validity of the underlying theory. The econometric specification for the deposit rate is similar to that above, but for the fact that default risks on the loan are ignored.[3]

3.4 Theoretical implications of the model

The above model presents the following implications to be tested empirically with our newly assembled database:

1. Compensation for the risks of refinancing in money markets (σ_r^2) requires a widening of bank profit margins, i.e. higher lending rates (r_L) and/or lower deposit rates (r_D);
2. Compensation for credit risk (σ_L^2) prompts higher lending rates (r_L);
3. Banks relying more heavily on ECB financing will charge higher lending rates (r_L) and offer higher deposit rates (r_D);
4. Banks issuing more debt (B) should offer loans with lower lending rates (r_L), and should equally offer lower deposit rates (r_D);
5. Interest rates charged for 'fixed' rate loans will be more sensitive to money market refinancing risks than those charged for 'floating' rate loans.

The first two facts are aligned with the results of Ho and Saunders (1981) and other similar studies. The last three follow from our extensions to the model.

4 The data

4.1 Bank rates

In this paper we use the "Individual MFI Interest Rate Statistics" (IMIR) collected by the ECB on a monthly frequency for the period from July-2007 to October 2014. This database provides monthly bank level information on lending rates charged by banks and deposit rates paid by the same individual banks across the euro area. In total, and after filtering for full data availability, a sample of 55 banks is selected from across eleven euro area countries: Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, Netherlands and Portugal.

The main focus of our empirical analysis will be studying the 'fixed' and 'floating' bank

[3] We estimate our benchmark model by means of maximum likelihood methods employing the lme4 package of the R programming language following the panel regression methodology. The probit model of step 1 is also estimated using the lme4 package of the R programming language.

lending rates offered by euro area banks to non-financial corporations (NFCs). The bank lending 'floating' rate will be that which in the IMIR ECB statistics is defined as the bank lending rate charged for floating rate loans and loans with an up to one-year initial rate fixation.[4] The bank lending 'fixed' rate relates to IMIR ECB bank lending rate charged for loans with over five years of initial rate fixation.

The ECB's IMIR Statistics also distinguishes among lending rates charged for large loans (of amounts larger than one million euro) versus small loans (granted for amounts smaller than one million euro). We assume that the first type is most representative for large corporations that may request larger loans, while the latter is more representative of small and medium sized enterprises (SMEs). When reporting our results below, and when we refer to lending rates to SMEs, it should be understood that we proxy this by the use the rate charged for small size loans.

Rather than focusing on various types of deposit rates, we choose to construct an aggregate representative deposit rate. We do this as follows. For the banks in our sample, most of the deposits held are deposits from households of shorter maturities. We thus compute a weighted average of the interest rate paid to households for overnight deposits and that paid for deposits of one year maturity. The weights used reflect the relative share of these deposits on the balance sheet of the bank.

4.2 Debt issuance and cost of debt financing

We retrieve data on banks' debt issuance volumes from Dealogic DCM.[5] We take in particular uncollateralised issuance that relates to short and medium term notes and corporate bonds. Debt issuance is zero in a large share of the months in the sample. We then transform the series of issuance volumes into a binary series that assigns the value of one when the issuance volume is larger than zero, and the value of zero otherwise.

For the computation of the bond yield, r_B, we proceed as follows. We identify from Dealogic

[4] This should include long maturity loans for which the payment will be in the form of a floating rate for the remaining maturity of the loan, but may of course include fixed rate loans of less than one year of maturity.

[5] Issuance volumes are retrieved using the issuer parent identifier of the Dealogic DCM database. But for a few exceptions, the chosen banking groups have remained relatively stable in composition during the sample. Therefore, issuance volumes for the parent identifier should provide a reliable picture of issuance by the banking group. However, there were some notable exceptions to the composition rule over the sample that had to be addressed on an individual basis.

the ISIN codes of high yield or investment grade senior bonds of series with face value larger than 100 million to guarantee a certain liquidity and thus availability of frequent Bloomberg quotes. We exclude from the list bonds that have been kept in the balance sheet of the bank and those issued with a government guarantee. Quotes for those ISIN codes are then retrieved from Bloomberg. Our aim is to capture the market based cost of financing at the five-year maturity. To do so we choose from the available ISIN quotes for a bank, the one closest to the five year maturity, we then compute the spread between that quoted yield and the Euribor swap rate of similar maturity. The cost of market based financing is thus the sum of that spread (between quote and the Euribor swap rate of corresponding maturity) and the five-year Euribor swap rate.

4.3 Access to money market financing and money market rate

The short term money market rate is defined as $r_i = (r_{MRO})_t - \delta_t h_{it}$, where $(r_{MRO})_t$ is the interest rate of the ECB main refinancing operation, and δ_t is the difference between the ECB main refinancing rate and the EONIA rate; and h_{it} is a dummy variable that takes the value of 1 if bank i has access to financing in the money market at time t, and a value of 0 otherwise.

We construct the variable h_{it} as follows. For every bank in our sample, and using ECB internal data, we check whether the bank made use of the ECB refinancing operations with maturity lower than 3-months, in at least three of the previous six months. When that was the case, the dummy variable was assigned a value of 0.

4.4 Other variables

In line with the specification of our theoretical model, we also employ the following data series.

Funding risks in money markets, σ_r^2, is captured by the implied volatility of the three-month Euribor options with a time to maturity of three months.

Credit risks on bank loans, σ_L^2, is captured by the expected default frequency of non-financial corporations (NFCs) in a given country to measure the exposure of a bank on that country to risk of default on a loan. These series are taken from Moody's KFW.

Elasticity of demand for deposits, BEDF, to capture possible difficulties faced by banks to raise deposits, we include the expected default frequency of a bank in a given country. These series are taken from Moody's KFW.

Descriptive statistics of our dataset are provided in Table 1.

5 Estimation results

Our main results are shown in Table 2 (Step 1 estimation results) and in 3 (Step 2 estimation results). Robustness checks are reported in Tables 4 to 6.

5.1 Debt issuance decisions

Table 2 presents the probit estimation results of equation (11). The basic specification without the additional regressors $CBPP$ and $BEDF$ is reported as the benchmark model (1). The average marginal effects associated with the regressors are also reported in the Table.

As indicated in Section 3, the sign of the marginal impact of a regressor on debt issuance is not defined a priori, as it depends on the various regressors in a non-linear manner. Our estimation results report the 'average' marginal impact of a regressor over the sample, but the actual marginal effect is time varying and dependent on the value of the various regressors at different points in time. Bearing this consideration in mind, the following observations can be made. First, a higher corporate bond yield spread has on overage discouraged debt issuance. The average marginal effect comes negative and significant (although with a low impact) across the various specifications. Second, the average marginal effect associated with the funding risks in money markets, σ_r^2 is also negative (once more across all specifications). As discussed above, tensions in money markets would on the one hand render debt issuance more attractive, to avoid financing in the future at potentially higher costs, but would also make the return of money market deposits more uncertain if the bank were to make no use of the cash raised via debt issuance. Our estimation results indicate that funding risks in money markets have discouraged issuance (on average over the sample). Third, debt issuance does not appear responsive to credit risk exposure. Fourth, concerning the ECB non-standard measures, debt issuance responds positively and significantly to the CBPP program whose task was in fact to address malfunctioning in the covered bond markets, once of the market segments that provide financing to the banks. This result is in line with the evidence provided in Beirne et al. (2009) showing that activity in the covered bond market restarted after the launch of the CBPP in 2009. Fifth, and last, the average marginal effect associated with the BEDF regressor is negative. A priori, the sign of this coefficient is not identified. On the one hand, the higher the expected default frequency of banks in a country, the lower would be the likelihood of a future deposit arrival, and this should thus encourage issuance activity by the banks. On the other hand, the higher the expected default frequency of banks, the more difficult will be for the banks to find financing via debt issuance. The negative sign indicates that the second effect was possibly dominant during the crisis years.

5.2 Bank rate setting

We now turn to banks' setting of the deposit rate and the bank lending rates to non-financial corporations. A look at regression results on the determinants of retail banking rates shown in Table 3, suggests that the first four theoretical implications of our model listed in section 3.4 are broadly validated. First, our regression results show that both the deposit rate and the bank lending rate respond positively to an increase in money market uncertainty. The response of the bank lending rate to an increase σ_r^2 is larger than the response of the deposit rate, suggesting that banks widen their profit margins for being compensated for the higher refinancing risks in money markets. Second, higher risk of default on the loan leads to higher bank lending rates. Third, those banks with access to money markets, and thus banks that relied less on ECB financing, offered lower deposit rates and lower bank lending rates. Fourth, banks that choose to finance via debt offered both lower deposit rates and lower lending rates as shown by the negative coefficient associated with the variable $\sigma_r^2 * \mathcal{B}$ in table 3.

The fifth theoretical implication of our model listed in section 3.4 is, however, not validated by our empirical results. In contrast with what was to be expected, our regression results suggest that floating lending rates are more sensitive to bank's refinancing risks, σ_r^2, than fixed lending rates. This is somehow puzzling, and we do not have a satisfactory explanation for this result.

From a monetary policy perspective, both our theoretical model and the empirical results provide information on the impact of some of the measures introduced by the ECB during the financial crisis. First, the ECB introduced specific measures to alleviate tensions in money markets, e.g. fixed rate full allotment in main refinancing operations, extensions of maturity of liquidity providing monetary operations, and broadening of the collateral pool for conducting operations with the ECB. To the extent that these measures fostered stability in money markets, and reduced the volatility of money market rates, this paper shows that they were also channelled to bank rates. Second, the ECB also introduced measures to address tensions in covered bond markets, e.g. Covered Bond Purchases Programmes. These measures have reactivated activity in both the primary and secondary segments of these markets, as discussed in Beirne et al. (2009). Our results show indeed that access to debt financing has implications for bank rate setting. Finally, the ample provision of liquidity by the ECB has in effect created a two-tier system where banks that had access to money markets, and were less reliant on ECB financing, could finance at a lower cost, and could equally offer lower bank lending rates.

The estimation results presented in table 3 reveal some other interesting issues. For example, they also show that there are some, but not large, disparities between the pricing of loans to SMEs as compared to the pricing of loans to large NFCs. The first observation is that SMEs pay significantly higher interests than NFCs for both fixed and floating rate loans (see the intercepts). The second observation is that bank lending rates of loans to large NFCs appear less sensitive to bank's refinancing risks, σ_r^2. A possible explanation for this might be that large NFCs may have more negotiation powers with the banks through their greater access to several banks but also their ability to issue debt via the market for their financing. Such clout and greater competition (with other banks) certainly explain that tensions in money markets are less easily passed to a large customer. Beyond this difference, the remaining coefficients are broadly aligned with those of SMEs. This is in any case aligned with the results reported in Beck et al. (2008), who equally found in a survey no large discrepancies in bank's handling of large NFCs and SMEs.

A final observation is that the interest rate pass-through from market rates to bank lending rates is always significant and positive and is more sizeable in the case of floating rate loans. This is reflected in the still positive and significant coefficient on the regressor ECB_MRO.

5.3 Robustness check (I): share of floating loans in balance sheet

All euro area banks offer their customers the possibility of borrowing at fixed rates or at floating rates. However, the share of floating rate loans in the loan portfolio of a bank is not homogeneous across euro area banks. When market rates change, the impact on banks profitability across the euro area, can vary substantially due to the disparities in the composition of the loan portfolio. During the financial crisis, the ECB lower interest rates, and this had an impact on the value of the floating rate loans in the balance sheet of the bank. This might have potentially hampered the ability of certain banks to reduce their lending rates. To explore the dependence on this issue we split the sample of banks into two groups:

those banks which hold a relatively larger share of fixed rate loans in their loan portfolio, and those who have a smaller share. We identify those banks using the ECB "Individual MFI Interest Rate Statistics", which provide information on the loan volumes granted with a fixed rate contract and with a floating rate contract.[6]

The estimation results are presented in Table 4 for the decision on debt issuance, and on Table 5 for bank rate setting. Concerning debt issuance, Table 4 shows that there some but minor disparities in the estimated coefficients. These apply namely to the regressor $\sigma_r^2 * \sigma_L^2$. This disparity, however, does not translate in a major impact on the reported average marginal effects. On the whole, but for one exception, the estimation results for the bank rate setting presented in Table 5 are broadly aligned with our main results. That exception is that now the bank lending rates of loans awarded to SMEs by banks which hold a large share of fixed rate loans in their balance sheet, do not appear to decline when the bank finances via debt. Now the coefficient of σ_r^2 is positive although not significant.

This robustness check reveals two other interesting facts. First, the level of the rates is higher, as shown by the intercept term, among those banks which have a large share of floating rate loans in their portfolio. This is to be expected, and may most likely suggest that those banks had to protect their earnings from deteriorating further in an environment of declining interest rate. Second, and somehow interestingly, those banks with a large share of floating rate loans equally demand a higher compensation (both when setting fixed and floating rate loans) against refinancing risks in money markets. This is a result that parallels the puzzle we identified when commenting our main results, namely our failure to find empirical support for the fifth theoretical implication of our model listed in Section 3.4.

5.4 Robustness check (II): countries under financial stress

The sample of banks comprises banks in euro area countries that were subject to significant financial stress, and in particular, in countries which saw a huge escalation of the cost of financing of governments. This equally translated in tensions in the access to financing of banks due to the important nexus between the public sector and the domestic banking system. To ascertain whether our results might fail to reflect important factors associated with this we split the sample of banks in two. The first sample related to those banks in euro area countries under financial stress, i.e. Cyprus, Greece, Ireland, Italy, Portugal and Spain;

[6] Strictly speaking, those loans which we classify as floating rate loans, may also contain some fixed rate loans, but the maturity of those loans is always less than one year.

the second those in euro area countries not under financial stress, i.e. Austria, Belgium, Germany, Finland, France and the Netherlands. The estimation results are shown in table 6.

Once more the first four theoretical implications of our model listed in section 3.4 are broadly validated, when splitting the sample across this dimension. The only caveat is that now the coefficient associated with $\sigma_r^2 * \mathcal{B}$ does not appear statistically significant for the sample of banks in countries not under financial stress, although the sign is negative in most instances. This broad validation of our theoretical model somehow equally reflects on the fact that, as we indicated in the introduction, the large heterogeneity of bank lending rates across the euro area banks was not circumscribed to banks in euro area countries under financial stress.

6 Concluding remarks

We focus on the bank interest rate setting and present a model to analyse if, and possibly how, financing tensions may have been reflected in banks' interest-setting. Our empirical analysis broadly supports our extension of the Ho and Saunders (1981) theoretical framework. In particular, four of the five theoretical implications of our model put to the test are fully validated. First, both the deposit rate and the bank lending rate respond to money market uncertainty, and banks widen the spread between lending rates and deposit rates to compensate for the higher refinancing risks in money markets. Second, higher risk of default on the loan leads to higher bank lending rates. Third, those banks with access to money markets, and thus banks that relied less on ECB financing, offered lower deposit rates and lower bank lending rates. Fourth, banks that choose to finance via debt offered both lower deposit rates and lower lending rates.

The fifth theoretical implication of our model listed in Section 3.4 is, however, not immediately validated by our empirical results. In contrast with what was to be expected, our regression results suggest that floating lending rates are more sensitive to bank's refinancing risks, than fixed lending rates. This is somehow puzzling, and we do not have a complete explanation for this finding. One very tentative explanation is that banks, as part of their marketing strategy, favour smoothing fixed rates more than floating rates, because fixed rates are likely to be more heavily demanded by customers that are more risk averse. This is, however, an issue that we leave for future research.

We have equally argued that both our theoretical model and the empirical results provide a vehicle to understand some of the measures introduced by the ECB during the financial crisis. By implementing measures that helped to alleviate tensions in some market segments, the ECB foster a more stable financing environment for the banks, which in turn was channelled to bank lending rates. At a minimum, this last finding appears consistent with other studies suggesting that the ECB measures during the financial crisis assisted in avoiding a more severe credit crunch (and the possible related deflationary effects) through the stabilisation of inflation expectations and the provision of support to economic activity; see, for example, Lenza et al. (2010), Fahr et al. (2011) and Giannone et al. (2012).

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Technical Appendix

A Derivation of $E\left(W-W_0\right)$ and $E\left(W-W_0\right)^2$

Results are simple following the independence assumptions on the shocks and noting that for the Bernoulli random variables it follows that $E\left(R_D\right)=\lambda_D$ and $E\left(R_D^2\right)=E\left(R_D\right)=\lambda_D$.

$$E\left(W-W_0\right)=E\left[Bs_B-BZ_r+\left(-Qa+QZ_r\right)R_D+\left(-QZ_r+Qb+QZ_L\right)R_L\right]$$

$$=Bs_B-\lambda_D Qa+\lambda_L Qb$$

For the derivation of the square term, and as mentioned in the text, it is assumed that the terms involving the square terms of the loan and deposit margins a and b are negligible and can be safely ignored. We also follow this same rationale with the cross product between the loan and deposit margin with the spread s_B.

$$E\left(W-W_0\right)^2=E\left[Bs_B+Z_r\left(-B+R_DQ-R_LQ\right)+Z_LQR_L-R_DQa+R_LQb\right]^2$$

$$\approx E\left[Z_r\left(-B+R_DQ-R_LQ\right)\right]^2+E\left[Z_LQR_L\right]^2$$

$$\approx \sigma_r^2\left[B^2+\lambda_DQ^2+\lambda_LQ^2+2BQ\left(\lambda_L-\lambda_D\right)\right]+\sigma_L^2Q^2\lambda_L$$

Table 1: Descriptive Statistics of Data.

Series	Min	1st Quantile	Median	3rd Quantile	Maximum	Mean	standard deviation
Debt Asset ratio	0.000	0.000	0.000	0.020	5.438	0.127	0.411
r_D	0.005	0.663	1.120	1.967	7.725	1.363	0.940
Lending rates							
- floating SME	1.200	3.009	4.174	5.576	10.195	4.326	1.556
- floating large NFC	0.410	2.256	3.140	4.760	9.456	3.479	1.485
- fixed SME	0.001	4.100	5.225	6.125	19.768	5.228	1.724
- fixed large NFC	0.001	3.396	4.377	5.347	9.300	4.411	1.400
r_B	0.608	3.064	4.236	5.263	39.241	4.454	2.492
σ_L^2	0.040	0.260	0.430	0.880	12.880	0.759	1.126
ECB_MRO	0.050	1.000	1.000	1.500	4.250	1.575	1.291
σ_r^2	0.000	0.202	0.251	0.323	0.774	0.283	0.138
δ	-0.047	0.000	0.052	0.542	0.682	0.240	0.276

Table 2: Debt Issuance. Step one regression results.

	(1)	(2)	(3)	(4)
Intercept	-1.07^{***}	-1.10^{***}	-1.08^{***}	-1.12^{***}
	(0.24)	(0.24)	(0.24)	(0.24)
s_B	-0.07^{*}	-0.08^{*}	-0.05	-0.05
	(0.04)	(0.04)	(0.04)	(0.04)
σ_r^2	-0.63^{*}	-0.57^{*}	-0.63^{*}	-0.57^{*}
	(0.33)	(0.33)	(0.33)	(0.33)
σ_L^2	0.01	-0.07	0.08	0.01
	(0.10)	(0.10)	(0.10)	(0.10)
$s_B * \sigma_r^2$	0.06	0.06	0.04	0.05
	(0.13)	(0.13)	(0.13)	(0.13)
$s_B * \sigma_L^2$	0.00	0.01	0.00	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
$\sigma_r^2 * \sigma_L^2$	0.10	0.15	0.12	0.18
	(0.29)	(0.29)	(0.30)	(0.30)
CBPP		0.21^{***}		0.23^{***}
		(0.06)		(0.06)
BEDF			-0.08^{**}	-0.10^{***}
			(0.03)	(0.04)
	Average marginal effects			
Intercept	-0.22^{***}	-0.23^{***}	-0.22^{***}	-0.23^{***}
	(0.04)	(0.04)	(0.04)	(0.04)
s_B	-0.01^{***}	-0.01^{***}	-0.01^{**}	-0.01^{**}
	(0.00)	(0.00)	(0.00)	(0.00)
σ_r^2	-0.09^{**}	-0.07^{*}	-0.09^{**}	-0.07^{*}
	(0.04)	(0.04)	(0.04)	(0.04)
σ_L^2	0.01	-0.00	0.02^{*}	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
CBPP		0.04^{***}		0.05^{***}
		(0.01)		(0.01)
BEDF			-0.02^{**}	-0.02^{***}
			(0.01)	(0.01)
obs.	3975	3975	3921	3921
No. banks	62	62	62	62
No. countries	11	11	11	11
Var. banks	2.30	2.31	2.33	2.34
Var. country	0.00	0.00	0.00	0.00

NOTE: Standard deviations of estimated coefficients are reported in between brackets. Significance levels higher than 1%, 5% and 10% are denoted respectively with and ***, ** and *. obs is used to denote available observations, No. banks gives the number of banks in the sample, and No countries the number of countries. The model was estimated with both bank level and country level random effects. The variance of these random effects are reported as 'Var. banks' and 'Var. country' in the table.

Table 3: Deposit rate and lending rate of loans to NFCs. Step two regression results.

	Deposit rate		Fixed rate loans		Floating rate loans	
	(1)	(2)	SME	NFC	SME	NFC
Intercept	0.64***	0.51***	4.28***	3.53***	3.02***	2.12***
	(0.13)	(0.13)	(0.30)	(0.15)	(0.30)	(0.16)
ECB_MRO	0.47***	0.50***	0.33***	0.45***	0.67***	0.76***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)
δ	−0.23***	−0.24***	−0.17**	−0.02	−0.54***	−0.75***
	(0.04)	(0.04)	(0.09)	(0.08)	(0.06)	(0.05)
σ_r^2	0.53***	0.46***	0.20	0.03	0.84***	0.75***
	(0.09)	(0.08)	(0.18)	(0.17)	(0.12)	(0.11)
$\sigma_r^2 * \mathcal{B}$	−0.91***	−0.56**	−2.37***	0.21	−1.42***	−1.48***
	(0.22)	(0.22)	(0.48)	(0.42)	(0.32)	(0.31)
BEDF		0.10***				
		(0.01)				
σ_L^2			0.37***	0.10***	0.23***	0.29***
			(0.03)	(0.03)	(0.02)	(0.02)
	Average marginal effects					
σ_r^2	0.27***	0.30***	−0.47***	0.09	0.44***	0.33***
	(0.07)	(0.07)	(0.14)	(0.13)	(0.09)	(0.09)
$\mathcal{B}$	−0.24***	−0.15**	−0.64***	0.06	−0.38***	−0.40***
	(0.06)	(0.06)	(0.13)	(0.11)	(0.09)	(0.08)
obs.	3068	3068	3418	3428	3386	3453
No. banks	54	54	57	58	58	59
No. countries	11	11	11	11	11	11
Var. banks	0.07	0.07	0.80	0.62	0.42	0.23
Var. country	0.15	0.15	0.73	0.07	0.84	0.21
Var: Residual	0.24	0.23	1.24	1.01	0.50	0.47

NOTE: Standard deviations of estimated coefficients are reported in between brackets. Significance levels higher than 1%, 5% and 10% are denoted respectively with and ***, ** and *. obs is used to denote available observations, No. banks gives the number of banks in the sample, and No countries the number of countries. The variance of the bank level and country level random effects are reported as 'Var. banks' and 'Var. country'.

Table 4: Debt Issuance. Step one regression results (SAMPLE SPLIT).

	Large % of fixed rate loans in balance sheet				Large % of floating rate loans in balance sheet			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Intercept	−1.24***	−1.22***	−1.28***	−1.26***	−0.72**	−0.76**	−0.74**	−0.80***
	(0.43)	(0.43)	(0.44)	(0.43)	(0.30)	(0.30)	(0.30)	(0.30)
s_B	−0.05	−0.06	−0.03	−0.04	−0.09*	−0.09*	−0.06	−0.05
	(0.09)	(0.09)	(0.09)	(0.09)	(0.05)	(0.05)	(0.05)	(0.05)
σ_r^2	−0.71	−0.79	−0.64	−0.70	−0.80*	−0.71*	−0.79*	−0.69
	(0.66)	(0.66)	(0.65)	(0.66)	(0.42)	(0.42)	(0.42)	(0.42)
σ_L^2	−0.32	−0.54*	−0.07	−0.28	0.04	−0.05	0.10	0.01
	(0.28)	(0.30)	(0.30)	(0.32)	(0.11)	(0.11)	(0.11)	(0.12)
$s_B * \sigma_r^2$	0.00	0.03	−0.05	−0.02	0.11	0.11	0.08	0.07
	(0.32)	(0.32)	(0.32)	(0.32)	(0.15)	(0.16)	(0.16)	(0.16)
$s_B * \sigma_L^2$	−0.01	−0.00	−0.01	−0.00	0.01	0.01	0.00	0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
$\sigma_r^2 * \sigma_L^2$	1.24	1.61**	1.20	1.50*	−0.05	−0.01	−0.06	0.00
	(0.76)	(0.80)	(0.76)	(0.80)	(0.33)	(0.33)	(0.34)	(0.34)
CBPP		0.22**		0.21*		0.28***		0.33***
		(0.11)		(0.11)		(0.08)		(0.09)
BEDF			−0.16*	−0.16*			−0.07*	−0.11***
			(0.09)	(0.09)			(0.04)	(0.04)
	Average marginal effects							
Intercept	−0.22***	−0.21***	−0.23***	−0.22***	−0.18***	−0.19***	−0.18***	−0.20***
	(0.06)	(0.06)	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
s_B	−0.01	−0.01	−0.01	−0.01	−0.01**	−0.01***	−0.01	−0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)
σ_r^2	0.02	0.06	−0.02	0.00	−0.13**	−0.10	−0.16**	−0.13*
	(0.06)	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
σ_L^2	0.00	−0.02	0.04	0.02	0.01	−0.00	0.02	0.01
	(0.02)	(0.03)	(0.03)	(0.03)	(0.01)	(0.02)	(0.02)	(0.02)
CBPP		0.04**		0.04*		0.07***		0.08***
		(0.02)		(0.02)		(0.02)		(0.02)
BEDF			−0.03*	−0.03*			−0.02*	−0.03***
			(0.02)	(0.02)			(0.01)	(0.01)
obs.	1734	1734	1725	1725	1987	1987	1942	1942
No. banks	28	28	28	28	30	30	30	30
No. countries	10	10	10	10	9	9	9	9
Var. banks	2.94	2.95	3.03	3.00	1.72	1.73	1.76	1.78
Var. country	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: Standard deviations of estimated coefficients are reported in between brackets. Significance levels higher than 1%, 5% and 10% are denoted respectively with and ***, ** and *. obs is used to denote available observations, No. banks gives the number of banks in the sample, and No countries the number of countries. The variance of the bank level and country level random effects are reported as 'Var. banks' and 'Var. country'.

Table 5: Deposit rate and lending rate of loans to NFCs. Step two regression results (SAMPLE SPLIT).

	Large % of fixed rate loans in balance sheet					Large % of floating rate loans in balance sheet				
		Fixed rate loans		Floating rate loans			Fixed rate loans		Floating rate loans	
	Dep. rate	SME	NFC	SME	NFC	Dep. rate	SME	NFC	SME	NFC
Intercept	0.55***	3.88***	3.62***	2.56***	1.91***	0.43***	4.56***	3.42***	3.38***	2.24***
	(0.18)	(0.34)	(0.22)	(0.25)	(0.16)	(0.12)	(0.38)	(0.20)	(0.41)	(0.23)
ECB_MRO	0.50***	0.46***	0.47***	0.77***	0.81***	0.51***	0.26***	0.45***	0.60***	0.74***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.03)	(0.02)	(0.02)	(0.01)
δ	−0.10	0.18	−0.05	−0.38***	−0.61***	−0.31***	−0.39***	0.09	−0.58***	−0.82***
	(0.09)	(0.12)	(0.11)	(0.08)	(0.09)	(0.04)	(0.12)	(0.11)	(0.08)	(0.07)
σ_r^2	0.45**	0.07	−0.22	0.75***	0.71***	0.49***	0.56*	0.26	0.90***	0.79***
	(0.18)	(0.23)	(0.21)	(0.17)	(0.18)	(0.08)	(0.29)	(0.26)	(0.17)	(0.15)
$\sigma_r^2 * \mathcal{B}$	−0.55	0.30	−0.08	0.49	−1.10**	−0.60***	−4.08***	0.46	−2.12***	−1.64***
	(0.51)	(0.63)	(0.57)	(0.51)	(0.53)	(0.20)	(0.71)	(0.61)	(0.43)	(0.38)
BEDF	0.07***					0.11***				
	(0.02)					(0.01)				
σ_L^2		0.12***	0.19***	0.22***	0.29***		0.61***	0.05	0.23***	0.30***
		(0.03)	(0.04)	(0.02)	(0.02)		(0.04)	(0.04)	(0.02)	(0.02)
	Average marginal effects					*Average marginal effects*				
σ_r^2	0.30*	0.15	−0.24	0.89***	0.40**	0.32***	−0.60***	0.39**	0.30**	0.33***
	(0.17)	(0.20)	(0.17)	(0.15)	(0.16)	(0.06)	(0.21)	(0.19)	(0.12)	(0.11)
$\mathcal{B}$	−0.15	0.08	−0.02	0.13	−0.30**	−0.16***	−1.10***	0.12	−0.57***	−0.44***
	(0.14)	(0.17)	(0.15)	(0.14)	(0.14)	(0.05)	(0.19)	(0.17)	(0.12)	(0.10)
obs.	1176	1552	1608	1471	1480	1817	1790	1748	1840	1848
No. banks	23	27	28	27	27	30	29	29	30	30
No. countries	10	10	10	10	10	9	8	9	9	9
Var. banks	0.12	0.54	0.81	0.36	0.22	0.03	1.29	0.33	0.41	0.19
Var. country	0.21	0.76	0.11	0.42	0.11	0.11	0.56	0.14	1.29	0.37
Var. residual	0.40	0.95	0.83	0.43	0.52	0.12	1.40	1.17	0.53	0.43

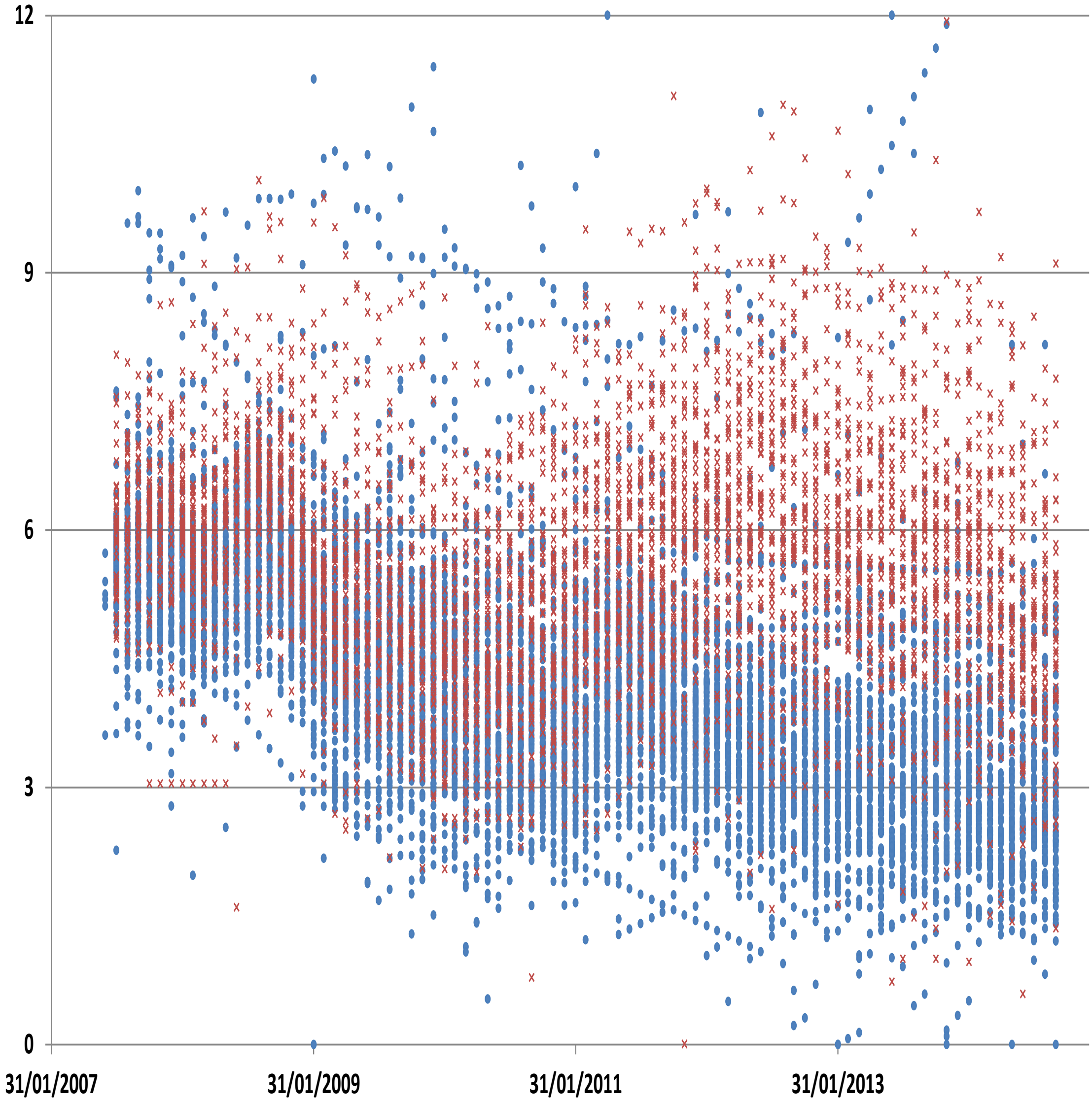
NOTE: Standard deviations of estimated coefficients are reported in between brackets. Significance levels higher than 1%, 5% and 10% are denoted respectively with and ***, ** and *. obs is used to denote available observations, No. banks gives the number of banks in the sample, and No countries the number of countries. The variance of the bank level and country level random effects are reported as 'Var. banks' and 'Var. country'.

Table 6: Deposit rate and lending rate of loans to NFCs. Step two regression results (STRESS COUNTRY SAMPLE SPLIT).

	Banks in countries under financial stress					Banks in countries NOT under financial stress				
		Fixed rate loans		Floating rate loans			Fixed rate loans		Floating rate loans	
	Dep. rate	SME	NFC	SME	NFC	Dep. rate	SME	NFC	SME	NFC
Intercept	0.54***	5.68***	4.05***	4.04***	2.57***	0.41*	3.05***	2.87***	2.10***	1.75***
	(0.14)	(0.29)	(0.19)	(0.37)	(0.25)	(0.22)	(0.25)	(0.15)	(0.17)	(0.12)
ECB_MRO	0.45***	0.16***	0.38***	0.57***	0.71***	0.59***	0.54***	0.52***	0.83***	0.86***
	(0.01)	(0.03)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
δ	−0.16***	−0.19	−0.00	−0.38***	−0.75***	−0.23**	−0.18**	−0.21**	−0.56***	−0.58***
	(0.03)	(0.14)	(0.12)	(0.08)	(0.07)	(0.10)	(0.07)	(0.09)	(0.07)	(0.08)
σ_r^2	0.41***	0.36	−0.05	1.16***	1.04***	0.51***	−0.20	−0.21	0.41***	0.55***
	(0.07)	(0.32)	(0.27)	(0.18)	(0.16)	(0.19)	(0.15)	(0.18)	(0.14)	(0.16)
$\sigma_r^2 * \mathcal{B}$	−0.38**	−4.53***	0.39	−2.34***	−2.09***	−0.82*	−0.13	0.16	0.01	−0.67
	(0.18)	(0.84)	(0.71)	(0.48)	(0.43)	(0.48)	(0.37)	(0.44)	(0.37)	(0.41)
BEDF	0.08***					0.13				
	(0.00)					(0.10)				
σ_L^2		0.25***	0.02	0.18***	0.28***		1.02***	0.88***	0.21***	−0.02
		(0.03)	(0.03)	(0.02)	(0.02)		(0.07)	(0.09)	(0.06)	(0.07)
	Average marginal effects					*Average marginal effects*				
σ_r^2	0.31***	−0.93***	0.06	0.49***	0.45***	0.28*	−0.24**	−0.16	0.42***	0.36***
	(0.05)	(0.24)	(0.20)	(0.13)	(0.12)	(0.16)	(0.12)	(0.14)	(0.12)	(0.14)
$\mathcal{B}$	−0.10**	−1.22***	0.10	−0.63***	−0.56***	−0.22*	−0.03	0.04	0.00	−0.18
	(0.05)	(0.22)	(0.19)	(0.13)	(0.11)	(0.13)	(0.10)	(0.12)	(0.10)	(0.11)
obs.	1922	1875	1861	2001	2010	1146	1543	1567	1385	1443
No. banks	33	33	34	34	34	21	24	24	24	25
No. countries	5	5	5	5	5	6	6	6	6	6
Var. banks	0.04	1.16	0.80	0.49	0.22	0.11	0.29	0.40	0.24	0.20
Var. countries	0.09	0.14	0.01	0.55	0.24	0.21	0.26	0.00	0.09	0.01
Var. residual	0.08	1.82	1.32	0.60	0.51	0.45	0.38	0.60	0.28	0.38

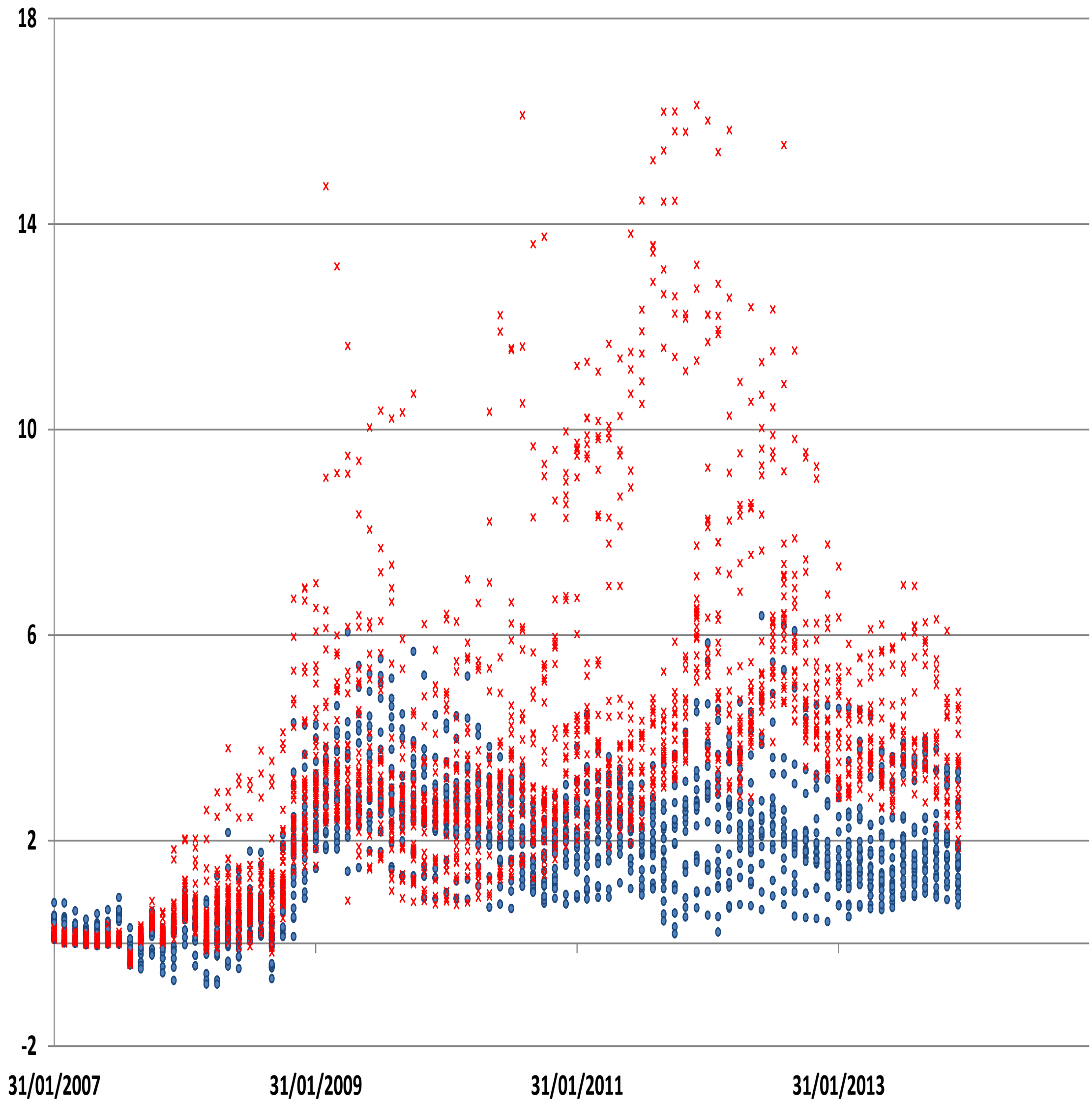
NOTE: Standard deviations of estimated coefficients are reported in between brackets. Significance levels higher than 1%, 5% and 10% are denoted respectively with and ***, ** and *. obs is used to denote available observations, No. banks gives the number of banks in the sample, and No countries the number of countries. The variance of the bank level and country level random effects are reported as 'Var. banks' and 'Var. country'.

Figure 1: Bank lending rates for medium term loans to SMEs.



Sources:ECB Individual MFI interest rate statistics.
Note:bank level data, every cross represents a point observation for a bank of the bank lending rate to NFCs of loans with a maturity of one to five years an amount smaller than 1 euro million. A red cross symbol is used for banks in euro area countries under financial stress, and a red dot for banks in euro area countries not under financial stress. Euro area countries under financial stress are: GR, IE, IT, PT and SP. Euro area countries not under financial stress refer to AT, BE, DE, FI, FR and NL.

Figure 2: Corporate bond yield spread of euro area banks.



Sources:Thomson Reuters and ECB calculations.
Note:bank level data, every symbol represents a point observation for a bank of the spread between the yield paid for medium-term unsecured debt and the 3-month Euribor rate. Details on the computation of the senior unsecured bank bond yield spread are given in section 3. A red cross symbol is used for banks in euro area countries under financial stress, and a red dot for banks in euro area countries not under financial stress. Euro area countries under financial stress are: GR, IE, IT, PT and SP. Euro area countries not under financial stress refer to AT, BE, DE, FI, FR and NL.

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