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Jagged cliffs and stumbling blocks: interest rate pass-through fragmentation during the euro area crisis

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Abstract

The financial crisis has been characterised by fragmentation in the transmission of monetary policy, reflected in high dispersion in the cost of bank finance for euro area firms. Using micro-level bank data across a number of euro area countries, we identify individual bank balance sheet characteristics that contributed to this fragmentation. Interest rate pass-through heterogeneity is estimated using an error correction framework, which captures banks' funding constraints and balance sheet structures. Results show incomplete pass-through of changes in money market rates targeted by the central bank to firms' lending rates, with increases in sovereign bond yields affecting the cost of finance for firms, particularly in stressed countries. Individual bank characteristics have an effect on pass-through during the crisis, even after controlling for changes in macroeconomic conditions. The effect is greatest when looking at characteristics that capture bank funding difficulties, suggesting that a recovery in banks' funding capacities is an important element in reducing fragmentation in the transmission of monetary policy.

JEL Classification: E52, E58, G01, G20, E43.
Keywords: Interest rate pass-through, Monetary policy transmission, Financial crises.

Non-Technical Summary

The financial crisis has been characterised by fragmentation in the transmission of monetary policy, reflected in the high dispersion in the cost of bank finance across euro area firms. Interest rates, in particular on smaller loans, remained stubbornly high in many peripheral euro area countries, despite the highly accommodative monetary policy. This suggests that banks, albeit to varying degrees, did not fully pass on policy rate cuts to the real economy. In fact, lending rates to firms diverged significantly both across and within countries, suggesting that dispersion was not only driven by differences in macroeconomic conditions and borrower quality, but also by bank level factors. Understanding the source of disruptions to the monetary transmission mechanism, and the extent to which macroeconomic and bank level factors impact pass-through, is vital to ensure effective policy formulation and implementation.

Using a new micro dataset on euro area banks, we identify which factors affected the response of individual banks to monetary policy changes. We investigate the transmission of monetary policy using an error correction framework and determine whether, and which, individual bank characteristics contributed to its fragmentation, over and above the macroeconomic and country factors at play. We focus on lending rates to firms as these rates saw the most dispersion and greatest disruption. We also look at the lending rates on small and large loans separately as proxies for lending to small and large firms respectively. We cover a range of individual bank characteristics that are expected to influence banks' funding costs and, consequently, the lending rates they set.

Our results show that changes in policy rates were only incompletely passed on to firms' lending rates during the crisis period. Increases in sovereign bond yields affected the cost of finance for firms, particularly in stressed countries. Individual bank characteristics also had an effect on the pass-through of policy rate cuts, even after changes in macroeconomic conditions and country differences are controlled for. Similar to previous literature we examine the impact of variables such as size, liquidity and capital and we also look at variables which became more relevant during the crisis, such as recourse to central bank borrowing and credit default swap spreads, as they capture funding risks. We analyse a number of different aspects of pass-through and assess how bank characteristics are relevant for both short run adjustments and for the overall level of rates set by banks. Bank specific effects are greatest when looking at characteristics that capture bank funding difficulties, with riskier banks transmitting less of the policy rate cuts through to firms. We find that these characteristics can affect overall pass-through of monetary policy rates and not only the short run adjustments. Moreover, we show that the overall pass-through of policy rate cuts has been lower for smaller loans, suggesting that small and medium sized enterprises (SMEs) may have been most adversely affected by the fragmentation in the transmission of monetary policy.

The analysis draws on a novel dataset collected by the European Central Bank (ECB) on individual balance sheet and interest rate information for a sample of monetary and financial institutions (MFIs) from mid-2007 to mid-2012. With these data, we are among the first to examine the factors behind interest rate heterogeneity using micro data across a number of euro area countries and therefore provide a unique contribution to the literature on banks' interest rate pricing during the crisis. Our findings are robust to a number of different specifications and they underscore the importance of bank balance sheets and the recovery in banks' funding capacities for the effective transmission of monetary policy.

"during the crisis, normal heterogeneity has turned into detrimental fragmentation: a landscape with natural diverse scenery has turned into a dangerous surface with jagged cliffs and stumbling blocks."

- Mario Draghi, 2013

1 Introduction

One of the most salient features of the recent euro area crisis has been the wide and persistent dispersion in the cost of bank credit in particular to non-financial corporations (NFCs). Despite highly accommodative monetary policy, interest rates, in particular on smaller loans to NFCs, remained stubbornly high in many peripheral euro area countries. The extent to which many banks passed on the changes in money market rates targeted by the central bank to their borrowers diminished as the crisis escalated, as can be seen in the increased spread on NFC loans over money market rates (see Appendix Figure 1). Divergence in lending conditions across countries stabilised at historically high levels after a first upward shock in early 2009 - as is demonstrated by the cross country coefficient of interest rate variation (see Appendix Figure 2). Variation was not only seen across countries however; micro data show that the dispersion in interest rates set by individual banks also increased within given countries (see Appendix Figure 3). This indicates that the dispersion was not only driven by heterogeneity in macroeconomic conditions and borrower quality, but also by bank-level factors. Therefore, notwithstanding the increase in risk premia in many countries, heterogeneity in interest rate pricing was high and the transmission mechanism of monetary policy impaired.

Using a novel dataset collected by the European Central Bank (ECB) on individual balance sheet and interest rate information for a sample of monetary and financial institutions (MFIs), we analyse some of the "jagged cliffs and stumbling blocks" that drive this detrimental fragmentation. While many country- and bank-level factors may lead to the heterogeneous transmission of monetary policy, we focus on the latter set of characteristics by exploiting the information on individual banks in our dataset. Existing micro-based studies are largely for individual countries, while the data used in this paper include many euro area countries.[1] In this way, our paper makes a significant contribution to the interest rate pass-through literature and derives important findings for the euro area during this crisis period. We investigate the overall extent of the breakdown in the transmission of monetary policy and determine whether, and which, individual bank characteristics contributed to fragmentation, over and above the macroeconomic factors at play. We focus on lending rates to NFCs as these are the rates that have seen the most dispersion and greatest disruption. We also look separately at the lending

[1] See for example, Weth (2002) on Germany, Gambacorta (2008) on Italy, Rocha (2012) on Portugal, De Graeve, De Jonghe, and Vennet (2007) for Belgium and Hofmann and Mizen (2004) for the UK.

rates on small and large loans as proxies for lending to small and large firms respectively. We focus on a range of individual bank characteristics that are expected to influence banks' funding costs and, consequently, the lending rates they set. Some of the variables include: individual banks' borrowings from the Eurosystem, their holdings of government securities, liquid assets and credit default swap (CDS) spreads.

Our work provides a number of important results for the crucial crisis period from the middle of 2007 to 2012. First, we show that pass-through of changes in policy rates to NFC interest rates was incomplete over this period, in both stressed and non-stressed countries, even after controlling for the changes in macroeconomic variables. Moreover, we show that overall pass-through of policy changes has been weaker for smaller loans as compared to large loans. This suggests that interest rates on loans to SMEs decreased by less than those on loans to large firms as policy rates were cut. With regards to macro variables, sovereign bond yields had an effect on interest rate pricing over the period, especially in stressed countries. For the micro variables, individual banks' balance sheet characteristics have affected how banks respond to monetary policy changes: variables that are most associated with funding difficulties over the crisis, such as banks' CDS spreads and Eurosystem borrowings, show the biggest influence on how banks' respond to changes in money market rates, not only in the short run, but also in the overall level reaction.

Peek and Rosengren (2013) assert that the recent crisis has led to a significant re-evaluation of the crucial role that financial intermediaries can play in the transmission of monetary policy and in amplifying the impact of financial shocks in general. Our results offer evidence to support this assertion. They are also in line with the claim by Disyatat (2010), that banks, depending on the strength of their balance sheets, can act either as absorbers or amplifiers of shocks. Overall, our paper shows evidence of a bank lending channel, as we find that credit supply conditions can be affected by bank characteristics, that are unrelated to borrower quality.[2]

The rest of the paper is organised as follows. Section 2 reviews the literature on interest rate pass-through which is relevant for our analysis. Section 3 outlines the empirical methodology. It introduces our baseline specification to analyse interest rate pass-through and our extended specification which captures the effects of bank-level characteristics. Section 4 describes the dataset and variables used. Section 5 presents the results for the baseline estimation for the euro area and for stressed and non-stressed country groupings and then shows results for the effect of bank characteristics on interest rate pricing. Section 6 presents a number of robustness checks and section 7 concludes.

[2]The bank lending channel refers to the view that the health of the banking sector is important for monetary policy transmission, as it can affect the behaviour of banks and impact the nature and size of their response to shifts in monetary policy (Peek and Rosengren (1995a)).

2 Theory and literature

The interest rate channel is concerned with the extent to which monetary policy is transmitted to the real economy. When a central bank changes the official rate, it affects short term money market rates, longer-term rates, banks' cost of funds, and, ultimately, bank lending rates (Borio and Fritz (1995)). However, the timing and extent of this transmission depends on additional factors which are often outside the direct control of monetary policy. These factors can be related to banks' and firms' external financing premium, as accounted for in the bank lending and the balance sheet channels of monetary policy (Bernanke and Gertler (1995)). As banks often do not fully pass on rate adjustments to the real economy they have also been labelled "non-neutral conveyors of monetary policy" (Kwapil and Scharler (2007)).

There is a large literature on interest rate pass-through for the euro area. In the pre-crisis period, overall pass-through was generally larger than 0.8 and in many cases full pass-through could not be rejected (de Bondt (2002), Toolsema, Sturm, and Haan (2002), Angeloni and Ehrmann (2003), Sorensen and Werner (2006) and van Leuvensteijn, Sorensen, Bikker, and van Rixtel (2008) among others). This implied that more than 80% of the policy rate change would be passed onto borrowers in the long run. Estimates for short run pass-through were more varied, in general suggesting that around half of the changes in policy rates would be immediately passed onto lending rates.

A more recent strand of the literature has focused on the effects of the financial crisis. Hristov, Hülsewig, and Wollmershäuser (2012) find that pass-through in the euro area became significantly less complete during the crisis. Using country-level data, Darracq-Paries, Moccero, Krylova, and Marchini (2014) find that heterogeneity in interest rates during the euro area financial and sovereign debt crisis is related to credit risk and risk perceptions, banks' under-capitalisation, poor quality of their assets and fragmentation in bank funding conditions. Arnold and van Ewijk (2014) find that the dispersion in interest rates across the euro area was caused by heterogeneity in sovereign and credit risk. For Italian banks, Albertazzi, Ropele, Sene, and Signoretti (2012) also find that an increase in the sovereign bond yield increases the cost of funding and leads to a rise in the cost of credit to the private sector. Illes and Lombardi (2013) show that for a number of advanced economies, the relationship between policy and lending rates became misaligned in all areas following the onset of the financial crisis in 2008, but by 2013 the relationship had returned close to the pre-crisis levels in the United States and Germany, while it remained impaired in peripheral euro area countries. Illes, Lombardi, and Mizen (2015) find that the change in banks' weighted average cost of funding is the main reason why lending rates did not fall to the same extent as policy rates. When taking into account pass-through from funding costs, they find that bank pricing behaviour remained stable across a number of European countries.

Others have looked at whether there are differences in the transmission for large and small loans.

When looking at a sample of euro area countries between 2003 to 2011 using a Markov switching VAR framework, Aristei and Gallo (2014) find that the degree of pass-through for large loans is higher than that of small loans. This result is confirmed by Al-Eyd and Berkmen (2013) who show that both long and short run pass-through is lower for small loans, and that pass-through is dampened during the crisis.

Micro data from individual banks has been used to investigate which bank specific characteristics have an effect on pass-through. De Graeve, De Jonghe, and Vennet (2007) use pre-crisis micro data to investigate pass-through in Belgium and find that overall pass-through is incomplete in the long run. They ascribe the substantial degree of heterogeneity in pricing to banks' market power and individual characteristics. Specifically, well capitalised and highly liquid banks are not as responsive to changing market conditions as others. Gambacorta (2008) finds that heterogeneity in pass-through exists only in the short run and not in the long run, using a panel of Italian banks. He also finds that the rates of liquid and well-capitalised banks react less to changes in official rates, but that bank size is not relevant. Cecchin (2011) and Raknerud, Vatne, and Rakkestad (2011) find evidence that pass-through is sluggish and incomplete for Swiss and Norwegian banks respectively. Gambacorta and Mistrulli (2011) analyse interest rate pricing in Italy following the collapse of Lehman Brothers. Using both micro bank and firm data, they find that close lending relationships were more insulated from the financial crisis and that interest rate spreads increased by less in banks that were well-capitalised, liquid and that engaged mainly in traditional lending business. For Japan, Kitamura, Muto, and Takei (2015) find, using data on individual banks and firms, that borrower characteristics seemed to be less important determinants of pass-through during the crisis than in normal times. They also find, in contrast to studies on European countries, that banks increased pass-through during the crisis, due possibly to pressure to from competition and to the extensive monetary easing.

Our analysis significantly contributes to the literature using micro bank balance sheet data and the literature that focuses on the crisis. We are among the first to use harmonised data on individual banks across a number of euro area countries and therefore we can look beyond country-level factors to analyse which bank characteristics have affected pass-through during the crisis. For this reason, our results are more generalisable, and not specific to single countries. Moreover, we analyse results for different lending rates on small and large loans. While a number of papers also focussed on the asymmetric effects of monetary policy changes on interest rate pricing behaviour (for example, Sander and Kleimeier (2004) and de Bondt, Mojon, and Valla (2005)), our dataset only covers a period of significant monetary loosening and so affords no opportunity to look at these effects.[3] A well-known problem in this literature is that it can be difficult to distinguish between supply and demand when

[3]The policy rate was cut from 4.25 per cent in the middle of 2007 to just 1 per cent in the middle of 2012, with only two marginal increases of 25 basis points in the middle of 2011, which were subsequently reversed.

we see a change in credit conditions, and moreover whether changes in supply are related to the banks' or borrowers' balance sheets.[4] Similar to other papers in this area, we follow the rationale that bank-specific characteristics (size, capital and liquidity, for instance) influence loan supply and are unrelated to borrower demand or quality to overcome this problem (Kashyap and Stein (2000), Gambacorta (2008)).

3 Empirical methodology

When central banks change their official rate they aim to impact interest rates set by banks ($ir_{i,t}$), by targeting money market rates (mr_t) that affect banks' cost of funds. Banks also set rates with a mark-up to cover fixed costs and to make a profit. Clearly, cross-country macroeconomic differences emerged during the financial crisis that also affect interest rate pricing. The deterioration in economic conditions, not only diminished banks' balance sheet capacity to lend, but also led to a deterioration in borrowers' balance sheets increasing the risk of lending. Economic developments also affect investment prospects and firms' demand for finance which additionally impact the price of credit provided by banks.

In order to analyse the relationship between interest rates, money market rates and macroeconomic conditions thoroughly and to capture both the long and short term dynamics, we use a single equation generalised error correction model (ECM) as outlined in Banerjee, Galbraith, and Dolado (1990), which can be specifed as follows:

$$\triangle ir_{i,t} = \mu_i + \sum_{j=1}^{n} \alpha_j \triangle ir_{i,t-j} + \sum_{j=0}^{n} \beta_j \triangle mr_{t-j} + \delta(ir_{i,t-1} - mr_{t-1}) \\ + \eta mr_{t-1} + \sum_{j=0}^{n} \gamma_j \triangle X_{k,t-j} + \epsilon_t. \quad (1)$$

In this framework, monthly changes in a bank's interest rates at time t ($\triangle ir_{i,t}$) depend on their past changes, changes in the money market rate ($\triangle mr_t$) which reflect movements in monetary policy, and the misalignment or "error" from the overall relationship between the level of the interest rate with the level of money market rates in the previous period ($ir_{i,t-1} - mr_{t-1}$). To allow the long run relationship between the variables to deviate from one-to-one, a lagged term of mr_{t-1} is entered to

[4] A number of recent papers have made advances in this area by combining bank- and firm-level data to separate these effects. Jimenez, Ongena, Peydro, and Saurina (2012) find evidence of a bank lending channel by showing that tighter monetary and worse economic conditions reduce loans from banks with lower capital or liquidity ratios after they control for time-varying firm heterogeneity in loan demand. They show that in responding to loan applications from the same firm, weak banks are less likely to grant a loan.

break homogeneity, as in Banerjee, Galbraith, and Dolado (1990). $\triangle X_k$ is a vector of changes in a number of important macroeconomic variables - government bond yields, unemployment and inflation - for each country k. These variables capture the economic deterioration that would affect banks' willingness and capacity to lend. We also include bank fixed effects (μ_i) in all specifications to control for any additional unobserved bank specific differences that may affect loan pricing.[5] In line with the methodology of Banerjee, Galbraith, and Dolado (1990) and similar to Gambacorta (2008), we use the following autoregressive distributed lag specification for ease of estimation:

$$\triangle ir_{i,t} = \mu_i + \sum_{j=1}^{n} \alpha_j \triangle ir_{i,t-j} + \sum_{j=0}^{n} \beta_j \triangle mr_{t-j} + \delta ir_{i,t-1} + \theta mr_{t-1} + \sum_{j=0}^{n} \gamma_j \triangle X_{k,t-j} + \epsilon_t \tag{2}$$

The estimation of equation (2) provides the same results as the estimation of equation (1) and yields crucial information about the relationship between money market rates targeted by policymakers and interest rates set by banks. The immediate reaction of a bank to a change in the money market rate is captured by β_0. δ allows us to assess how fast a bank adjusts the interest rate when its level is out of line with its equilibrium relationship with money market rates. It is basically the percentage of the error that is corrected in the next period. This coefficient should be negative and significant if a cointegrating relationship exists between the variables: the more negative it is, the faster is the adjustment to equilibrium. Finally, the overall relationship between the two is measured by comparing the coefficients on the level of the bank and the money market rate ($-\theta/\delta$).[6] If pass-through is complete and banks pass on all changes in money market rates, this ratio will equal 1.

As we are interested in the individual characteristics that may affect banks' response to changes in monetary policy, we extend equation (2) by adding bank-level characteristics. Using a similar methodology as in Gambacorta (2008), we interact bank characteristics with changes in money market rates and with the levels of money market and bank rates and adjust equation (2) as follows:

$$\begin{aligned} \triangle ir_{i,t} = \mu_0 &+ \sum_{j=1}^{n} \alpha_j \triangle ir_{i,t-j} + \sum_{j=0}^{n} (\beta_j + \beta_j^* Z_{i,t-1}) \triangle mr_{t-j} + \lambda Z_{i,t-1} \\ &+ (\delta + \delta^* Z_{i,t-1}) ir_{i,t-1} + (\theta + \theta^* Z_{i,t-1}) mr_{t-1} + \sum_{j=0}^{n} \gamma_j \triangle X_{k,t-j} + \epsilon_t \end{aligned} \tag{3}$$

[5] In all estimations shown in sections 5 and 6 n=1, but the main findings are not sensitive to the lag length selection.

[6] Comparing equations (1) and (2) shows that θ from equation (2) is equivalent to $(\eta - \delta)$ from equation (1). Therefore, it is easily shown that overall pass-through calculated from equation (2) using $-\theta/\delta$ is the same as the overall pass-through calculated from equation (1) using 1-(η/δ).

In this equation, Z is a set of bank-level characteristics that may impact pass-through. In all cases we include these variables at a lag (t-1) to mitigate endogeneity concerns. Each variable is normalised with respect to the average across all banks, in each period of time, so that the coefficients on β^*, δ^* and θ^* are directly interpretable as average effects (as in Gambacorta 2004 and 2008). We can determine which bank characteristics affect pass-through by observing which of these interactions are significant and which are not. We look at each characteristic separately and measure its effect on pass-through using the following formulae:

- **Overall pass-through**:

$$-(\theta + \theta^* \overline{Z}^p_{i,t-1})/(\delta + \delta^* \overline{Z}^p_{i,t-1}) \tag{4}$$

- **Immediate pass-through**:

$$\beta_0 + \beta_0^* \overline{Z}^p_{i,t-1} \tag{5}$$

- **Adjustment**:

$$\delta + \delta^* \overline{Z}^p_{i,t-1} \tag{6}$$

Where $\overline{Z}^p_{i,t-1}$ denotes the mean of each specific bank characteristic in different percentiles, starting from the 10th up until the 90th. Estimated in this way, we can see the extent to which different bank characteristics affect pass-through. For instance, we can see whether banks pass on more of the overall changes in money market rates, have faster adjustment or a bigger immediate reaction depending on whether they have high or low levels of certain characteristics (i.e liquidity, capital) and we can test whether the differences in pass-through between different types of banks are significant.

We estimate our main results for equation (3) using panel ordinary least squares (OLS) with bank fixed effects and White heteroskedastic-consistent standard errors. However, we also use a number of different estimators to test the robustness of our main results in section 6. For the main results, we use Eonia as our measure of money market rates, although in section 6 we run all estimations using 3 month Euribor. We also check the robustness of the results by adding the levels as well as the changes in macroeconomic variables (X) to fully account for the effect that different macro conditions have on pass-through. Therefore, as a check, we estimate the following equation:

$$\begin{aligned} \triangle ir_{i,t} = \mu_i + \sum_{j=1}^{n} \alpha_j \triangle ir_{i,t-j} + \sum_{j=0}^{n} (\beta_j + \beta_j^* Z_{i,t-1}) \triangle mr_{t-j} + \lambda Z_{i,t-1} + (\delta + \delta^* Z_{i,t-1}) ir_{i,t-1} \\ + (\theta + \theta^* Z_{i,t-1}) mr_{t-1} + \sum_{j=0}^{n} \gamma_j \triangle X_{k,t-j} + \psi X_{k,t} + \epsilon_t \end{aligned} \tag{7}$$

This final specification should fully control for any impact stemming from the different macroeconomic conditions that prevailed in each country over the crisis. There are likely to be more factors at a country-level or differences in banking systems that are not captured by macroeconomic variables. For instance, the level of competition and concentration in different markets could affect interest rate pricing, as outlined in De Graeve, De Jonghe, and Vennet (2007), Sander and Kleimeier (2004) and van Leuvensteijn, Sorensen, Bikker, and van Rixtel (2008). As our dataset does not include every bank in each country, it is hard to determine the degree of competition in each market. Therefore to fully control for these factors, we also include country-year dummies in section 6, so that we know our findings on individual bank characterisitics are robust and are not due to unobserved country factors.

4 Data description

We use two novel datasets collected by the ECB on individual balance sheet items (IBSI) for approximately 250 MFIs and individual MFI interest rate statistics (IMIR) for approximately 200 institutions from August 2007 until June 2012. While the sample is biased towards large banks, its coverage is quite high - approximating 70% of euro area MFIs' main assets. For our empirical investigation, we use a balanced panel of 188 euro area banks with monthly data from August 2007 to June 2012, yielding 59 observations for each bank. Sample shrinkage stems from the fact that not all MFIs included in the original ECB sample actually report information on interest rates. We also exclude a number of banks that underwent major restructuring during the period. In terms of country composition, Germany, France, Italy and Spain account for almost 70% of the observations and Austria, Belgium, Finland, Ireland, Luxembourg, Netherlands, Portugal and Slovenia for the remainder (see Appendix Table 8). To the information on loan interest rates and balance sheet items of individual banks', we add two additional sources of information on: (1) banks' liquidity operations with the European system of central banks or the Eurosystem and (2) banks' regulatory variables and market performance using private data providers. The next section describes in detail the variables used in the empirical analysis. An overview of all these variables is shown in Appendix Table 9.

4.1 Dependent variables

The interest rates we focus on ($ir_{i,t}$) are on new loans to NFCs with a short fixation period (up to 1 year). This includes all floating rate loans and those with an initial rate fixation period of up to and including one year. Using these shorter term rates helps bypass the additional issues which emerge when analysing the longer end of the interest rate term-structure. We analyse separately the interest rates set on loans up to 1 and over 1 million euro. These rates are commonly used as proxies for lending to SMEs and large enterprises respectively and are shown in Appendix Figure 4.[7]

4.2 Explanatory variables

To capture the effect of monetary policy, we use money market rates (mr_t), which are targeted by policymakers and typically affect banks' cost of funds. In the main analysis we use Eonia as our measure of money market rates and also use 3 month Euribor as a robustness check.

4.2.1 Bank characteristics

As outlined in the literature review, a number of bank characteristics are believed to be important for loan pricing. In equation (3), these are represented by Z. In our empirical strategy, we look at the classic characteristics such as bank size, liquidity and capital. However, during the crisis, the transmission of monetary policy changes to lending rates largely suffered due to the weakness of banks' balance sheets and their inability to fund themselves at interbank rates, in line with the reformulation of the bank lending channel by Disyatat (2010). Therefore, we also use bank characteristics that capture stress and impaired access to funding markets as explanatory variables.

In our empirical analysis, the size variable is constructed as the ratio of main assets of a bank over the total assets of the respective country. The literature on SME credit suggests that smaller banks may be better able to develop stronger relationships with smaller firms (Berger and Udell (2001)) and this is associated with better credit terms (Berger and Udell (1995)). It is also possible that during the crisis, bigger banks were more exposed to the financial and money market tensions, and therefore experienced the most impairment in their balance sheets (Bundesbank (2009)). Or indeed, larger banks may exercise more market power. However, much of the past literature finds no effect of size on interest rate pricing (Chatelain, Generale, Vermeulen, Ehrmann, Martínez-Pagés, and Worms (2003) and Gambacorta (2008)).

Bank liquidity is defined as the sum of the most liquid assets over main assets; the items included are loans to MFIs (including deposits with the Eurosystem) and holdings of government and private sector securities. Higher liquid assets would indicate a healthier balance sheet, particularly during the crisis. Bluhm, Faia, and Krahnen (2014) found that banks with more illiquid assets are more exposed to shocks and therefore had to deleverage more during the crisis. Gambacorta and Mistrulli (2011) also found that more liquid Italian banks had smaller markups on their loans during the crisis. As liquid assets also include government bonds, it is possible that the sovereign debt market tensions affected the perceived liquidity of these assets over the period in question. For this reason, we also isolate the

[7] In the case that we have missing observations in any month, we use the observation for the previous period. But if we have any more than 15 missing observations for any bank we drop it completely from our dataset.

effect of these assets by looking at the effect of domestic government bond holdings separately.

Due to of a lack of appropriate data on individual MFI capital levels, we use two proxy variables. Our first variable measures both capital and reserves at the individual MFI level and is obtained from the IBSI dataset. This measure differs from regulatory measures, as it includes additional items such as loan loss provisions and retained earnings.[8] Our second variable measures consolidated banks' risk-weighted tier 1 capital ratio at a yearly frequency and is obtained from SNL Financials for a subsample of roughly 80 institutions. A higher level of capital would generally be perceived as a sign of a healthy balance sheet. However, given the large scale recapitalisation of weak banks, our measures of capital may not adequately capture balance sheet health during the crisis. Therefore, higher capital levels may not lead to improvements in banks' credit supply over this period (Brei, Gambacorta, and von Peter (2011)). For this reason, we use other variables that are more likely to be able to identify stress in the context of the crisis.

In order to capture banks' funding position and stress to it over the crisis, we look at the share of non-financial private sector (NFPS) deposits over total liabilities to see whether banks with a more stable funding structure are better placed to transmit policy changes. We also look at external liabilities as a percentage of total liabilities, as they are highly susceptible to markets' risk perceptions and can cause funding stress. To capture interbank funding constraints, we use net Eurosystem credit constructed by using the ECB's liquidity operations data which measures the sum of credit borrowed in all monetary operations (MROs, longer term operations with a maturity of 1, 3, 6, 12, and 36 months, and the marginal lending facility) minus the amount of liquidity deposited with the ECB (deposit facility and current account). To capture banks' perceived market risk, CDS spreads are used which are monthly averages of daily close prices and are obtained from DataStream.

Our government securities measure is calculated as holdings of domestic government bonds over total assets, which would capture banks' exposure to their sovereign and so their (sovereign-induced) vulnerability during the crisis. While the impact of this variable is likely to depend on the state of sovereign finances in each country, in general it has been recognised as a crucial contributor to the euro area crisis and a factor that can substantially hamper monetary transmission (Garicano and Reichlin (2013)). Finally, to capture balance sheet risk and impairment, data on banks' reported levels of yearly loan loss provisions (scaled by total assets) are used. These data are also obtained from SNL Financials (annual data for 80 institutions): we would expect banks with higher provisions to have more impaired monetary policy transmission.

The summary statistics for these variables are presented in Table 1, for the euro area as a whole, and

[8] The "capital and reserves" measure we use includes: (a) equity capital (b) non-distributed benefits or funds (c) specific and general provisions against loans, securities and other types of assets (may be recorded according to the accounting rules).

for financially stressed and non-stressed countries separately. We can see that larger banks with more capital (measured according to our IBSI statistics) are concentrated in stressed countries. These figures could reflect recent efforts to consolidate and recapitalise the banking systems in stressed countries. It could also be because the series contains loan provisions, which would be higher in stressed countries, as confirmed by the levels of loan loss provisions shown separately in the table. These provisions are higher in expectation of losses, given the protracted economic recession in these countries. In contrast, our measure of regulatory capital instead suggests that better capitalised institutions are concentrated in non-stressed countries. Banks in stressed countries have accumulated more net Eurosystem credit, as their access to wholesale markets decreased, hold a higher share of own government securities and have lower liquidity. Banks in non-stressed countries have a slightly higher share of external liabilities, indicating that non-euro area residents were less likely to have withdrawn funds from banks in these countries. The share of NFPS deposits is very similar across the two country groups.

Table 1: Summary of data

	Euro area		Non-stressed		Stressed	
Variable	Obs.	Mean	Obs.	Mean	Obs.	Mean
Size	10729	6.5	7018	5.8	3711	7.7
Liquidity	10610	33.1	6968	37.0	3642	25.7
Capital and reserves	10625	6.8	6959	5.9	3666	8.5
Tier 1 capital ratio	4068	12.6	2514	13.3	1554	11.5
NFPS deposits	10729	32.8	7018	33	3711	32.5
External liabilities	10729	9.9	7018	10.6	3711	8.5
Net Eurosys. Credit	10729	2.1	7018	1.6	3711	2.9
CDS spreads	4579	191	2906	158.9	1673	247
Govt. securities	10724	3	7013	2.8	3711	3.5
Loan loss provisions	4020	0.5	2436	0.3	1584	0.8

ECB, SNL Financials, DataStream. Data in percentages, with exception of CDS (basis points).

Appendix Table 10 presents statistics on the cross tabulation of these variables with the lending rates charged on small and large loans and this is shown over time in Appendix Figures 5 and 6. This is only indicative of pass-through as they only show interest rate levels, and do not take account of any fixed effect differences in pricing across banks. Even so, several patterns emerge. Large banks charge higher interest rates, particularly on smaller loans, which would be in line with Peek and Rosengren (1995b) who find that large banks tend not to have close lending relationships with smaller borrowers. Therefore larger banks may be less interested in making smaller loans and could price loans less favourably on this basis. It is also in line with the claim that large banks were more exposed to financial market tensions, particularly at the beginning of the crisis (Bundesbank (2009)). It could also be related to the market power that larger banks have. For capital and reserves, we can see that banks with high levels tend to charge higher interest rates, however the regulatory capital variable shows an opposite effect. Again, these converse results could be due to the different measurement of the variables and the interpretation could be complicated given the large scale recapitalisations over the period (as in Brei, Gambacorta, and von Peter (2011)). NFPS deposits, and to a lesser extent liquidity, seem to have a non-monotonic relationship with loan interest rates. On closer inspection this pattern appears to be driven by differences across euro area countries. For instance, if we look at the relationship in stressed and non-stressed countries separately, the non-monotonic relationship is not present (Appendix Figure 7). For non-stressed countries, the differences between banks are not nearly as pronounced, while for stressed countries there are some differences in particular for liquidity. In stressed countries, it appears that banks with higher liquidity have higher interest rates. While this could be related to holdings of government bonds (which we look at separately), it is important to notice that these differences were also present at the beginning of the sample, and therefore may not tell us much about the changes in interest rates ($\triangle ir_{i,t}$) and the effect of liquidity on a bank's reaction to money markets rates. As for the other characteristics, the charts show that vulnerable banks, with high CDS, high borrowings from the Eurosystem, high holdings of own government bonds and high loan loss provisions have higher interest rates over the period. Also notable is that the differences appear to be greater for smaller loans than for bigger loans.

These charts give some indication of the differences in the levels of interest rates across different types of banks, but they do not account for all differences in how banks price loans or for how they change rates relative to money market rate changes. Moreover, they do not capture changes in the macroeconomic environment that would have had an effect. The ECM methodology with fixed effects overcomes these problems in three ways: it looks at *changes* in the interest rate; it eliminates any unobserved fixed differences across banks; and it controls for changes in the macroeconomic environment. Section 5.2 therefore presents the results for this estimation across these different bank characteristics.

4.2.2 Macro variables

We include a number of macro variables as controls in our regressions. These are captured by the vector X_k in section 3, which contains 10 year government bond yields, inflation and unemployment in each country k ($\triangle GBY_k$, $\triangle Inf_k$, $\triangle Unemp_k$). In the absence of monthly GDP data, we use the unemployment rate to control for loan demand by firms and to capture the risks of lending into certain markets. The expected effect is unclear and will depend on whether demand or risk effects dominate. If deterioration in the economy leads to a fall in the demand for loans, we expect a negative effect on interest rates; whereas if a decline in activity damages borrowers' creditworthiness, we expect it to increase rates through a rise in risk premia. We include yields on 10 year government bonds to account for the bank-sovereign nexus and to capture the effect of the sovereign debt crisis on firms' cost of financing. Lastly, we include a measure of inflation.

5 Results

To test the order of integration of the series, we use a Fisher type approach proposed by Maddala and Wu (1999). Appendix Table 11 shows that the series are I(1). Then we use Westerlund (2007) to test for the presence of cointegration. This involves using four panel cointegration tests that are based on structural rather than residual dynamics. They test the null hypothesis of no cointegration by inferring whether the error-correction term in a conditional panel ECM is equal to zero. The results shown in Appendix Table 12 strongly reject the hypothesis that the series are not cointegrated.

With this strong evidence of cointegration, we can proceed to analyse the relationship between the variables in the framework set out in section 3. The main results are obtained using ordinary least squares with fixed effects and White heteroskedastic-consistent standard errors.[9]

5.1 Overall pass-through during the crisis

Heterogeneity in interest rate pass-through in the euro area over the crisis is clear from the differences in the levels of interest rates across countries and is well documented at a country-level (Darracq-Paries, Moccero, Krylova, and Marchini (2014)). We extend on this past research by looking at bank-level characteristics which contributed to this breakdown.

Before we investigate the implications of different bank characteristics, we estimate equation (2) to observe the effects of changes in macroeconomic conditions and to measure the extent of differences in pass-through. Columns (1)-(3) in Table 2 show the results for small loans estimated for all banks in the euro area and then for banks in the stressed and non-stressed countries respectively. By stressed countries we are referring to Ireland, Italy, Spain, Portugal and Slovenia, as these countries were in general most affected by financial market and sovereign tensions, albeit to varying degrees. Columns (4)-(6) show the same results for large loans. Before discussing the characteristics of pass-through, we focus first on the changes in macroeconomic variables, shown in the bottom half of the table.

The coefficients on changes in sovereign bond yields ($\triangle GBY$) are in general significant for both

[9] Our sample has 59 time periods, so any bias that may arise in a dynamic setting with lagged dependent variables as regressors would be small. However, we also use generalised method of moments estimators (GMM) developed by Arellano and Bover (1995) and Blundell and Bond (1998), as a robustness check in section 6. These techniques were developed for panels with small T and large N. Given the relatively large size of T in our sample, overfitting and instrument proliferation is a worry. For this reason, we only use these estimators to check our main results. We run all regressions with random effects, fixed effects without White adjusted standard errors, and both system and difference GMM. Our main results hold irrespective of which estimator is used.

Table 2: Pass-through results for small and large loans - estimation of equation (2)

	Small			Large		
	(1)	(2)	(3)	(4)	(5)	(6)
Dep var: $\triangle$ $\text{ir}_{i,t}$	Euro area	Stressed	Non-Stressed	Euro area	Stressed	Non-Stressed
$\triangle$ mr_t (β_0)	0.360***	0.304***	0.401***	0.442***	0.425***	0.470***
	(19.52)	(15.22)	(14.33)	(19.07)	(10.51)	(15.74)
$\triangle$ mr_{t-1}	0.245***	0.279***	0.197***	0.224***	0.270***	0.155***
	(7.17)	(11.50)	(4.00)	(7.94)	(5.80)	(4.28)
$\triangle$ $\text{ir}_{i,t-1}$	-0.223***	-0.159***	-0.183**	-0.235***	-0.332***	-0.127***
	(-4.24)	(-3.63)	(-2.59)	(-8.05)	(-8.81)	(-3.49)
ir_{t-1} (δ)	-0.241***	-0.0799***	-0.363***	-0.353***	-0.265***	-0.498***
	(-5.81)	(-5.74)	(-5.03)	(-10.25)	(-8.77)	(-7.68)
mr_{t-1} (θ)	0.174***	0.0498***	0.288***	0.277***	0.183***	0.422***
	(5.66)	(4.97)	(4.84)	(9.28)	(8.13)	(6.98)
$\triangle$ GBY_t	0.0758***	0.0808***	0.0600	0.110***	0.115***	0.0751*
	(3.44)	(4.84)	(1.10)	(4.67)	(3.55)	(1.98)
$\triangle$ GBY_{t-1}	0.0912***	0.0913***	0.0687**	0.112***	0.128***	0.0879***
	(5.06)	(5.15)	(1.99)	(5.46)	(4.57)	(2.99)
$\triangle$ Inf_t	0.0131*	0.0190**	0.00815	0.0231**	0.0205	0.0229*
	(1.73)	(2.17)	(0.57)	(2.22)	(1.34)	(1.71)
$\triangle$ Inf_{t-1}	0.0449***	0.0342***	0.0545***	0.0367***	0.0573***	0.0129
	(6.11)	(4.84)	(3.59)	(3.32)	(4.68)	(0.62)
$\triangle$ Unemp_t	-0.0441**	-0.01000	-0.0522**	-0.0103	0.0458	-0.0181
	(-2.05)	(-0.42)	(-2.15)	(-0.43)	(0.90)	(-0.73)
$\triangle$ Unemp_{t-1}	-0.0606***	-0.0204	-0.0682***	-0.0584***	-0.0146	-0.0633***
	(-3.48)	(-0.84)	(-3.52)	(-2.92)	(-0.31)	(-2.98)
N	8420	3127	5293	8026	3127	4899
r2	0.239	0.202	0.278	0.304	0.307	0.331

t statistics in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$. Panel OLS with bank fixed effects. Stressed countries are Ireland, Italy, Spain, Portugal and Slovenia.

small and large loans, and the positive coefficient indicates that increases in sovereign bond yields are associated with smaller cuts in the interest rates by banks. Surveying the coefficients, it seems that this is particularly the case in stressed countries, as the coefficients are larger and more significant than for non-stressed countries. As for inflation, we can see that increases in inflation are positively related to changes in nominal interest rates. This suggests that real interest rates are stickier and also likely reflects differences in demand across countries as captured by inflation.

Finally, increases in unemployment in the euro area as a whole are related to decreases in the interest rate at the euro area level. This suggests that when the real economy was in decline the interest rate fell by more, which may have been a response to the fall off in the demand for credit as investment opportunities diminished. This may indicate that the demand effect outweighed the risk effect from a deterioration in the real economy and borrowers' balance sheets. Interestingly, we can see that when we perform this estimation for stressed and non-stressed countries separately, the effect is only present in the non-stressed countries. This suggests that interest rate decreases from falling demand for credit may apply only to banks in the non-stressed countries and not the stressed group, where increasing risk premia may have offset the declines. It could also be the case that as the Phillips curve relationship between unemployment and inflation suggests, these two variables are likely to be correlated and the effect of one variable could be driving out the other.

The interest rate pass-through characteristics from these estimations are summarised in Table 3. Similar to Gambacorta (2008), the standard errors for overall pass-through are calculated using the Delta method, as described by Greene (2003), which involves an approximation of the estimate using its derivative with respect to each coefficient and the variance-covariance matrix of the model.

Table 3: Pass-through results for small and large loans for small and large loans - estimation of equation (2)

	Overall	St.er.	Immediate	St.er.	Adjustment	St.er.
Small						
Euro area	0.72 ***	0.02	0.36 ***	0.02	-0.24 ***	0.04
Stressed	0.62 ***	0.03	0.3 ***	0.02	-0.08 ***	0.01
Non-stressed	0.79 ***	0.02	0.4 ***	0.03	-0.36 ***	0.07
Large						
Euro area	0.79 ***	0.02	0.44 ***	0.02	-0.35 ***	0.03
Stressed	0.69 ***	0.02	0.43 ***	0.04	-0.27 ***	0.03
Non-stressed	0.85 ***	0.02	0.47 ***	0.03	-0.5 ***	0.06

Overall=$-\theta/\delta$, Immediate=β_0 and adjustment=δ

Starting with the results for overall pass-through for small loans, we can see that from the middle of 2007 until the middle of 2012, if money market rates changed by 100 basis points, overall loans to NFCs would change by 72 basis points. For non-stressed countries, this was higher at nearly 80 basis points, whereas in stressed countries it was much lower at 62 basis points, and this is even after controlling for changes in macroeconomic variables and with bank fixed effects.

Shorter-term dynamics show a similar picture. When there is a change in the money market rate, 36% of that change will be immediately passed through for the euro area as a whole, whereas for stressed countries this is lower at 30% and for non-stressed countries its higher at 40%. The adjustment of rates is also more sluggish in stressed countries. When there is a disequilibrium between in the relationship between small loans to NFCs and Eonia, only 8% of this disequilibrium will be corrected in the next period, whereas for the euro area and for non-stressed countries, its 24% and 36% respectively.

The results for large loans are similar, with overall pass-through being higher and faster in non-stressed countries as compared to stressed countries. However, it is clear that overall pass-through is higher for larger loans as compared to small loans, in both stressed and non-stressed countries and in the euro area as a whole.

We can see that even after controlling for changes in macroeconomic conditions, there is still a large amount of heterogeneity in interest rate pricing across stressed and non-stressed countries. We therefore look at banks' balance sheet characteristics contributing to this.

5.2 Effect of bank characteristics

The full results for the estimation of equation (3) for small loans are shown in Table 4. We estimate it for the 10 different bank characteristics separately. We look at the standard bank characteristics that have been investigated in previous literature (size, liquidity and capital), at variables that capture banks' funding situation (NFPS deposits and external liabilities) and at variables that are particularly relevant during the recent financial and sovereign debt crisis (Eurosystem borrowings, CDS, domestic government securities and loan loss provisions). By observing whether the coefficients on β^*, δ^* and θ^* are significant we can tell whether the variable affects immediate pass-through, adjustment to equilibrium and overall pass-through. We then calculate the effects for each characteristic using equations (4), (5) and (6) and the results are shown in Table 5.

From Table 4, we can see from the coefficient β_0^* that the size of a bank, its capital level, CDS and holdings of government securities have all influenced the immediate response of a bank to a change in money market rates. We can see from the coefficients on δ^* and θ^*, that size, capital, liquidity, external liabilities, the amount borrowed from the Eurosystem and CDS affect overall pass-through and the adjustment of rates to their equilibrium. T1 capital ratio, NFPS deposits and loan loss provisions do not have a significant effect on pass-through for small loans. The results are perhaps affected by the smaller sample for T1 capital and loan provisions and the fact that the data have a lower frequency (annual) than the other characteristics, meaning that there is less variation in the series. NFPS deposits are clearly related to the level of the interest rate offered by the bank, and because this is likely to be jointly determined with lending rates, interpretation of deposit movements may be complicated.

To assess the extent of the effect of each of these variables for small loans, Table 5 shows the immediate, adjustment and overall pass-through by banks within different percentiles for each characteristic that is significant. As before, standard errors for each of the percentiles are calculated using the Delta method. This allows us to test whether the estimates of adjustment, overall and immediate pass-through are significantly different for banks that have high or low holdings of each variable.[10] The p-values from the Wald tests are also reported in Table 5 for this purpose.

[10]Because some of the estimates for the very high buckets are not significantly different from zero, given the high standard errors, we perform the Wald tests for both the very high and high buckets for completeness.

Table 4: Pass-through results for small loans with the effect of each different bank characteristic (Z_i)

(Dep var: $\triangle$ $ir_{i,t}$)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Z_i:	Size	Liquidity	Capital	T1 Ratio	NFPS dep.	Ext. liab.	Euros. Borr.	CDSs	Gov. sec.	Loan prov.
$\triangle$ $ir_{i,t-1}$	-0.177***	-0.189***	-0.184***	-0.245***	-0.193***	-0.193***	-0.185***	-0.162***	-0.192***	-0.272***
	(-3.32)	(-3.54)	(-3.67)	(-8.08)	(-3.77)	(-3.68)	(-3.46)	(-5.49)	(-3.87)	(-7.26)
$\triangle$ mr_t (β_0)	0.359***	0.371***	0.357***	0.381***	0.359***	0.364***	0.364***	0.346***	0.348***	0.395***
	(19.24)	(19.28)	(18.72)	(13.91)	(19.51)	(18.92)	(18.83)	(12.37)	(17.73)	(14.66)
$\triangle$ mr_{t-1}	0.228***	0.246***	0.226***	0.258***	0.237***	0.238***	0.235***	0.229***	0.221***	0.280***
	(6.54)	(7.13)	(6.45)	(10.10)	(6.89)	(6.92)	(6.82)	(8.89)	(6.36)	(8.08)
$\triangle$ mr_t*$Z_{i,t-1}$(β^*)	-0.00265*	0.0637	-0.0208***	-0.0152	-0.000296	0.000670	-0.000884	-0.000439***	-0.0208***	-6.469
	(-1.70)	(0.46)	(-3.17)	(-1.60)	(-0.30)	(0.51)	(-0.18)	(-2.83)	(-2.85)	(-1.21)
$\triangle$ mr_{t-1}*$Z_{i,t-1}$	0.00251	-0.0805	-0.0100	-0.0289***	-0.00236*	0.000979	0.0111**	-0.0000729	-0.0148*	-7.316*
	(1.30)	(-0.51)	(-1.47)	(-3.59)	(-1.95)	(1.00)	(2.46)	(-0.36)	(-1.89)	(-1.85)
$Z_{i,t-1}$	-0.0223**	0.924**	-0.0336***	0.00634	-0.000289	0.00117	-0.00428	0.000429**	-0.0146	-1.771
	(-2.36)	(2.48)	(-3.02)	(0.82)	(-0.07)	(0.35)	(-0.93)	(2.57)	(-0.74)	(-1.14)
$ir_{i,t-1}$ (δ)	-0.257***	-0.247***	-0.264***	-0.171***	-0.248***	-0.251***	-0.268***	-0.289***	-0.260***	-0.161***
	(-6.76)	(-5.92)	(-6.33)	(-4.28)	(-6.19)	(-6.28)	(-6.29)	(-6.87)	(-6.13)	(-4.50)
$ir_{i,t-1}$*$Z_{i,t-1}$(δ^*)	0.00887***	-0.228*	0.0155***	0.00279	-0.00161	-0.00202**	0.00618***	0.0000706**	0.0109	0.419
	(3.47)	(-1.92)	(3.61)	(1.04)	(-1.07)	(-2.01)	(3.75)	(2.62)	(1.65)	(0.67)
mr_{t-1} (θ)	0.191***	0.181***	0.193***	0.113***	0.178***	0.183***	0.196***	0.193***	0.191***	0.116***
	(6.41)	(5.50)	(6.09)	(3.85)	(5.83)	(5.99)	(5.95)	(6.02)	(5.90)	(4.32)
mr_{t-1}*$Z_{i,t-1}$(θ^*)	-0.00715***	0.218*	-0.0159***	-0.00809**	0.00142	0.00152*	-0.00676***	-0.000355***	-0.0118**	1.353
	(-3.82)	(1.87)	(-4.11)	(-2.34)	(1.13)	(1.85)	(-3.47)	(-4.11)	(-2.04)	(0.72)
$\triangle$ GBY_t	0.0705***	0.0712***	0.0765***	0.0621***	0.0728***	0.0724***	0.0694***	0.0665***	0.0673***	0.0708***
	(3.34)	(3.27)	(3.60)	(3.33)	(3.42)	(3.38)	(3.27)	(4.42)	(3.36)	(3.93)
$\triangle$ GBY_{t-1}	0.0822***	0.0829***	0.0880***	0.0971***	0.0830***	0.0840***	0.0834***	0.0723***	0.0826***	0.0889***
	(4.35)	(4.32)	(4.83)	(5.35)	(4.38)	(4.45)	(4.41)	(3.54)	(4.39)	(4.46)
$\triangle$ Inf_t	0.0135*	0.0148*	0.0122	0.0216*	0.0133*	0.0121	0.0108	0.0159	0.0113	0.0218*
	(1.83)	(1.96)	(1.63)	(1.79)	(1.81)	(1.62)	(1.46)	(1.52)	(1.51)	(1.88)
$\triangle$ Inf_{t-1}	0.0448***	0.0447***	0.0424***	0.0270**	0.0443***	0.0437***	0.0440***	0.0379***	0.0404***	0.0300***
	(6.14)	(5.97)	(5.82)	(2.59)	(6.05)	(5.97)	(6.01)	(3.96)	(5.50)	(2.71)
$\triangle$ $Unemp_t$	-0.0441**	-0.0415*	-0.0373*	-0.0177	-0.0457**	-0.0435**	-0.0423**	-0.0364	-0.0432**	-0.0198
	(-2.11)	(-1.96)	(-1.79)	(-0.66)	(-2.13)	(-2.07)	(-2.00)	(-1.54)	(-2.06)	(-0.67)
$\triangle$ $Unemp_{t-1}$	-0.0568***	-0.0564***	-0.0559***	-0.0412*	-0.0573***	-0.0567***	-0.0560***	-0.0389**	-0.0556***	-0.0585***
	(-3.26)	(-3.18)	(-3.25)	(-1.85)	(-3.30)	(-3.26)	(-3.23)	(-2.27)	(-3.19)	(-2.83)
N	8342	8207	8318	3622	8342	8342	8342	3434	8335	3581
R^2	0.248	0.242	0.245	0.239	0.238	0.237	0.242	0.261	0.241	0.251

t statistics in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$. Panel OLS with bank fixed effects.

Table 5: Distributional effects of bank characteristics on pass-through for small loans (from estimation of equation (3))

	Size		**Liquidity**		**Cap. res.**		**Ext. liab.**		**Euros. Borr.**		**CDS Spreads**		**Gov. sec.**	
	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.
Overall														
Very Low (p10)	0.75***	0.02	0.67***	0.05	0.79***	0.02	0.72***	0.02	0.76***	0.02	0.80***	0.02		
Low (p10-p25)	0.75***	0.02	0.70***	0.03	0.77***	0.02	0.72***	0.02	0.74***	0.02	0.78***	0.02		
Medium (p25-p75)	0.74***	0.02	0.73***	0.02	0.73***	0.02	0.72***	0.02	0.73***	0.02	0.72***	0.02		
High (p75-p90)	0.72***	0.03	0.76***	0.03	0.66***	0.03	0.72***	0.02	0.71***	0.02	0.57***	0.05		
Very High (p90)	0.37	0.51	0.78***	0.05	0.53***	0.08	0.73***	0.03	0.63***	0.05	0.1	0.17		
V.low=V.high (p-value)	0.45		0.22		0.00		0.85		0.04		0.00			
V.low=High (p-value)	0.18		0.21		0.00		0.85		0.04		0.00			
Immediate														
Very Low (p10)	0.37***	0.02			0.45***	0.04					0.40***	0.03	0.40***	0.03
Low (p10-p25)	0.37***	0.02			0.41***	0.03					0.39***	0.03	0.40***	0.03
Medium (p25-p75)	0.36***	0.02			0.36***	0.02					0.36***	0.03	0.36***	0.02
High (p75-p90)	0.34***	0.02			0.29***	0.02					0.30***	0.03	0.29***	0.03
Very High (p90)	0.29***	0.04			0.21***	0.04					0.15**	0.07	0.21***	0.05
V.low=V.high (p-value)	0.09				0.00						0.01		0.01	
V.low=High (p-value)	0.09				0.00						0.01		0.01	
Adjustment														
Very Low (p10)	-0.32***	0.05	-0.19***	0.04	-0.33***	0.05	-0.23***	0.04	-0.29***	0.05	-0.29***	0.04		
Low (p10-p25)	-0.31***	0.05	-0.21***	0.04	-0.30***	0.05	-0.23***	0.04	-0.27***	0.04	-0.29***	0.04		
Medium (p25-p75)	-0.28***	0.04	-0.24***	0.04	-0.27***	0.04	-0.24***	0.04	-0.27***	0.04	-0.29***	0.04		
High (p75-p90)	-0.19***	0.03	-0.27***	0.05	-0.22***	0.04	-0.27***	0.04	-0.25***	0.04	-0.28***	0.04		
Very High (p90)	-0.03	0.06	-0.31***	0.06	-0.15***	0.05	-0.32***	0.05	-0.21***	0.04	-0.25***	0.04		
V.low=V.high (p-value)	0.00		0.06		0.00		0.05		0.00		0.01			
V.low=High (p-value)	0.00		0.06		0.00		0.05		0.00		0.01			

Very Low is a bank with a characteristic Z (size, liquidity, capital, external liabilities, Eurosystem borrowings, CDS, government securities) below the 10th percentile, Low is between the 10th and 25th percentile, Medium is between the 25th and 75th percentile, High is between the 75th and 90th percentile, and Very High is above 90th percentile. The overall pass-through is calculated as $-(\theta + \theta^* \overline{Z}^p_{t-1})/(\delta + \delta^* \overline{Z}^p_{t-1})$, immediate as $\beta_0 + \beta^*_0 \overline{Z}^p_{t-1}$ and adjustment as $\delta + \delta^* \overline{Z}^p_{t-1}$, where $\overline{Z}^p_{t-1}$ denotes the mean of the characteristic in each percentile as already defined. Results only reported when β^*, δ^* and θ^* in Table 4 are significant. P values for Wald tests of equality between the pass-through coefficients are also shown; if p<0.1 we can reject that pass-through is the same across two categories of banks at 10% significance level. Standard errors are calculated using the Delta method.

Starting with size, Table 5 shows that there are only very small differences between banks in the very low and high buckets for overall pass-through, at 0.75 and 0.72 respectively. Differences are more pronounced when looking at the shorter term dynamics. In terms of immediate pass-through, we can see that if there was a change in money market rates of 100 basis points in a month, very small banks passed on about 37 basis points of this change in the same month, compared to 29 basis points for a very large bank. We can also see that small banks had a faster adjustment when in disequilibrium during the crisis. Specifically, when there was a deviation from the long run relationship, very small banks corrected 32% of the deviation in the next period, while big banks corrected only 19%. The Wald tests show that we cannot reject that overall pass-through is equal for very big and very small banks, however we can reject that the shorter term dynamics are equal, which confirms that banks respond differently to monetary policy changes in the short run depending on their size. The fact that smaller banks show stronger pass-through than larger banks on the smaller loans (which likely proxy for smaller borrowers) is in line with relationship lending literature (Peek and Rosengren (1995b) among others) and that large banks may have suffered more from the financial market tensions (Bundesbank (2009)). It could also be due to the fact that smaller banks have less market power, which is in line with Ryan, O'Toole, and McCann (2013), who find that increased market power leads to increased financing constraints for SMEs.

Moving to liquidity, we can see that banks with less liquid assets had lower overall pass-through (0.67) compared to banks with higher liquidity (0.78) but the differences between the two categories of banks are not significant. However, banks with less liquid assets also had slower adjustment (-0.19 compared to -0.31) and here the results are significant. This confirms the finding of Bluhm, Faia, and Krahnen (2014), that banks with high levels of non-liquid assets are more exposed to negative shocks in the value of these assets, which can cause balance sheet impairments in times of crisis.

For capital and reserves, we can see that banks with higher capital had lower overall pass-through over the crisis, slower adjustment and less immediate pass-through with differences between banks being significant in all cases. Generally, having high capital would be traditionally seen as a sign of health for a bank and past literature, such as Gambacorta (2008), finds that for a given shock to the economy (for example, a monetary contraction) the supply of credit is curtailed most by poorly capitalised banks, which have less access to markets for uninsured funding and are perceived as riskier and are therefore less able to shield their customers from a shock. The crisis may have affected this interpretation: many banks have been recapitalised by governments, but continue to have unrecognised losses and impairments on their balance sheet.[11] Moreover, the level of measure of capital and reserves

[11] An ECB article (2013) states that estimated direct capital of around around €270 billion was injected by governments between 2007 and mid-2013. (`https://www.ecb.europa.eu/pub/pdf/other/art1_mb201308en_pp75-91en.pdf`)

is not the same as the regulatory measure. However, when we include our additional measure of regulatory T1 capital, shown in Table 4, this does not appear to have a significant effect on pass-through, possibly due to the lower frequency. Therefore, it is likely that some of the other variables we consider in the paper are better able to capture a bank's real health.

Turning to bank funding, NFPS deposits do not appear to affect pass-through, while external liabilities have a significant effect on overall pass-through and on adjustment to equilibrium. Having higher external liabilities increases overall pass-through only marginally, meaning that we cannot reject that overall pass-through for banks with high and low external liabilities is the same (see Table 5). However, banks with high amounts of external liabilities do adjust interest rates significantly faster than banks with low external liabilities.

In terms of differences between banks according to their level of borrowings from the Eurosystem, we can see that banks with high recourse to central bank funding passed on less of the cut in the policy rate. Banks with high borrowings had an overall pass-through of 0.63, while banks with low borrowings had overall pass-through of around 0.76. The results of the Wald tests show that these differences are statistically significant. Banks with access to interbank funds, which did not borrow as much from the Eurosystem also adjusted their rates at a significantly faster pace than those without access.

CDS spreads, which capture the riskiness of a bank, affect all aspects of pass-through. We can see in Table 5 that the riskiest banks - i.e. with the highest CDS spreads - had the lowest pass-through overall (57% of rate cuts as compared to 80% for banks with low CDS spreads). They also had the lowest immediate pass-through and were slower in adjusting. The Wald tests show that, in all cases, differences between banks with high and low CDS spreads are significant.

Finally, banks with high holdings of domestic government securities had a significantly lower immediate reaction to changes in monetary policy rates during the crisis (21% of changes immediately passed through) than banks with low holdings (40%).

Table 6 shows the results of equation (3) for large loans, and the pass-through coefficients are summarised in Table 7 when significant. When comparing the results to small loans, individual bank characteristics seem to be slightly less important. Size is no longer significant for loan pricing. However, capital and reserves are significant, with a similar pattern as observed for smaller loans; Tier 1 capital ratio is also significant, but the results are mixed. While banks with higher regulatory capital do appear to have slightly higher overall pass-through, differences between banks are not significant. For the shorter term dynamics, banks with higher regulatory capital adjust quicker, but their immediate reaction to changes is less. Overall however, even for the shorter term dynamics the equality between the buckets can only be rejected at a 10% level (as p-values for differences in adjustment and immediate pass-through are 0.07 and 0.09 respectively). CDS spreads continue to be very important, with riskier banks having significantly slower and lower overall pass-through as compared to banks with lower CDS spreads. Finally, holdings of domestic sovereign bonds have a significant effect on pass-through, indicating that banks with lower holdings of domestic sovereign bonds had significantly higher overall pass-through (0.84) than banks with high holdings (0.58) and they also had faster adjustment and higher immediate pass-through. This suggests that banks' exposure to governments during the sovereign bond crisis affected the cost of finance to some of their customers. This confirms that sovereign bonds have an important impact on banks and consequently their borrowers through a number of channels (as discussed by Gonzalez-Paramo (2011)).

Overall, we can see that bank characteristics have a more significant effect on short run rather than long run pass-through, which is similar to the findings of Gambacorta (2008). However, over the crisis, certain bank characteristics, closely related to measures of financial stress, had an effect even on overall pass-through. Generally, individual bank characteristics have a bigger effect on small loans as compared to large loans. This may be because banks with profitability and balance sheet problems pass on less of the cuts in interest rates to their smaller loans, compared to larger loans, as SMEs (which are more likely to be drawing down these smaller loans) are more bank dependent and have fewer external financing options than larger firms and therefore may be forced to accept higher interest rates (ECB (2014)). Indeed, Santos (2011) finds that U.S banks with larger losses during the subprime crisis increased the spreads on loans to bank-dependent borrowers but not on loans to nondependent borrowers, with the rationale being that former group of firms have less opportunities to switch to alternative sources of finance.

Table 6: Pass-through results for large loans with the effect of each different bank characteristic (Z_i)

(Dep var: $\triangle ir_{i,t}$) Z_i:	(1) Size	(2) Liquidity	(3) Capital	(4) T1 Ratio	(5) NFPS dep.	(6) Ext. liab.	(7) Euros. Borr.	(8) CDSs	(9) Gov. sec.	(10) Loan prov.
$\triangle ir_{i,t-1}$	-0.230***	-0.226***	-0.231***	-0.232***	-0.232***	-0.233***	-0.221***	-0.147***	-0.219***	-0.230***
	(-7.65)	(-7.50)	(-7.95)	(-11.13)	(-8.17)	(-7.77)	(-7.37)	(-3.90)	(-7.40)	(-10.71)
$\triangle mr_t$ (β_0)	0.441***	0.442***	0.433***	0.398***	0.441***	0.442***	0.444***	0.448***	0.421***	0.409***
	(18.86)	(19.85)	(18.77)	(10.98)	(18.91)	(18.90)	(19.53)	(9.63)	(17.49)	(12.00)
$\triangle mr_{t-1}$	0.218***	0.224***	0.213***	0.231***	0.222***	0.221***	0.221***	0.156***	0.190***	0.244***
	(7.89)	(8.33)	(7.39)	(7.25)	(8.04)	(7.85)	(8.10)	(3.28)	(6.74)	(7.87)
$\triangle mr_t$*$Z_{i,t-1}(\beta^*)$	-0.00105	0.312**	-0.0186**	-0.0240*	-0.000190	0.000271	-0.00473	-0.000173	-0.0314***	-6.056
	(-0.52)	(1.99)	(-2.56)	(-1.73)	(-0.18)	(0.17)	(-0.88)	(-0.79)	(-4.11)	(-1.41)
$\triangle mr_{t-1}$*$Z_{i,t-1}$	0.00165	-0.0990	-0.0222**	-0.0322**	-0.00155	0.00290**	0.0141***	0.0000789	-0.0139	-6.778**
	(1.07)	(-0.63)	(-2.40)	(-2.41)	(-1.42)	(2.33)	(3.18)	(0.34)	(-1.45)	(-2.23)
$Z_{i,t-1}$	-0.0102*	0.514	-0.00938	0.0314**	-0.00401	-0.000251	0.00201	0.000573**	-0.0214*	3.130***
	(-1.70)	(1.60)	(-0.84)	(2.25)	(-1.04)	(-0.07)	(0.40)	(2.10)	(-1.71)	(2.70)
$ir_{i,t-1}$ (δ)	-0.363***	-0.364***	-0.361***	-0.281***	-0.358***	-0.358***	-0.381***	-0.495***	-0.379***	-0.265***
	(-11.07)	(-10.72)	(-10.24)	(-7.92)	(-10.37)	(-10.19)	(-10.39)	(-7.55)	(-11.48)	(-7.80)
$ir_{i,t-1}$*$Z_{i,t-1}(\delta^*)$	0.00362	-0.0465	0.0100*	-0.0121*	-0.00129	-0.00142	0.00644**	0.000148**	0.0221***	-1.490
	(1.63)	(-0.30)	(1.90)	(-1.81)	(-0.83)	(-0.78)	(2.30)	(2.08)	(4.04)	(-1.40)
mr_{t-1} (θ)	0.287***	0.292***	0.284***	0.221***	0.281***	0.282***	0.302***	0.364***	0.302***	0.207***
	(10.15)	(9.86)	(9.23)	(6.93)	(9.39)	(9.22)	(9.46)	(6.15)	(10.48)	(6.52)
mr_{t-1}*$Z_{i,t-1}(\theta^*)$	-0.00402**	0.114	-0.0122**	0.0115*	0.00122	0.000871	-0.00612*	-0.000575***	-0.0256***	2.162
	(-2.14)	(0.85)	(-2.48)	(1.76)	(0.90)	(0.52)	(-1.81)	(-3.57)	(-5.18)	(0.57)
$\triangle GBY_t$	0.109***	0.114***	0.114***	0.0663**	0.109***	0.112***	0.105***	0.0992***	0.104***	0.0594*
	(4.60)	(4.71)	(4.81)	(2.18)	(4.61)	(4.71)	(4.44)	(4.33)	(4.38)	(1.90)
$\triangle GBY_{t-1}$	0.109***	0.109***	0.112***	0.117***	0.107***	0.111***	0.109***	0.0489*	0.107***	0.117***
	(5.31)	(5.13)	(5.60)	(4.80)	(5.32)	(5.46)	(5.37)	(1.92)	(5.26)	(4.70)
$\triangle Inf_t$	0.0229**	0.0256***	0.0234**	0.0195	0.0227**	0.0228**	0.0217**	0.0306*	0.0208**	0.0260
	(2.20)	(2.65)	(2.30)	(1.12)	(2.23)	(2.20)	(2.15)	(1.88)	(2.00)	(1.55)
$\triangle Inf_{t-1}$	0.0363***	0.0372***	0.0349***	0.0576***	0.0356***	0.0355***	0.0353***	0.0135	0.0302***	0.0603***
	(3.27)	(3.35)	(3.14)	(5.69)	(3.22)	(3.23)	(3.21)	(0.81)	(2.81)	(5.79)
$\triangle Unemp_t$	-0.0107	-0.00664	-0.00639	-0.0214	-0.0103	-0.0110	-0.00976	-0.00401	-0.0107	-0.0306
	(-0.45)	(-0.28)	(-0.27)	(-0.60)	(-0.43)	(-0.46)	(-0.41)	(-0.13)	(-0.46)	(-0.84)
$\triangle Unemp_{t-1}$	-0.0596***	-0.0584***	-0.0561***	-0.0494*	-0.0591***	-0.0590***	-0.0572***	-0.0257	-0.0575***	-0.0530*
	(-2.96)	(-2.92)	(-2.83)	(-1.67)	(-2.95)	(-2.96)	(-2.87)	(-1.07)	(-2.93)	(-1.72)
N	7991	7866	7967	3567	7991	7991	7991	3353	7984	3509
R^2	0.307	0.308	0.309	0.280	0.306	0.306	0.311	0.330	0.316	0.274

t statistics in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$. Panel OLS with bank fixed effects.

Table 7: Distributional effects of bank characteristics on pass-through for large loans (from estimation of equation (3))

	Liquidity		**Cap. res.**		**Tier 1 ratio**		**Euros. Borr.**		**CDS Spreads**		**Gov. sec.**	
	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.
Overall												
Very Low (p10)			0.83***	0.02	0.76***	0.04	0.80***	0.02	0.85***	0.02	0.84***	0.01
Low (p10-p25)			0.82***	0.02	0.76***	0.03	0.79***	0.02	0.83***	0.02	0.84***	0.01
Medium (p25-p75)			0.79***	0.02	0.78***	0.03	0.79***	0.02	0.78***	0.03	0.81***	0.01
High (p75-p90)			0.75***	0.02	0.80***	0.04	0.78***	0.02	0.65***	0.05	0.72***	0.03
Very High (p90)			0.68***	0.05	0.81***	0.05	0.76***	0.04	0.2	0.18	0.58***	0.08
V.low=V.high			0.01		0.39		0.48		0.00		0.00	
V.low=High			0.01		0.38		0.49		0.00		0.00	
Imm.												
Very Low (p10)	0.37***	0.04	0.52***	0.04	0.47***	0.05					0.50***	0.03
Low (p10-p25)	0.39***	0.03	0.48***	0.03	0.45***	0.04					0.50***	0.03
Medium (p25-p75)	0.43***	0.02	0.44***	0.02	0.40***	0.04					0.44***	0.02
High (p75-p90)	0.48***	0.04	0.37***	0.03	0.34***	0.05					0.33***	0.03
Very High (p90)	0.53***	0.06	0.30***	0.06	0.26***	0.09					0.22***	0.06
V.low=V.high	0.05		0.01		0.09						0.00	
V.low=High	0.05		0.01		0.09						0.00	
Adjust.												
Very Low (p10)			-0.40***	0.05	-0.24***	0.04	-0.40***	0.04	-0.51***	0.07	-0.44***	0.04
Low (p10-p25)			-0.38***	0.04	-0.25***	0.04	-0.39***	0.04	-0.51***	0.07	-0.43***	0.04
Medium (p25-p75)			-0.36***	0.04	-0.27***	0.04	-0.38***	0.04	-0.50***	0.07	-0.39***	0.03
High (p75-p90)			-0.33***	0.03	-0.30***	0.04	-0.36***	0.03	-0.48***	0.06	-0.32***	0.03
Very High (p90)			-0.29***	0.04	-0.34***	0.06	-0.32***	0.04	-0.42***	0.06	-0.23***	0.04
V.low=V.high			0.06		0.07		0.02		0.04		0.00	
V.low=High			0.06		0.07		0.02		0.04		0.00	

Very Low is a bank with a characteristic Z (Liquidity, capital, T1 capital, Eurosystem borrowings, CDS, Government securities) below the 10th percentile, Low is between the 10th and 25th percentile, Medium is between the 25th and 75th percentile, High is between the 75th and 90th percentile, and Very High is above 90th percentile. The overall pass-through is calculated as $-(\theta + \theta^* \overline{Z}^p_{t-1})/(\delta + \delta^* \overline{Z}^p_{t-1})$, immediate as $\beta_0 + \beta_0^* \overline{Z}^p_{t-1}$ and adjustment as $\delta + \delta^* \overline{Z}^p_{t-1}$, where $\overline{Z}^p_{t-1}$ denotes the mean of the characteristic in each percentile as already defined. Results only reported when β^*, δ^* and θ^* in Table 6 are significant. P values for Wald tests of equality between the pass-through coefficients are also shown; if p<0.1 we can reject that pass-through is the same across two categories of banks at 10% significance level. Standard errors are calculated using the Delta method.

6 Robustness checks

We check the robustness of these results in three ways: first, we use an alternative money market rate; second, we compare our results to those obtained using other panel estimators; third, we extend our analysis by adding the levels of macroeconomic conditions and country-year dummies to equation (3).

6.1 Robustness to alternative money market rates

During the period under study, only a limited number of banks were able to secure inter-bank funding at the Eonia rate. For this reason, we measure our results against an alternative money market rate that may have become more relevant for the pricing of loans by banks. We estimate equation (3) using the 3 month euro interbank offered rate (Euribor) and compute the pass-through coefficients for different types of loans. The results are shown in Appendix Tables 13 and 14 for small loans and 15 and 16 for large loans. Our main results are qualitatively confirmed. For small loans we can see that same bank characteristics are significant. There are some slight differences in the effects. For instance, domestic government securities seem to have a stronger effect on small loans and the distinction between banks according to their central bank borrowings is less pronounced. For large loans, the same characteristics are significant, with the exception of liquidity (which is now insignificant) and loan provisions (which is now significant). However, we can confirm that overall the main variables that identify stressed banks with funding difficulties continue to affect pass-through in a similar way when using another money market rate.

6.2 Robustness to alternative estimators

The results discussed in section 5 are estimated using ordinary least squares with bank fixed effects and White heteroskedastic-consistent standard errors. The appropriateness of the estimator is confirmed by Judson and Owen (1999) who use a Monte Carlo approach to investigate the performance of different estimators developed for dynamic panel data models. They find that the bias can be significant as long as the time dimension of the panel is lower than 30. Given that our time dimension is nearly double their threshold, we are confident that the bias is contained.

Nevertheless, for completeness we perform a series of robustness checks by estimating our pass-through model using a battery of alternative estimators and we present these results graphically in Appendix Figures 8 to 11. For each bank characteristic we estimate equation (3) for large and small loans, using a random effects (RE), fixed effects (FE), fixed effects with White heteroskedastic-consistent standard errors (FE-cor - our main results), difference GMM à la Arellano and Bond (1991) (D-GMM) and system GMM estimators à la Blundell and Bond (1998) (S-GMM). We compare the pass-through coefficients obtained with each estimator for the different buckets of bank characteristics.[12] We chart the pass-through results obtained with a given estimator only if the interaction variables of interest (i.e. coefficients β^*, δ^* and θ^*) are significant. The first column shows overall pass-through coefficients, the second portrays immediate pass-through coefficients, and the third the loading coefficients.

Overall, we can see that while the extent of the impact can vary slightly, in general the effects of each characteristic are the same regardless of which estimator is used. For small loans, we can see that overall the effects of size, liquidity, capital and reserves, external liabilities, Eurosystem credit, CDS spreads and government securities are all generally the same when using the different estimators. For large loans, the effects of liquidity, capital and reserves, Tier 1 ratio, Eurosystem borrowing, CDS and government securities are also generally the same using a number of different estimators.[13]

6.3 Robustness to the inclusion of levels of macroeconomic variables and country-year dummies

We estimate equation (7) for small and large loans, and the results are shown in the Appendix Tables 17 and 19 respectively. The corresponding Wald tests are shown in Tables 18 and 20 respectively. Appendix Table 17 shows that levels of the sovereign bond yields are associated with higher $\triangle ir$, indicating that banks in countries with sovereign market stress had smaller cuts in interest rates. Changes in sovereign yields are generally insignificant when the level of sovereign bonds is included. This likely reflects that it is the overall level of the sovereign yield, rather than the incremental changes, that mainly affects banks' funding costs. In general, the level of inflation is positively associated with changes in interest rates, indicating a demand effect. When the level of inflation is included, some changes in inflation remain significant, though less so.

Including the level of unemployment reveals an interesting result. In general the coefficient is positive and significant, even though the changes in unemployment continue to be negative and significant. This indicates that increases in unemployment clearly affect demand for finance, which has a downward pressure on the interest rates. However, when the level of unemployment is high, the deterioration in the economy causes an increase in the risk premium. This would be linked to the fact that defaults tend to be greater in countries with high unemployment. Overall, the results suggest that the risk channel appears to have an upward effect on interest rates, however marginal increases

[12] There tend to be bigger differences between buckets when using GMM methods, but the standard errors also tend to be larger.

[13] Appendix Figures 8 to 11 show that some of the other estimators have significant results even though our main estimator (fixed effects with White heteroskedastic-consistent standard errors) does not. For instance, government securities appear to have an effect on overall pass-through when using random effects and fixed effects without robust standard errors for small loans. However, we believe our main estimator which controls for fixed effects and has robust standard errors yields the most reliable estimates.

in the unemployment rate are still related to decreases in interest rates due to changes in demand.

The results for the levels of the macro variables for large loans in the Appendix Table 19 are similar, as there is less impact from the changes in government bond yields and inflation once their levels are included. One notable point is that the level of unemployment is less significant for large loans. This may imply that larger companies which receive these large loans are perhaps less dependent on the domestic economy and not as exposed to the risk of a specific country.

Next, we look to see if the effects of the bank-level characteristics are altered once we add these cross country-level differences, as summarised in Tables 18 and 20 in the Appendix for small and large loans respectively. For small loans, we can compare the results in Tables 17 and 18 with those in Tables 4 and 5 respectively. The results discussed in section 5.2 are mostly unchanged, except for liquidity and NFPS deposits, which no longer have a significant effect on a bank's reaction to a money market rate change. This is not overly surprising given the different behaviour of interest rates for NFPS deposits and liquidity in stressed and non-stressed countries (shown in Appendix Figure 7). Once we add the level of the macro variables, T1 capital has a significant effect on pass-through, in that higher capital levels mean lower pass-through. All other results remain broadly unchanged, as larger banks with higher borrowings from the Eurosystem, higher CDS, higher capital and reserves have lower and slower pass-through (though the Wald tests for overall pass-through for capital and Eurosystem borrowings are no longer significantly different from each other); banks that have high holdings of domestic sovereign bonds have a lower immediate reaction to money market rate changes.

Looking at the effect of bank characteristics on large loans, the results show that external liabilities and NFPS deposits no longer affect banks' immediate response to money market rate changes. Neither measure of capital is significant in the long run, though the immediate reaction to a change in money market rates is lower with higher capital. The effects of Eurosystem borrowings is no longer significant for large loans. The findings that CDS and holdings of domestic government securities diminish pass-through still hold, as does the finding that banks with higher liquidity have a swifter reaction to changes in money market rates.

Finally, we include country-year dummies and the results are shown in Tables 21 and 22 for small loans and 23 and 24 for large loans. This would control for all remaining differences across banking systems and countries so that the variation in interest rate pricing can clearly be attributed to the bank-level characteristics identified and not due to unobserved country characteristics. The results are very similar to when the levels of macroeconomic variables are used (Tables 18 and 20), with only slight differences. As we can see in Table 21 for small loans, T1 capital is no longer significant, but the effects of size, capital, Eurosystem borrowings and CDS spreads on overall pass-through are generally the same. Holdings of domestic government securities continue to weaken immediate pass-through even after controlling for country-year effects. For large loans shown in Table 23, the principal findings are also basically the same. The main difference is that when including country-year dummies, it appears that having higher levels of NFPS deposits leads to higher overall pass-through. Lastly, banks with high domestic government securities holdings and CDS spreads again show lower overall pass-through of the cuts in policy rates over the crisis.

While adding the level of macro variables or country-year dummies to our specification diminishes some of the effects certain bank characteristics, the most important ones continue to affect interest rate pass-through, particularly for small loans. The variables we found to affect pass-through the most during this crisis - size, capital, Eurosystem borrowings and CDS for small loans and CDS and holdings of domestic government securities for large loans - continue to impact banks' overall reaction to money market rates, even after fully controlling for differences across countries.

7 Conclusion

The recent crisis has been characterised by high variation in interest rates on bank loans, as firms in parts of the euro area failed to fully benefit from monetary policy easing. Using a new dataset on individual bank balance sheets, we identify those bank-level characteristics which affected credit supply conditions for firms and contributed to the "detrimental fragmentation" in the transmission of monetary policy over the crisis.

We contribute to the literature on the pass-through heterogeneity using micro bank data in an important way. First, we find evidence of disruption in the transmission of monetary policy in the euro area and that, during the crisis, there was incomplete pass-through of monetary policy. Second, we show that considerable differences in pass-through exist across countries, even after controlling for changes in sovereign bond yields and macroeconomic conditions. Importantly, we find that a number of bank balance sheet characteristics appear to affect interest rate pass-through. The factors that have the biggest effects are those that saw the largest changes and differences over the crisis, such as reliance on Eurosystem credit, CDS spreads and holdings of government securities. These effects appear to be stronger for smaller loans. This suggests that SMEs suffered more than large firms from the impairment in banks' balance sheets, perhaps because they have fewer external financing alternatives and so are forced to accept higher interest rates.

By showing that individual bank characteristics had an impact on interest rate pass-through over the crisis, we add to the evidence on the existence of a bank lending channel. Our findings support the view that bank-level characteristics play an important role in the transmission of policy, thus underscoring the importance of restoring bank balance sheet strength to improve credit conditions. Our results also highlight the importance of macroeconomic conditions for loan pricing. An interesting avenue for future research would be the interaction between macroeconomic conditions and bank characteristics. This will be particularly relevant when looking at a longer time period with evolving macroeconomic and banking sector conditions.

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8 Appendix

Table 8: Summary of data by country

Country	Freq.	Percent	Cum.
AT	531	4.79	4.79
BE	413	3.72	8.51
DE	3,422	30.85	39.36
ES	1,416	12.77	52.13
FI	354	3.19	55.32
FR	1,416	12.77	68.09
IE	413	3.72	71.81
IT	1,416	12.77	84.57
LU	531	4.79	89.36
NL	590	5.32	94.68
PT	295	2.66	97.34
SI	295	2.66	100
Total	11,092	100	

Source: ECB, Individual MFI datasets.

Table 9: Data description

Variables	Symbols	Description
Dependent variables	ir	Interest rates on loans to non financial corporations with an initial rate fixation of up to 1 year (ECB IMIR): Total Small loans - up to 1 million euro Large loans - over 1 million euro
Money market rate	mr	Eonia (DataStream) 3-month EURIBOR (ECB SDW)
Macro variables	X	10 year government bond yield (DataStream) Inflation (DataStream) Unemployment rate (DataStream)
Bank-specific characteristics	Z	Size: total assets of a bank relative to total country bank assets (ECB IBSI) Liquidity: ratio of holdings of loans to MFIs (including the Eurosystem) and MFIs, government and private sector securities holdings (ECB IBSI) to total assets Capital and reserves: capital and reserves as a percentage of main assets (ECB IBSI) Regulatory capital (T1 cap): defined as banks' risk-weighted capital ratio (SNL Financials) NFPS deposits: Household and non-financial corporations deposits as a percentage of main assets External liabilities: External liabilities as a percentage of main assets (ECB IBSI) Net eurosystem borrowing: sum of credit borrowed in all monetary operations minus the amount of liquidity deposited with the ECB, over main assets.(ECB) CDS spreads: monthly averages of daily close prices (DataStream) Dom government securities: ratio of domestic government securities held over main assets (ECB IBSI) Loan loss provisions: provisions for loan losses reported / total assets (SNL Financials)

Table 10: Summary of interest rates by bank characteristic (percentages)

	<1 million			>1 million		
	Average	>p75	<p25	Average	>p75	<p25
Size	4.1	4.5	4.1	3.6	3.7	3.4
Liquidity	4.3	4	4.2	3.6	3.4	3.5
Capital and reserves	4.1	4.4	4.1	3.5	3.6	3.4
Risk weighted capital ratio	4.3	3.7	4.2	3.5	3.1	3.6
NFPS deposits	4.4	4.1	3.9	3.7	3.4	3.3
External liabilities	4.2	4.2	4.2	3.6	3.4	3.5
Net Eurosys. Credit	4.1	4.6	4.1	3.4	3.9	3.2
CDS spreads	3.9	4.5	4.2	3.2	3.5	3.6
Domestic govt. securities	4.2	4.4	4	3.5	3.7	3.4
Loan loss provisions	4.2	4.9	4.1	3.4	3.7	3.5

Source: ECB, Individual MFI datasets.

Table 11: Fisher test for panel unit root using an augmented Dickey-Fuller test

	Levels		Differences	
	Chi sq	Prob value	Chi sq	Prob value
$ir_{i,t}$ (Small)	134.4	1	1477.55	0
$ir_{i,t}$ (Large)	100.3	1	1717.22	0
Eonia	29.8	1	457.74	0
10yr govt bond yields	352.9	0.8	2275.65	0
Inflation	201.2	1	3372.94	0
Unemployment	650.5	0	2092.75	0

Note: Test includes 2 lags and a trend.

Table 12: Calculating Westerlund ECM panel cointegration tests (H0: no cointegration)

Small loans			
Statistic	Value	Z-value	P-value
Gt	-3.266	-13.464	0
Ga	-31.692	-35.208	0
Pt	-39.107	-15.332	0
Pa	-24.271	-30.433	0
Large loans			
Statistic	Value	Z-value	P-value
Gt	-3.611	-18.186	0
Ga	-38.343	-45.979	0
Pt	-41.990	-19.331	0
Pa	-32.517	-45.674	0

Note: Test includes 2 lags and a trend.

Table 13: Pass-through results for small loans - using 3 month Euribor

(Dep var: $\triangle$ $ir_{i,t}$)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Z_i:	Size	Liquidity	Capital	T1 Ratio	NFPS dep.	Ext. liab.	Euros. Borr.	CDSs	Gov. sec.	Loan prov.
$\triangle ir_{i,t-1}$	-0.202***	-0.215***	-0.208***	-0.278***	-0.218***	-0.219***	-0.209***	-0.209***	-0.215***	-0.308***
	(-3.53)	(-3.76)	(-3.88)	(-8.82)	(-3.97)	(-3.92)	(-3.67)	(-5.79)	(-4.07)	(-8.07)
$\triangle mr_t$ (β_0)	0.735***	0.753***	0.737***	0.747***	0.736***	0.745***	0.751***	0.671***	0.724***	0.741***
	(22.68)	(22.53)	(22.25)	(14.50)	(22.63)	(22.85)	(23.37)	(11.70)	(21.28)	(15.34)
$\triangle mr_{t-1}$	0.0615*	0.0726**	0.0669*	0.100**	0.0692*	0.0708**	0.0717**	0.151***	0.0743**	0.123***
	(1.73)	(2.03)	(1.95)	(2.27)	(1.95)	(2.02)	(2.05)	(4.11)	(2.15)	(2.68)
$\triangle mr_t$* $Z_{i,t-1}$ (β^*)	-0.00479*	0.106	-0.0190**	-0.0166	-0.000703	0.00127	-0.00493	-0.000171	-0.0257**	-16.50*
	(-1.77)	(0.47)	(-1.99)	(-1.06)	(-0.50)	(0.69)	(-0.86)	(-0.41)	(-2.04)	(-1.75)
$\triangle mr_{t-1}$* $Z_{i,t-1}$	-0.00147	-0.166	0.00707	-0.00514	-0.00149	0.000414	0.00587	-0.000414*	0.0184**	2.123
	(-0.57)	(-0.99)	(0.83)	(-0.42)	(-1.15)	(0.25)	(1.10)	(-1.72)	(2.05)	(0.45)
$Z_{i,t-1}$	-0.0197**	0.864**	-0.0309***	0.00739	-0.00104	0.000270	-0.00109	0.000402***	-0.0119	-2.246
	(-2.20)	(2.52)	(-2.92)	(1.03)	(-0.29)	(0.09)	(-0.24)	(2.70)	(-0.64)	(-1.51)
$ir_{i,t-1}$* (δ)	-0.255***	-0.244***	-0.261***	-0.166***	-0.246***	-0.249***	-0.269***	-0.278***	-0.258***	-0.157***
	(-6.37)	(-5.57)	(-5.97)	(-3.86)	(-5.85)	(-5.90)	(-6.03)	(-6.14)	(-5.76)	(-4.11)
$ir_{i,t-1}$* $Z_{i,t-1}$ (δ^*)	0.00888***	-0.228*	0.0165***	0.00194	-0.00160	-0.00199*	0.00667***	0.0000793***	0.0118*	0.617
	(3.36)	(-1.84)	(3.57)	(0.76)	(-1.08)	(-1.96)	(3.76)	(2.81)	(1.71)	(0.85)
mr_{t-1} (θ)	0.173***	0.164***	0.174***	0.0943***	0.161***	0.166***	0.181***	0.172***	0.174***	0.0962***
	(5.97)	(5.12)	(5.67)	(3.34)	(5.43)	(5.57)	(5.64)	(5.54)	(5.48)	(3.74)
mr_{t-1}* $Z_{i,t-1}$ (θ^*)	-0.00658***	0.202*	-0.0150***	-0.00651*	0.00135	0.00133*	-0.00644***	-0.000252***	-0.0115**	0.430
	(-3.65)	(1.80)	(-3.92)	(-1.90)	(1.18)	(1.76)	(-3.56)	(-2.79)	(-2.05)	(0.27)
$\triangle$ GBY_t	0.00676	0.00403	0.0107	0.00412	0.00751	0.00666	0.00367	0.0281*	0.00258	0.0117
	(0.37)	(0.21)	(0.56)	(0.23)	(0.40)	(0.35)	(0.20)	(1.73)	(0.15)	(0.65)
$\triangle$ GBY_{t-1}	0.0160	0.0134	0.0224	0.0151	0.0148	0.0152	0.0134	0.00913	0.0167	0.0101
	(0.99)	(0.78)	(1.42)	(0.88)	(0.89)	(0.92)	(0.80)	(0.48)	(0.98)	(0.59)
$\triangle$ Inf_t	0.0124	0.0134*	0.0107	0.0171	0.0123	0.0112	0.0107	0.0184*	0.00981	0.0167
	(1.65)	(1.77)	(1.42)	(1.38)	(1.64)	(1.48)	(1.44)	(1.72)	(1.30)	(1.43)
$\triangle$ Inf_{t-1}	0.00886	0.00709	0.00672	-0.00452	0.00780	0.00706	0.00708	0.0129	0.00604	-0.00467
	(1.19)	(0.93)	(0.91)	(-0.45)	(1.05)	(0.95)	(0.96)	(1.31)	(0.80)	(-0.44)
$\triangle$ $Unemp_t$	-0.0300*	-0.0255	-0.0243	0.00820	-0.0300*	-0.0276	-0.0277	-0.0168	-0.0281	0.00505
	(-1.75)	(-1.46)	(-1.45)	(0.36)	(-1.69)	(-1.60)	(-1.59)	(-0.94)	(-1.64)	(0.21)
$\triangle$ $Unemp_{t-1}$	-0.000894	0.00126	0.000730	0.0128	-0.000423	0.000455	0.00124	-0.000527	0.000140	-0.00199
	(-0.07)	(0.09)	(0.05)	(0.61)	(-0.03)	(0.03)	(0.09)	(-0.03)	(0.01)	(-0.12)
N	8342	8207	8318	3622	8342	8342	8342	3434	8335	3581
R^2	0.276	0.270	0.272	0.277	0.266	0.266	0.272	0.296	0.269	0.292

t statistics in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$. Panel OLS with bank fixed effects.

Table 14: Distributional effects of bank characteristics on small loans for different measures of pass-through - 3m Euribor

	Size Coeff.	St.er.	**Liquidity** Coeff.	St.er.	**Cap. res.** Coeff.	St.er.	**Ext. liab.** Coeff.	St.er.	**Euros. cred** Coeff.	St.er.	**CDS Spreads** Coeff.	St.er.	**Gov. sec.** Coeff.	St.er.	**Loan prov.** Coeff.	St.er.
Overall																
Very Low (p10)	0.69***	0.02	0.61***	0.04	0.72***	0.02	0.66***	0.02	0.69***	0.02	0.71***	0.02	0.70***	0.02		
Low (p10-p25)	0.69***	0.02	0.63***	0.03	0.70***	0.02	0.66***	0.02	0.68***	0.02	0.69***	0.02	0.70***	0.02		
Medium (p25-p75)	0.68***	0.02	0.66***	0.02	0.67***	0.02	0.66***	0.02	0.67***	0.02	0.65***	0.02	0.68***	0.02		
High (p75-p90)	0.65***	0.03	0.69***	0.03	0.61***	0.03	0.66***	0.02	0.65***	0.02	0.55***	0.06	0.63***	0.03		
Very High (p90)	0.30	0.59	0.71***	0.05	0.48***	0.08	0.66***	0.03	0.58***	0.04	0.2	0.18	0.55***	0.08		
V.low=V.high	0.05		0		0.01		0.56		0.49		0		0			
V.low=High	0.05		0.01		0.01		0.55		0.48		0		0			
Imm.																
Very Low (p10)	0.76***	0.04			0.82***	0.05							0.79***	0.04	0.83***	0.06
Low (p10-p25)	0.76***	0.04			0.78***	0.04							0.79***	0.04	0.80***	0.05
Medium (p25-p75)	0.75***	0.03			0.74***	0.03							0.74***	0.03	0.76***	0.05
High (p75-p90)	0.70***	0.04			0.68***	0.05							0.65***	0.05	0.71***	0.06
Very High (p90)	0.61***	0.07			0.60***	0.08							0.56***	0.09	0.44**	0.19
V.low=V.high	0.6				0.01								0		0.16	
V.low=High	0.6				0.01								0		0.16	
Adjust.																
Very Low (p10)	-0.31***	0.05	-0.19***	0.05	-0.33***	0.05	-0.22***	0.05	-0.29***	0.05	-0.28***	0.05	-0.29***	0.05		
Low (p10-p25)	-0.31***	0.05	-0.21***	0.04	-0.30***	0.05	-0.22***	0.05	-0.28***	0.05	-0.28***	0.05	-0.28***	0.05		
Medium (p25-p75)	-0.28***	0.05	-0.24***	0.04	-0.26***	0.04	-0.23***	0.04	-0.27***	0.05	-0.28***	0.05	-0.26***	0.05		
High (p75-p90)	-0.19***	0.04	-0.27***	0.05	-0.21***	0.04	-0.26***	0.04	-0.25***	0.04	-0.27***	0.04	-0.22***	0.05		
Very High (p90)	-0.03	0.06	-0.31***	0.06	-0.14***	0.05	-0.32***	0.05	-0.20***	0.04	-0.24***	0.04	-0.18***	0.06		
V.low=V.high	0.11		0.77		0.06		0.44		0.02		0.04		0			
V.low=High	0.11		0.77		0.06		0.44		0.02		0.04		0			

Very Low is a bank with a characteristic Z (size, liquidity, capital, external liabilities, Eurosystem borrowings, CDS, government securities, loan prov.) below the 10th percentile, Low is between the 10th and 25th percentile, Medium is between the 25th and 75th percentile, High is between the 75th and 90th percentile, and Very High is above 90th percentile. The overall pass-through is calculated as $-(\theta + \theta^* \overline{Z}^p_{t-1})/(\delta + \delta^* \overline{Z}^p_{t-1})$, immediate as $\beta_0 + \beta_0^* \overline{Z}^p_{t-1}$ and adjustment as $\delta + \delta^* \overline{Z}^p_{t-1}$, where $\overline{Z}^p_{t-1}$ denotes the mean of the characteristic in each percentile as already defined. Results only reported when β^*, δ^* and θ^* in Table 13 are significant. P values for Wald tests of equality between the pass-through coefficients are also shown; if p<0.1 we can reject that pass-through is the same across two categories of banks at 10% significance level. Standard errors are calculated using the Delta method.

Table 15: Pass-through results for large loans - using 3 month Euribor

(Dep var: $\triangle$ ir$_{i,t}$) Z$_i$:	(1) Size	(2) Liquidity	(3) Capital	(4) T1 Ratio	(5) NFPS dep.	(6) Ext. liab.	(7) Euros. Borr.	(8) CDSs	(9) Gov. sec.	(10) Loan prov.
$\triangle ir_{i,t-1}$	-0.230***	-0.226***	-0.231***	-0.232***	-0.232***	-0.233***	-0.221***	-0.147***	-0.219***	-0.230***
	(-7.65)	(-7.50)	(-7.95)	(-11.13)	(-8.17)	(-7.77)	(-7.37)	(-3.90)	(-7.40)	(-10.71)
$\triangle mr_t$ (β_0)	0.441***	0.442***	0.433***	0.398***	0.441***	0.442***	0.444***	0.448***	0.421***	0.409***
	(18.86)	(19.85)	(18.77)	(10.98)	(18.91)	(18.90)	(19.53)	(9.63)	(17.49)	(12.00)
$\triangle mr_{t-1}$	0.218***	0.224***	0.213***	0.231***	0.222***	0.221***	0.221***	0.156***	0.190***	0.244***
	(7.89)	(8.33)	(7.39)	(7.25)	(8.04)	(7.85)	(8.10)	(3.28)	(6.74)	(7.87)
$\triangle mr_t$* Z$_{i,t-1}$ (β^*)	-0.00105	0.312**	-0.0186**	-0.0240*	-0.000190	0.000271	-0.00473	-0.000173	-0.0314***	-6.056
	(-0.52)	(1.99)	(-2.56)	(-1.73)	(-0.18)	(0.17)	(-0.88)	(-0.79)	(-4.11)	(-1.41)
$\triangle mr_{t-1}$* Z$_{i,t-1}$	0.00165	-0.0990	-0.0222**	-0.0322**	-0.00155	0.00290**	0.0141***	0.0000789	-0.0139	-6.778**
	(1.07)	(-0.63)	(-2.40)	(-2.41)	(-1.42)	(2.33)	(3.18)	(0.34)	(-1.45)	(-2.23)
Z$_{i,t-1}$	-0.0102*	0.514	-0.00938	0.0314**	-0.00401	-0.000251	0.00201	0.000573**	-0.0214*	3.130***
	(-1.70)	(1.60)	(-0.84)	(2.25)	(-1.04)	(-0.07)	(0.40)	(2.10)	(-1.71)	(2.70)
$ir_{i,t-1}$* (δ)	-0.363***	-0.364***	-0.361***	-0.281***	-0.358***	-0.358***	-0.381***	-0.495***	-0.379***	-0.265***
	(-11.07)	(-10.72)	(-10.24)	(-7.92)	(-10.37)	(-10.19)	(-10.39)	(-7.55)	(-11.48)	(-7.80)
$ir_{i,t-1}$* Z$_{i,t-1}$ (δ^*)	0.00362	-0.0465	0.0100*	-0.0121*	-0.00129	-0.00142	0.00644**	0.000148**	0.0221***	-1.490
	(1.63)	(-0.30)	(1.90)	(-1.81)	(-0.83)	(-0.78)	(2.30)	(2.08)	(4.04)	(-1.40)
mr_{t-1} (θ)	0.287***	0.292***	0.284***	0.221***	0.281***	0.282***	0.302***	0.364***	0.302***	0.207***
	(10.15)	(9.86)	(9.23)	(6.93)	(9.39)	(9.22)	(9.46)	(6.15)	(10.48)	(6.52)
mr_{t-1}* Z$_{i,t-1}$(θ^*)	-0.00402**	0.114	-0.0122**	0.0115*	0.00122	0.000871	-0.00612*	-0.000575***	-0.0256***	2.162
	(-2.14)	(0.85)	(-2.48)	(1.76)	(0.90)	(0.52)	(-1.81)	(-3.57)	(-5.18)	(0.57)
$\triangle$ GBY$_t$	0.109***	0.114***	0.114***	0.0663**	0.109***	0.112***	0.105***	0.0992***	0.104***	0.0594*
	(4.60)	(4.71)	(4.81)	(2.18)	(4.61)	(4.71)	(4.44)	(4.33)	(4.38)	(1.90)
$\triangle$ GBY$_{t-1}$	0.109***	0.109***	0.112***	0.117***	0.107***	0.111***	0.109***	0.0489*	0.107***	0.117***
	(5.31)	(5.13)	(5.60)	(4.80)	(5.32)	(5.46)	(5.37)	(1.92)	(5.26)	(4.70)
$\triangle$ Inf$_t$	0.0229**	0.0256***	0.0234**	0.0195	0.0227**	0.0228**	0.0217**	0.0306*	0.0208**	0.0260
	(2.20)	(2.65)	(2.30)	(1.12)	(2.23)	(2.20)	(2.15)	(1.88)	(2.00)	(1.55)
$\triangle$ Inf$_{t-1}$	0.0363***	0.0372***	0.0349***	0.0576***	0.0356***	0.0355***	0.0353***	0.0135	0.0302***	0.0603***
	(3.27)	(3.35)	(3.14)	(5.69)	(3.22)	(3.23)	(3.21)	(0.81)	(2.81)	(5.79)
$\triangle$ Unemp$_t$	-0.0107	-0.00664	-0.00639	-0.0214	-0.0103	-0.0110	-0.00976	-0.00401	-0.0107	-0.0306
	(-0.45)	(-0.28)	(-0.27)	(-0.60)	(-0.43)	(-0.46)	(-0.41)	(-0.13)	(-0.46)	(-0.84)
$\triangle$ Unemp$_{t-1}$	-0.0596***	-0.0584***	-0.0561***	-0.0494*	-0.0591***	-0.0590***	-0.0572***	-0.0257	-0.0575***	-0.0530*
	(-2.96)	(-2.92)	(-2.83)	(-1.67)	(-2.95)	(-2.96)	(-2.87)	(-1.07)	(-2.93)	(-1.72)
N	7991	7866	7967	3567	7991	7991	7991	3353	7984	3509
R^2	0.307	0.308	0.309	0.280	0.306	0.306	0.311	0.330	0.316	0.274

t statistics in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$. Panel OLS with bank fixed effects.

Table 16: Distributional effects of bank characteristics on large loans for different measures of pass-through - 3m Euribor

	Cap. res.		**Tier 1 ratio**		**Euros. cred**		**CDS Spreads**		**Gov. sec.**		**Loan prov.**	
	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.
Overall												
Very Low (p10)	0.76***	0.02	0.65***	0.04	0.73***	0.02	0.76***	0.02	0.77***	0.01		
Low (p10-p25)	0.74***	0.02	0.67***	0.03	0.73***	0.02	0.75***	0.02	0.77***	0.01		
Medium (p25-p75)	0.72***	0.02	0.69***	0.03	0.72***	0.01	0.71***	0.02	0.74***	0.01		
High (p75-p90)	0.68***	0.02	0.71***	0.04	0.72***	0.02	0.62***	0.04	0.66***	0.03		
Very High (p90)	0.63***	0.05	0.73***	0.05	0.71***	0.04	0.33***	0.12	0.52***	0.07		
v.low=v.high (p-value)	0.01		0.39		0.49		0.00		0.00			
v.low=high (p-value)	0.01		0.38		0.48		0.00		0.00			
Imm.												
Very Low (p10)											0.90***	0.06
Low (p10-p25)											0.87***	0.06
Medium (p25-p75)											0.84***	0.06
High (p75-p90)											0.78***	0.07
Very High (p90)											0.53***	0.17
v.low=v.high (p-value)											0.16	
v.low=high (p-value)											0.16	
Adjust.												
Very Low (p10)	-0.41***	0.05	-0.23***	0.04		0.05	-0.51***	0.07	-0.44***	0.04		
Low (p10-p25)	-0.39***	0.04	-0.24***	0.04		0.04	-0.50***	0.07	-0.44***	0.04		
Medium (p25-p75)	-0.36***	0.04	-0.27***	0.04		0.04	-0.49***	0.07	-0.39***	0.04		
High (p75-p90)	-0.32***	0.04	-0.30***	0.04		0.04	-0.47***	0.06	-0.31***	0.03		
Very High (p90)	-0.28***	0.05	-0.35***	0.06		0.04	-0.40***	0.06	-0.23***	0.04		
v.low=v.high (p-value)	0.06		0.07				0.04		0.00			
v.low=high(p-value)	0.06		0.07				0.04		0.00			

Very Low is a bank with a characteristic Z (capital, tier 1 ratio, Eurosystem borrowings, CDS, government securities, loan prov.) below the 10th percentile, Low is between the 10th and 25th percentile, Medium is between the 25th and 75th percentile, High is between the 75th and 90th percentile, and Very High is above 90th percentile. The overall pass-through is calculated as $-(\theta + \theta^* \overline{Z}_{t-1}^p)/(\delta + \delta^* \overline{Z}_{t-1}^p)$, immediate as $\beta_0 + \beta_0^* \overline{Z}_{t-1}^p$ and adjustment as $\delta + \delta^* \overline{Z}_{t-1}^p$, where $\overline{Z}_{t-1}^p$ denotes the mean of the characteristic in each percentile as already defined. Results only reported when β^*, δ^* and θ^* in Table 15 are significant. P values for Wald tests of equality between the pass-through coefficients are also shown; if p<0.1 we can reject that pass-through is the same across two categories of banks at 10% significance level. Standard errors are calculated using the Delta method.

Table 17: Pass-through results for small loans - including macro levels (estimation of equation (7))

(Dep var: $\triangle$ $ir_{i,t}$)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Z_i:	Size	Liquidity	Capital	T1 Ratio	NFPS dep.	Ext. liab.	Euros. Borr.	CDSs	Gov. sec.	Loan prov.
$\triangle$ $ir_{i,t-1}$	-0.149***	-0.162***	-0.155***	-0.202	-0.163***	-0.163***	-0.162***	-0.143***	-0.165***	-0.244***
	(-2.75)	(-2.97)	(-2.96)	(-7.71)	(-3.07)	(-3.04)	(-2.99)	(-4.58)	(-3.12)	(-7.92)
$\triangle$ mr_t (β_0)	0.359***	0.363***	0.353***	0.370***	0.356***	0.358***	0.357***	0.335***	0.348***	0.389***
	(19.22)	(19)	(18.48)	(13.73)	(19.2)	) (18.92)	(18.64)	(12.16)	(17.68)	(14.87)
$\triangle$ mr_{t-1}	0.163***	0.180***	0.166***	0.0475	0.172***	0.173***	0.173***	0.065	0.168***	0.105
	(4.41)	(4.8)	(4.37)	(0.58)	(4.58)	(4.55)	(4.58)	(0.95)	(4.42)	(1.24)
$\triangle$ mr_t*$Z_{i,t-1}$ (β^*)	-0.00243	0.0397	-0.0195***	-0.0414***	-0.0005	0.000647	-0.000815	-0.000411***	-0.0176**	-0.648
	(-1.51)	-0.28	(-2.81)	(-2.85)	(-0.49)	-0.5	(-0.17)	(-3.18)	(-2.42)	(-0.38)
$\triangle$ mr_{t-1}*$Z_{i,t-1}$	0.00208	0.00651	-0.0121*	-0.0227***	-0.00234**	0.00155	0.00757*	-0.0000459*	-0.0165**	-6.682
	(1.15)	) (0.04)	(-1.80)	(-2.97)	(-2.00)	(1.56)	(1.84)	(-0.24)	(-2.24)	(-1.64)
$Z_{i,t-1}$	-0.0161	0.648*	-0.0463***	-0.0125	0.000689	0.00273	-0.00501	0.0000168	-0.00922	1.13
	(-1.65)	(1.66)	(-4.13)	(-1.34)	(0.18)	(0.88)	(1.18)	(-0.14)	(-0.50)	(0.72)
$ir_{i,t-1}$ (δ)	-0.332***	-0.325***	-0.338***	-0.289***	-0.326***	-0.327***	-0.329***	-0.344***	-0.328***	-0.242***
	(-7.15)	(-6.51)	(-6.61)	(-3.13)	(-6.65)	(-6.53)	(-6.54)	(-6.74)	(-6.44)	(-4.43)
$ir_{i,t-1}$*$Z_{i,t-1}$ (δ^*)	0.00744***	-0.145	0.0132***	0.0097*	-0.00124	-0.00082	0.00293*	0.0000780***	0.00262	-0.498
	(3.35)	(-1.29)	(3.91)	) (3.13)	(-0.91)	(-0.77)	(1.95)	(2.93)	(0.41)	(-0.89)
mr_{t-1} (θ)	0.277***	0.260***	0.267***	0.208***	0.261***	0.262***	0.267***	0.261***	0.261***	0.184***
	(6.74)	(6.09)	(6.1)	(4.72)	(6.17)	(6.09)	(6.05)	(6.04)	(6.02)	(4.07)
mr_{t-1}*$Z_{i,t-1}$ (θ^*)	-0.00609***	0.0898	-0.0148***	-0.0163*	0.00109	0.000585	-0.000352*	-0.00031***	-0.00358	1.771
	(-3.92)	(0.78)	(-3.69)	(-3.96)	(0.97)	(0.7)	(-1.87)	(-3.18)	(-0.58)	(0.78)
$\triangle$ GBY_t	0.0185	0.00923	0.0105	-0.00816	0.0103	0.0107	0.0156	0.0431***	0.0102	0.0172
	(0.84)	(0.39)	(0.44)	(-0.40)	(0.45)	(0.45)	(0.7)	(-3.15)	(0.43)	(-1.11)
$\triangle$ GBY_{t-1}	0.0323*	0.0224	0.0303	0.0271	0.0231	0.0239	0.0297	0.0540***	0.0225	0.0349**
	(1.69)	(1.07)	(1.14)	(1.57)	(1.13)	(1.16)	(1.51)	(2.71)	(1.02)	(2.07)
$\triangle$ Inf_t	-0.00373	-0.00378	-0.00445	0.00334	-0.00442	-0.00518	-0.00581	-0.0398	-0.00449	-0.00603
	(-0.52)	(-0.50)	(-0.59)	(0.31)	(-0.61)	(-0.69)	(-0.78)	(-0.38)	(-0.60)	(-0.57)
$\triangle$ Inf_{t-1}	0.0259***	0.0248***	0.0244***	0.00698	0.0253***	0.0250***	0.0254***	0.0152	0.0240***	0.0129
	(3.46)	(3.23)	(3.27)	(0.6)	(3.4)	(3.31)	) (3.42)	(1.51)	(3.19)	(1.1)
$\triangle$ $Unemp_t$	-0.0459**	-0.0428**	-0.0397*	-0.0108	-0.0453**	-0.0441**	-0.0434**	-0.0364	-0.0437**	-0.017
	(-2.21)	(-2.03)	(-1.93)	(-0.42)	(-2.15)	(-2.12)	(-2.06)	(-1.56)	(-2.08)	(-0.60)
$\triangle$ $Unemp_{t-1}$	-0.0602***	-0.0580***	-0.0596***	-0.0323	-0.0577***	-0.0581***	-0.0578***	-0.0426***	-0.0570***	-0.0572***
	(-3.52)	(-3.27)	(-3.55)	(-1.67)	(-3.38)	(-3.39)	(-3.42)	(-3.90)	(-3.31)	(-1.54)
GBY	0.0555***	0.0752***	0.0760***	0.0867*	0.0732***	0.0731***	0.0644***	0.0292***	0.0725***	0.0678**
	(4.76)	(5.49)	(6.32)	(5.32)	(5.76)	(5.43)	(5.08)	(1.98)	(5.54)	(4398)
Inf	0.0282***	0.0282***	0.0287***	0.0263***	0.0284***	0.0287***	0.0285***	0.033***	0.0284***	0.025***
	(7.37)	(7.37)	(6.85)	(4.83)	(7.47)	(7.12)	(7.32)	(4.91)	(7.17)	(4.91)
Unemp	0.0201***	0.0131**	0.0131**	0.0091	0.0143**	0.0145**	0.0153**	0.0161*	0.0146**	0.006
	(2.92)	(2.12)	(1.99)	(0.89)	(2.21)	(2.25)	(2.41)	(1.97)	(2.28)	(0.77)
N	8342	8207	8318	3622	8342	8342	8342	3434	8335	3581
R^2	0.273	0.269	0.272	0.281	0.266	0.265	0.265	0.283	0.266	0.282

t statistics in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$. Panel OLS with bank fixed effects.

Table 18: Distributional effects of bank characteristics on small loans for different measures of pass-through - macro levels

	Size Coeff.	St.er.	**Cap. res.** Coeff.	St.er.	**Tier 1 ratio** Coeff.	St.er.	**Euros. cred** Coeff.	St.er.	**CDS Spreads** Coeff.	St.er.	**Gov. sec.** Coeff.	St.er.
Overall												
Very Low (p10)	0.83***	0.02	0.80***	0.02	0.79***	0.04	0.82***	0.03	0.85***	0.03		
Low (p10-p25)	0.83***	0.02	0.79***	0.02	0.78***	0.03	0.81***	0.03	0.83***	0.03		
Medium (p25-p75)	0.83***	0.02	0.79***	0.02	0.73***	0.04	0.81***	0.03	0.79***	0.03		
High (p75-p90)	0.83***	0.03	0.78***	0.03	0.65***	0.06	0.80***	0.02	0.69***	0.05		
Very High (p90)	0.85***	0.11	0.76***	0.06	0.49***	0.11	0.77***	0.04	0.40***	0.14		
v.low=v.high (p-value)	0.84		0.61		0.01		0.28		0.00			
Imm.												
Very Low (p10)			0.44***	0.04	0.42***	0.04			0.39***	0.03	0.39***	0.03
Low (p10-p25)			0.40***	0.03	0.40***	0.03			0.38***	0.03	0.39***	0.03
Medium (p25-p75)			0.36***	0.02	0.37***	0.03			0.35***	0.03	0.36***	0.02
High (p75-p90)			0.29***	0.02	0.33***	0.04			0.29***	0.03	0.30***	0.03
Very High (p90)			0.21***	0.05	0.27***	0.07			0.15**	0.08	0.23***	0.05
v.low=v.high (p-value)			0.01		0.11				0.01		0.02	
Adjust.												
Very Low (p10)	-0.38***	0.05	-0.39***	0.06	-0.32***	0.06	-0.34***	0.05	-0.35***	0.05		
Low (p10-p25)	-0.38***	0.05	-0.37***	0.05	-0.31***	0.06	-0.33***	0.05	-0.35***	0.05		
Medium (p25-p75)	-0.35***	0.05	-0.34***	0.05	-0.29***	0.05	-0.33***	0.05	-0.34***	0.05		
High (p75-p90)	-0.27***	0.04	-0.30***	0.05	-0.26***	0.05	-0.32***	0.05	-0.33***	0.05		
Very High (p90)	-0.14**	0.06	-0.24***	0.05	-0.22***	0.04	-0.30***	0.05	-0.30***	0.05		
v.low=v.high (p-value)	0.00		0.00		0.00		0.05		0.00			

Very Low is a bank with a characteristic Z (size, capital, tier 1 ratio, Eurosystem borrowings, CDS, government securities) below the 10th percentile, Low is between the 10th and 25th percentile, Medium is between the 25th and 75th percentile, High is between the 75th and 90th percentile, and Very High is above 90th percentile. The overall pass-through is calculated as $-(\theta + \theta^{*}\overline{Z}^{p}_{t-1})/(\delta + \delta^{*}\overline{Z}^{p}_{t-1})$, immediate as $\beta_0 + \beta_0^{*}\overline{Z}^{p}_{t-1}$ and adjustment as $\delta + \delta^{*}\overline{Z}^{p}_{t-1}$, where $\overline{Z}^{p}_{t-1}$ denotes the mean of the characteristic in each percentile as already defined. Results only reported when β^{*}, δ^{*} and θ^{*} in Table 17 are significant. P values for Wald tests of equality between the pass-through coefficients are also shown; if p<0.1 we can reject that pass-through is the same across two categories of banks at 10% significance level. Standard errors are calculated using the Delta method.

Table 19: Pass-through results for large loans - including macro levels (estimation of equation (7))

(Dep var: $\triangle$ $ir_{i,t}$)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Z_i:	Size	Liquidity	Capital	T1 Ratio	NFPS dep.	Ext. liab.	Euros. Borr.	CDSs	Gov. sec.	Loan prov.
$\triangle$ $ir_{i,t-1}$	-0.192***	-0.190***	-0.193***	-0.193**	-0.192***	-0.194***	-0.193***	-0.130***	-0.189***	-0.185***
	(-5.92)	(-5.74)	(-6.08)	(-7.64)	(-6.22)	(-6.15)	(-5.90)	(-3.42)	(-5.85)	(-7.08)
$\triangle$ mr_t (β_0)	0.438***	0.438***	0.432***	0.385***	0.437***	0.436***	0.437***	0.420***	0.423***	0.405***
	(18.69)	(19.33)	(18.42)	(10.65)	(18.72)	(18.64)	(18.94)	(9.28)	(17.46)	(12.43)
$\triangle$ mr_{t-1}	0.138***	0.147***	0.139***	0.157**	0.139***	0.142***	0.146***	0.0966*	0.129***	0.167**
	(4.62)	(4.94)	(4.55)	(4.60)	(4.66)	(4.76)	(4.73)	(1.94)	(4.19)	(4.90)
$\triangle$ mr_t*$Z_{i,t-1}$ (β^*)	-0.000426	0.352**	-0.0168**	-0.0215	-0.000198	0.000136	-0.00422	-0.00014	-0.0274***	-4.114
	(-0.21)	(2.23)	(-2.16)	(-1.63)	(-0.18)	(0.08)	(-0.78)	(-0.68)	(-3.54)	(-1.09)
$\triangle$ mr_{t-1}*$Z_{i,t-1}$	0.00156	0.0364	-0.0244***	-0.0285**	-0.00190*	0.00381***	0.00900**	0.0000954	-0.0160*	-4.486
	(1.01)	(0.24)	(-2.68)	(-2.35)	(-1.77)	(3.08)	(1.98)	(0.41)	(-1.81)	(-1.43)
$Z_{i,t-1}$	-0.00742	0.488	-0.0237**	-0.00381	-0.00195	0.0043	-0.00125	0.00011	-0.0222*	6.383***
	(-0.93)	(1.33)	(-2.24)	(-0.32)	(-0.43)	(1.56)	(-0.29)	(0.51)	(-1.91)	(5.29)
$ir_{i,t-1}$ (δ)	-0.464***	-0.464***	-0.463***	-0.381***	-0.462***	-0.460***	-0.462***	-0.537***	-0.467***	-0.375***
	(-10.77)	(-10.75)	(-10.42)	(-7.29)	(-10.63)	(-10.67)	(-10.06)	(-7.73)	(-10.77)	(-7.04)
$ir_{i,t-1}$*$Z_{i,t-1}$ (δ^*)	0.00228	-0.0658	0.00689	0.00230	-0.00155	0.000271	0.00241	0.000115**	0.0134**	-2.654***
	(0.97)	(-0.39)	(1.55)	(0.50)	(-0.99)	(0.14)	(0.99)	(2.03)	(2.44)	(-3.29)
mr_{t-1} (θ)	0.392***	0.390***	0.386***	0.291***	0.388***	0.384***	0.389***	0.402***	0.385***	0.288***
	(9.54)	(9.51)	(9.06)	(5.75)	(9.49)	(9.34)	(8.81)	(5.84)	(9.3)	(5.85)
mr_{t-1}*$Z_{i,t-1}$ (θ^*)	-0.00268	0.102	-0.0067	-0.00266	0.00159	-0.000759	-0.00154	-0.000467***	-0.0178***	1.065
	(-1.22)	(0.68)	(-1.54)	(-0.54)	(1.12)	(-0.43)	(-0.51)	(-2.98)	(-3.24)	(0.32)
$\triangle$ GBY_t	0.0294	0.0342	0.0282	0.00131	0.0268	0.026	0.0322	0.0587**	0.0312	-0.00715
	(1.27)	(1.46)	(1.18)	(0.05)	(1.14)	(1.14)	(1.37)	(2.44)	(1.33)	(-0.24)
$\triangle$ GBY_{t-1}	0.0416**	0.0391**	0.0380*	0.0587***	0.0378**	0.0375**	0.0445**	0.0131	0.0425**	0.0527**
	(2.2)	(2.03)	(1.95)	(2.7)	(2)	(1.99)	(2.47)	(0.51)	(2.29)	(2.29)
$\triangle$ Inf_t	-0.000449	0.00187	0.00119	0.00035	-0.000328	-0.000579	-0.00057	0.00878	0.000533	0.00507
	(-0.04)	(0.2)	(0.12)	(0.02)	(-0.03)	(-0.06)	(-0.06)	(0.54)	(0.05)	(0.30)
$\triangle$ Inf_{t-1}	0.0126	0.0133	0.0127	0.0338***	0.012	0.012	0.0129	-0.0114	0.0107	0.0378***
	(1.12)	(1.17)	(1.12)	(3.40)	(1.06)	(1.06)	(1.15)	(-0.67)	(0.98)	(3.65)
$\triangle$ $Unemp_t$	-0.0113	-0.00679	-0.00832	-0.00676	-0.0105	-0.0105	-0.0111	-0.0006	-0.01	-0.0165
	(-0.49)	(-0.30)	(-0.36)	(-0.19)	(-0.46)	(-0.46)	(-0.49)	(-0.02)	(-0.44)	(-0.45)
$\triangle$ $Unemp_{t-1}$	-0.0489***	-0.0471**	-0.0488***	-0.0305	-0.0480***	-0.0484***	-0.0477***	-0.0217	-0.0469**	-0.0409
	(-2.67)	(-2.55)	(-2.69)	(-1.15)	(-2.63)	(-2.67)	(-2.62)	(-0.92)	(-2.60)	(-1.43)
GBY	0.0937***	0.0994***	0.0998***	0.0958***	0.0974***	0.103***	0.0906***	0.0712***	0.0920***	0.097***
	(5.74)	(6.67)	(6.4)	(5.59)	(6.65)	(7.19)	(5.89)	(4.27)	(6.33)	(5.47)
Inf	0.0366***	0.0365***	0.0366***	0.0315***	0.0365***	0.0374***	0.0364***	0.038***	0.0346***	0.0321***
	(8.87)	(9.15)	(8.5)	(5.38)	(8.73)	(9.12)	(8.88)	(5.16)	(8.18)	(5.73)
Unemp	0.00576	-0.000592	0.0045	-0.0134*	0.00479	0.00394	0.00384	-0.0097	0.00213	-0.0109*
	(0.82)	(-0.09)	(0.67)	(-1.80)	(0.75)	(0.62)	(0.59)	(-0.77)	(0.33)	(-1.69)
N	7876	7751	7852	3535	7876	7876	7876	3353	7869	3477
R^2	0.343	0.344	0.345	0.316	0.344	0.343	0.342	0.346	0.346	0.316

t statistics in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$. Panel OLS with bank fixed effects.

Table 20: Distributional effects of bank characteristics on large loans for different measures of pass-through - macro levels

	Liquidity		**Cap. res.**		**CDS Spreads**		**Gov. sec.**		**Loan prov.**	
	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.
Overall										
Very Low (p10)					0.84***	0.04	0.86***	0.02		
Low (p10-p25)					0.82***	0.04	0.86***	0.02		
Medium (p25-p75)					0.78***	0.04	0.83***	0.02		
High (p75-p90)					0.68***	0.06	0.78***	0.04		
Very High (p90)					0.40**	0.16	0.71***	0.07		
v.low=v.high (p-value)					0.01		0.02			
Imm.										
Very Low (p10)	0.35***	0.04	0.51***	0.04			0.49***	0.03		
Low (p10-p25)	0.38***	0.03	0.47***	0.03			0.49***	0.03		
Medium (p25-p75)	0.42***	0.02	0.43***	0.02			0.44***	0.02		
High (p75-p90)	0.48***	0.03	0.38***	0.03			0.34***	0.03		
Very High (p90)	0.54***	0.06	0.31***	0.06			0.24***	0.06		
v.low=v.high (p-value)	0.03		0.03				0.00			
Adjust.										
Very Low (p10)					-0.55***	0.07	-0.50***	0.05	-0.35***	0.05
Low (p10-p25)					-0.54***	0.07	-0.50***	0.05	-0.36***	0.05
Medium (p25-p75)					-0.54***	0.07	-0.47***	0.04	-0.37***	0.05
High (p75-p90)					-0.52***	0.07	-0.43***	0.04	-0.37***	0.05
Very High (p90)					-0.48***	0.06	-0.38***	0.05	-0.42***	0.06
v.low=v.high (p-value)					0.04		0.01		0.00	

Very Low is a bank with a characteristic Z (liquidity, capital, CDS, government securities, loan prov.) below the 10th percentile, Low is between the 10th and 25th percentile, Medium is between the 25th and 75th percentile, High is between the 75th and 90th percentile, and Very High is above 90th percentile. The overall pass-through is calculated as $-(\theta + \theta^* \overline{Z}^p_{t-1})/(\delta + \delta^* \overline{Z}^p_{t-1})$, immediate as $\beta_0 + \beta_0^* \overline{Z}^p_{t-1}$ and adjustment as $\delta + \delta^* \overline{Z}^p_{t-1}$, where $\overline{Z}^p_{t-1}$ denotes the mean of the characteristic in each percentile as already defined. Results only reported when β^*, δ^* and θ^* in Table 19 are significant. P values for Wald tests of equality between the pass-through coefficients are also shown; if p<0.1 we can reject that pass-through is the same across two categories of banks at 10% significance level. Standard errors are calculated using the Delta method.

Table 21: Pass-through results for small loans - with country-year dummies

(Dep var: $\triangle$ $ir_{i,t}$)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Z_i:	Size	Liquidity	Capital	T1 Ratio	NFPS dep.	Ext. liab.	Euros. Borr.	CDSs	Gov. sec.	Loan prov.
$\triangle$ $ir_{i,t-1}$	-0.145**	-0.155***	-0.149***	-0.182***	-0.155***	-0.156***	-0.154***	-0.135***	-0.158***	-0.206***
	(-2.56)	(-2.72)	(-2.73)	(-6.14)	(-2.79)	(-2.78)	(-2.72)	(-3.64)	(-2.82)	(-5.39)
$\triangle$ mr_t (β_0)	0.289***	0.293***	0.287***	0.317***	0.288***	0.289***	0.287***	0.253***	0.284***	0.332***
	(13.34)	(13.39)	(13.35)	(9.91)	(13.48)	(13.28)	(13.08)	(8.22)	(12.93)	(10.25)
$\triangle$ mr_{t-1}	0.149***	0.159***	0.147***	0.159***	0.153***	0.153***	0.154***	0.146***	0.150***	0.180***
	(4.25)	(4.41)	(4.05)	(5.96)	(4.26)	(4.19)	(4.27)	(5.20)	(4.18)	(5.37)
$\triangle$ mr_t*$Z_{i,t-1}$ (β^*)	-0.00173	0.0298	-0.0188***	-0.00932	-0.000474	0.000869	-0.000886	-0.000474***	-0.0141**	-5.097
	(-1.02)	(0.21)	(-2.81)	(-0.91)	(-0.47)	(0.68)	(-0.19)	(-3.26)	(-2.03)	(-1.07)
$\triangle$ mr_{t-1}*$Z_{i,t-1}$	0.00262	-0.0152	-0.00931	-0.0199***	-0.00236**	0.00165*	0.00901**	-0.0000243	-0.0133*	-3.571
	(1.48)	(-0.10)	(-1.44)	(-2.82)	(-2.05)	(1.87)	(2.18)	(-0.11)	(-1.88)	(-0.95)
$Z_{i,t-1}$	-0.0165	0.581*	-0.0420***	-0.00402	0.00234	0.00201	-0.00702	0.000313*	-0.00428	-0.179
	(-1.50)	(1.71)	(-3.70)	(-0.24)	(0.58)	(0.63)	(-1.54)	(1.99)	(-0.22)	(-0.13)
$ir_{i,t-1}$ (δ)	-0.349***	-0.350***	-0.358***	-0.340***	-0.350***	-0.351***	-0.353***	-0.381***	-0.351***	-0.336***
	(-7.23)	(-6.71)	(-6.81)	(-5.34)	(-6.78)	(-6.66)	(-6.71)	(-7.06)	(-6.66)	(-5.24)
$ir_{i,t-1}$*$Z_{i,t-1}$ (δ^*)	0.00798***	-0.111	0.0128***	0.00388	-0.00128	-0.000723	0.00395***	0.0000768***	-0.0000206	0.164
	(3.07)	(-1.00)	(3.64)	(0.81)	(-0.93)	(-0.64)	(2.63)	(2.69)	(-0.00)	(0.30)
mr_{t-1} (θ)	0.203***	0.197***	0.206***	0.179***	0.198***	0.199***	0.201***	0.183***	0.200***	0.180***
	(4.78)	(4.39)	(4.66)	(3.52)	(4.51)	(4.45)	(4.48)	(3.93)	(4.46)	(3.32)
mr_{t-1}*$Z_{i,t-1}$ (θ^*)	-0.00599***	0.0677	-0.0113***	-0.00830	0.00118	0.000560	-0.00449**	-0.000398***	0.000582	-1.488
	(-3.27)	(0.66)	(-3.48)	(-1.55)	(1.03)	(0.60)	(-2.16)	(-3.88)	(0.10)	(-0.71)
$\triangle$ GBY_t	0.0756***	0.0777***	0.0783***	0.0647***	0.0797***	0.0791***	0.0774***	0.0680***	0.0777***	0.0743***
	(3.40)	(3.51)	(3.56)	(3.57)	(3.62)	(3.56)	(3.49)	(3.75)	(3.69)	(4.36)
$\triangle$ GBY_{t-1}	0.0410**	0.0398**	0.0416**	0.0568***	0.0414**	0.0412**	0.0415**	0.0358*	0.0385*	0.0496**
	(2.16)	(2.05)	(2.18)	(3.28)	(2.17)	(2.14)	(2.17)	(1.80)	(1.97)	(2.63)
$\triangle$ Inf_t	0.00133	0.000639	0.000223	0.00757	0.000529	-0.000300	-0.00110	0.00734	0.000175	0.00707
	(0.19)	(0.08)	(0.03)	(0.70)	(0.07)	(-0.04)	(-0.15)	(0.74)	(0.02)	(0.64)
$\triangle$ Inf_{t-1}	0.0308***	0.0287***	0.0291***	0.0123	0.0295***	0.0294***	0.0305***	0.0252**	0.0290***	0.0158
	(4.28)	(3.86)	(4.04)	(1.14)	(4.10)	(4.04)	(4.24)	(2.55)	(4.01)	(1.41)
$\triangle$ $Unemp_t$	-0.0471**	-0.0475**	-0.0435**	-0.0210	-0.0488**	-0.0481**	-0.0465**	-0.0396**	-0.0477**	-0.0210
	(-2.47)	(-2.47)	(-2.27)	(-0.95)	(-2.51)	(-2.52)	(-2.39)	(-2.00)	(-2.46)	(-0.84)
$\triangle$ $Unemp_{t-1}$	-0.0449***	-0.0468***	-0.0477***	-0.0167	-0.0458***	-0.0465***	-0.0459***	-0.0306**	-0.0452***	-0.0344*
	(-2.92)	(-2.96)	(-3.08)	(-0.79)	(-2.94)	(-3.00)	(-2.96)	(-2.08)	(-2.87)	(-1.77)
N	8342	8207	8318	3622	8342	8342	8342	3434	8335	3581
R^2	0.285	0.281	0.283	0.304	0.279	0.277	0.278	0.304	0.278	0.318

t statistics in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$. Panel OLS with bank fixed effects. Regressions include (72) country-year dummies.

Table 22: Distributional effects of bank characteristics on small loans for different measures of pass-through - country-year dummies

	Size		**Cap. res.**		**Euros. cred**		**CDS Spreads**		**Gov. sec.**	
	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.	Coeff.	St.er.
Overall										
Very Low (p10)	0.60***	0.05	0.62***	0.05	0.59***	0.06	0.60***	0.05		
Low (p10-p25)	0.60***	0.05	0.60***	0.05	0.58***	0.06	0.58***	0.05		
Medium (p25-p75)	0.59***	0.05	0.58***	0.05	0.57***	0.06	0.52***	0.06		
High (p75-p90)	0.54***	0.07	0.54***	0.06	0.55***	0.06	0.39***	0.09		
Very High (p90)	0.36*	0.21	0.47***	0.09	0.50***	0.07	0.0	0.20		
v.low=v.high (p-value)	0.20		0.05		0.11		0.00			
Imm.										
Very Low (p10)			0.37***	0.04			0.31***	0.03	0.32***	0.03
Low (p10-p25)			0.33***	0.03			0.30***	0.03	0.32***	0.03
Medium (p25-p75)			0.29***	0.02			0.27***	0.03	0.29***	0.02
High (p75-p90)			0.23***	0.02			0.21***	0.04	0.24***	0.03
Very High (p90)			0.15***	0.05			0.0	0.08	0.19***	0.05
v.low=v.high (p-value)			0.01				0.00		0.04	
Adjust.										
Very Low (p10)	-0.40***	0.06	-0.41***	0.06	-0.36***	0.06	-0.39***	0.06		
Low (p10-p25)	-0.40***	0.05	-0.39***	0.05	-0.36***	0.05	-0.38***	0.05		
Medium (p25-p75)	-0.37***	0.05	-0.36***	0.05	-0.35***	0.05	-0.38***	0.05		
High (p75-p90)	-0.29***	0.05	-0.32***	0.05	-0.34***	0.05	-0.37***	0.05		
Very High (p90)	-0.15**	0.07	-0.27***	0.06	-0.31***	0.05	-0.34***	0.05		
v.low=v.high (p-value)	0.00		0.00		0.01		0.00			

Very Low is a bank with a characteristic Z (size, capital, Eurosystem borrowing, CDS, government securities) below the 10th percentile, Low is between the 10th and 25th percentile, Medium is between the 25th and 75th percentile, High is between the 75th and 90th percentile, and Very High is above 90th percentile. The overall pass-through is calculated as $-(\theta+\theta^{*}\overline{Z}^{p}_{t-1})/(\delta+\delta^{*}\overline{Z}^{p}_{t-1})$, immediate as $\beta_0+\beta_0^{*}\overline{Z}^{p}_{t-1}$ and adjustment as $\delta+\delta^{*}\overline{Z}^{p}_{t-1}$, where $\overline{Z}^{p}_{t-1}$ denotes the mean of the characteristic in each percentile as already defined. Results only reported when β^{*}, δ^{*} and θ^{*} in Table 21 are significant. P values for Wald tests of equality between the pass-through coefficients are also shown; if p<0.1 we can reject that pass-through is the same across two categories of banks at 10% significance level. Standard errors are calculated using the Delta method.

Table 23: Pass-through results for large loans - with country-year dummies

(Dep var: △ $ir_{i,t}$) Z_i:	(1) Size	(2) Liquidity	(3) Capital	(4) T1 Ratio	(5) NFPS dep.	(6) Ext. liab.	(7) Euros. Borr.	(8) CDSs	(9) Gov. sec.	(10) Loan prov.
△ $ir_{i,t-1}$	-0.173***	-0.168***	-0.174***	-0.162***	-0.169***	-0.172***	-0.172***	-0.111**	-0.172***	-0.161***
	(-5.48)	(-5.30)	(-5.54)	(-5.43)	(-5.61)	(-5.57)	(-5.36)	(-2.63)	(-5.42)	(-5.45)
△ mr_t (β_0)	0.343***	0.341***	0.339***	0.302***	0.345***	0.343***	0.341***	0.299***	0.335***	0.297***
	(13.51)	(13.81)	(13.40)	(7.44)	(13.61)	(13.47)	(13.35)	(6.07)	(13.04)	(8.25)
△ mr_{t-1}	0.110***	0.112***	0.106***	0.112***	0.107***	0.110***	0.114***	0.0445	0.101***	0.116***
	(3.75)	(3.97)	(3.67)	(3.19)	(3.76)	(3.78)	(3.87)	(0.86)	(3.47)	(3.27)
△ mr_t*$Z_{i,t-1}$ (β^*)	0.000141	0.232	-0.0149*	-0.0233	0.000281	-0.000170	-0.00499	-0.000353	-0.0233***	-3.407
	(0.07)	(1.44)	(-1.93)	(-1.60)	(0.28)	(-0.10)	(-0.89)	(-1.64)	(-3.06)	(-0.83)
△ mr_{t-1}*$Z_{i,t-1}$	0.00117	-0.0471	-0.0213**	-0.0230*	-0.00176*	0.00334**	0.00980**	0.0000354	-0.0126	-4.799
	(0.69)	(-0.32)	(-2.48)	(-1.82)	(-1.70)	(2.59)	(2.26)	(0.15)	(-1.50)	(-1.43)
$Z_{i,t-1}$	-0.000671	0.243	-0.00880	0.0168	0.00267	0.00317	-0.000325	0.000459**	-0.0150	3.972**
	(-0.07)	(0.73)	(-0.79)	(1.22)	(0.69)	(1.19)	(-0.07)	(2.28)	(-1.30)	(2.60)
$ir_{i,t-1}$ (δ)	-0.493***	-0.500***	-0.491***	-0.455***	-0.500***	-0.494***	-0.495***	-0.585***	-0.492***	-0.441***
	(-11.36)	(-11.92)	(-11.17)	(-7.28)	(-12.35)	(-11.71)	(-10.90)	(-7.70)	(-11.32)	(-7.03)
ir_{t-1}*$Z_{i,t-1}$ (δ^*)	-0.0000188	0.0575	0.00431	-0.00610	-0.00217*	0.0000437	0.00256	0.000117**	0.00855	-2.175*
	(-0.01)	(0.38)	(0.88)	(-1.10)	(-1.68)	(0.02)	(1.07)	(2.13)	(1.54)	(-1.81)
mr_{t-1} (θ)	0.305***	0.312***	0.306***	0.262***	0.311***	0.306***	0.307***	0.313***	0.304***	0.238***
	(6.95)	(7.08)	(6.82)	(4.54)	(7.42)	(7.02)	(6.73)	(3.82)	(6.85)	(4.05)
mr_{t-1}*$Z_{i,t-1}$ (θ^*)	-0.000927	-0.0605	-0.00406	0.00172	0.00238**	-0.000844	-0.00266	-0.000629***	-0.0117**	3.190
	(-0.45)	(-0.43)	(-0.88)	(0.27)	(2.02)	(-0.42)	(-0.80)	(-4.51)	(-2.06)	(0.50)
△ GBY_t	0.111***	0.115***	0.109***	0.0537*	0.110***	0.112***	0.108***	0.0906***	0.108***	0.0508
	(4.52)	(4.62)	(4.41)	(1.78)	(4.51)	(4.53)	(4.45)	(3.24)	(4.35)	(1.63)
△ GBY_{t-1}	0.0467**	0.0464**	0.0444**	0.0571**	0.0443**	0.0470**	0.0460**	-0.0166	0.0443**	0.0470*
	(2.29)	(2.24)	(2.13)	(2.23)	(2.19)	(2.32)	(2.25)	(-0.59)	(2.15)	(1.79)
△ Inf_t	0.00719	0.00863	0.00854	0.000775	0.00759	0.00735	0.00724	0.0195	0.00730	0.00542
	(0.72)	(0.94)	(0.87)	(0.05)	(0.78)	(0.74)	(0.74)	(1.22)	(0.73)	(0.33)
△ Inf_{t-1}	0.0170	0.0174	0.0175	0.0369***	0.0162	0.0168	0.0174	-0.00419	0.0157	0.0389***
	(1.58)	(1.60)	(1.64)	(3.86)	(1.49)	(1.57)	(1.63)	(-0.26)	(1.49)	(3.99)
△ $Unemp_t$	-0.0158	-0.0151	-0.0134	-0.0305	-0.0146	-0.0157	-0.0155	-0.0206	-0.0157	-0.0359
	(-0.74)	(-0.71)	(-0.62)	(-0.99)	(-0.69)	(-0.75)	(-0.72)	(-0.78)	(-0.73)	(-1.16)
△ $Unemp_{t-1}$	-0.0478***	-0.0508***	-0.0479***	-0.0276	-0.0467***	-0.0483***	-0.0475***	-0.0239	-0.0477***	-0.0294
	(-2.67)	(-2.75)	(-2.68)	(-1.10)	(-2.63)	(-2.70)	(-2.66)	(-1.20)	(-2.68)	(-1.13)
Constant	1.393***	1.411***	1.382***	1.261***	1.421***	1.399***	1.392***	1.560***	1.386***	1.260***
	(12.23)	(13.36)	(12.00)	(7.84)	(13.69)	(13.12)	(12.28)	(7.97)	(12.46)	(7.70)
N	7991	7866	7967	3567	7991	7991	7991	3353	7984	3509
R^2	0.349	0.351	0.351	0.342	0.351	0.350	0.350	0.367	0.351	0.341

t statistics in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$. Panel OLS with bank fixed effects. Regressions include (72) country-year dummies.

Table 24: Distributional effects of bank characteristics on large loans for different measures of pass-through - country-year dummies

	Cap. res. Coeff.	St.er.	**Dep. NFPS** Coeff.	St.er.	**CDS Spreads** Coeff.	St.er.	**Gov. sec.** Coeff.	St.er.	**Loan prov.** Coeff.	St.er.
Overall										
Very Low (p10)			0.54***	0.07	0.66***	0.07				
Low (p10-p25)			0.56***	0.06	0.64***	0.07				
Medium (p25-p75)			0.62***	0.04	0.58***	0.07				
High (p75-p90)			0.66***	0.04	0.45***	0.10				
Very High (p90)			0.68***	0.04	0.0	0.19				
v.low=v.high (p-value)			0.04		0.00					
Imm.										
Very Low (p10)	0.41***	0.04					0.39***	0.03		
Low (p10-p25)	0.38***	0.03					0.39***	0.03		
Medium (p25-p75)	0.34***	0.03					0.35***	0.03		
High (p75-p90)	0.29***	0.04					0.27***	0.04		
Very High (p90)	0.23***	0.06					0.18***	0.06		
v.low=v.high(p-value)	0.05						0.00			
Adjust.										
Very Low (p10)			-0.43***	0.06	-0.60***	0.08			-0.42***	0.06
Low (p10-p25)			-0.44***	0.06	-0.59***	0.08			-0.43***	0.06
Medium (p25-p75)			-0.49***	0.04	-0.59***	0.08			-0.43***	0.06
High (p75-p90)			-0.54***	0.04	-0.57***	0.07			-0.44***	0.06
Very High (p90)			-0.58***	0.06	-0.53***	0.06			-0.48***	0.06
v.low=v.high (p-value)			0.09		0.03				0.07	

Very Low is a bank with a characteristic Z (capital, deposits, CDS, government securities, loan prov.) below the 10th percentile, Low is between the 10th and 25th percentile, Medium is between the 25th and 75th percentile, High is between the 75th and 90th percentile, and Very High is above 90th percentile. The overall pass-through is calculated as $-(\theta + \theta^* \overline{Z}^p_{t-1})/(\delta + \delta^* \overline{Z}^p_{t-1})$, immediate as $\beta_0 + \beta_0^* \overline{Z}^p_{t-1}$ and adjustment as $\delta + \delta^* \overline{Z}^p_{t-1}$, where $\overline{Z}^p_{t-1}$ denotes the mean of the characteristic in each percentile as already defined. Results only reported when β^*, δ^* and θ^* in Table 23 are significant. P values for Wald tests of equality between the pass-through coefficients are also shown; if p<0.1 we can reject that pass-through is the same across two categories of banks at 10% significance level. Standard errors are calculated using the Delta method.

Figure 1: Loans to NFCs interest rate spread over Eonia

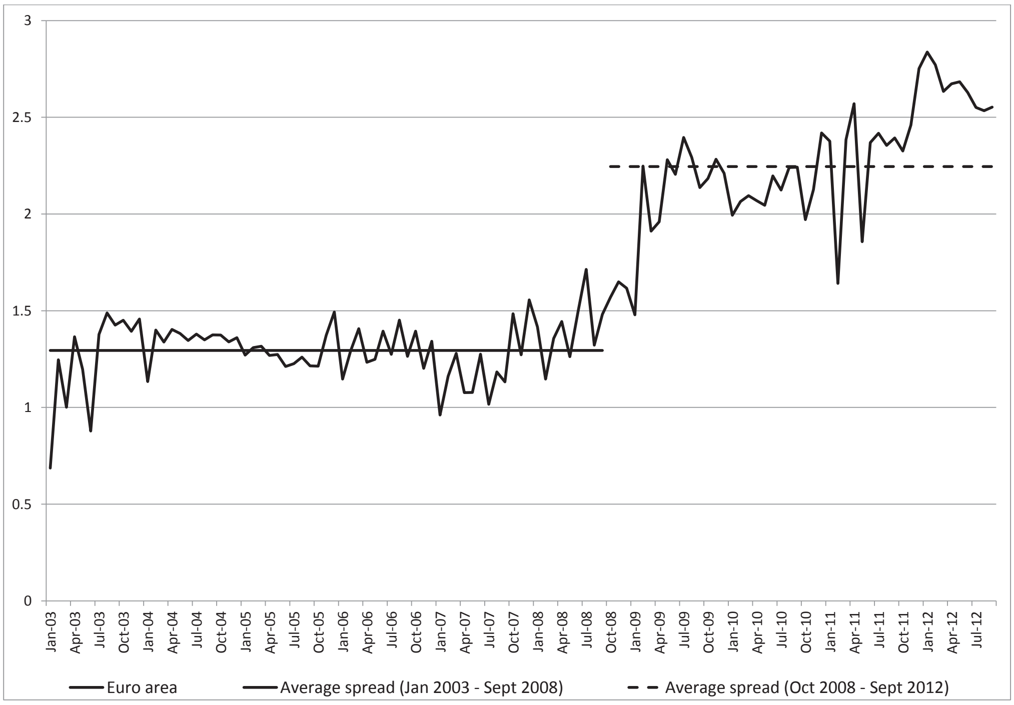


Figure 2: Coefficient of variation in interest rates across euro area countries *(percentages per annum; three-month moving averages; loans to NFCs up to (small) and above (large) 1 million)*

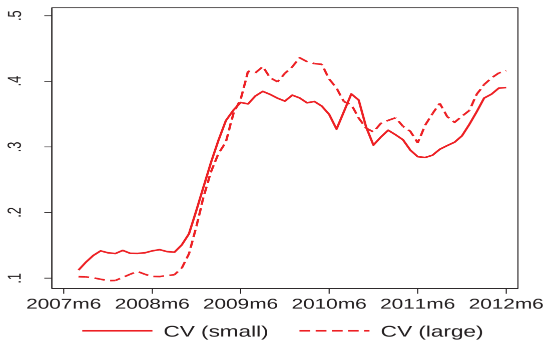


Figure 3: Dispersion of interest rates within countries *(circle is median rate, box is 75-25th quartiles and dash is 90th and 10th deciles)*

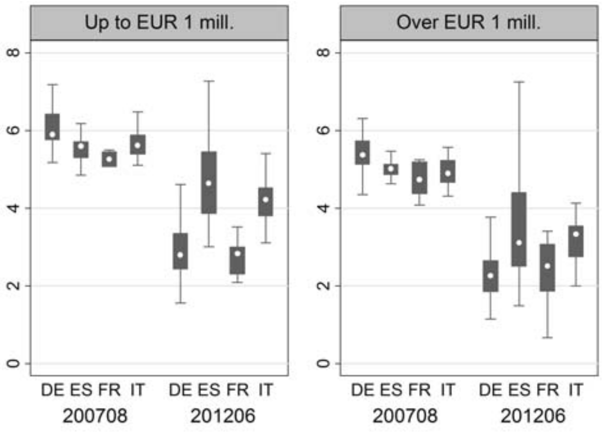


Figure 4: Interest rates on short term loans up to 1 mn (left) and over 1 mn (right) with the median absolute deviations

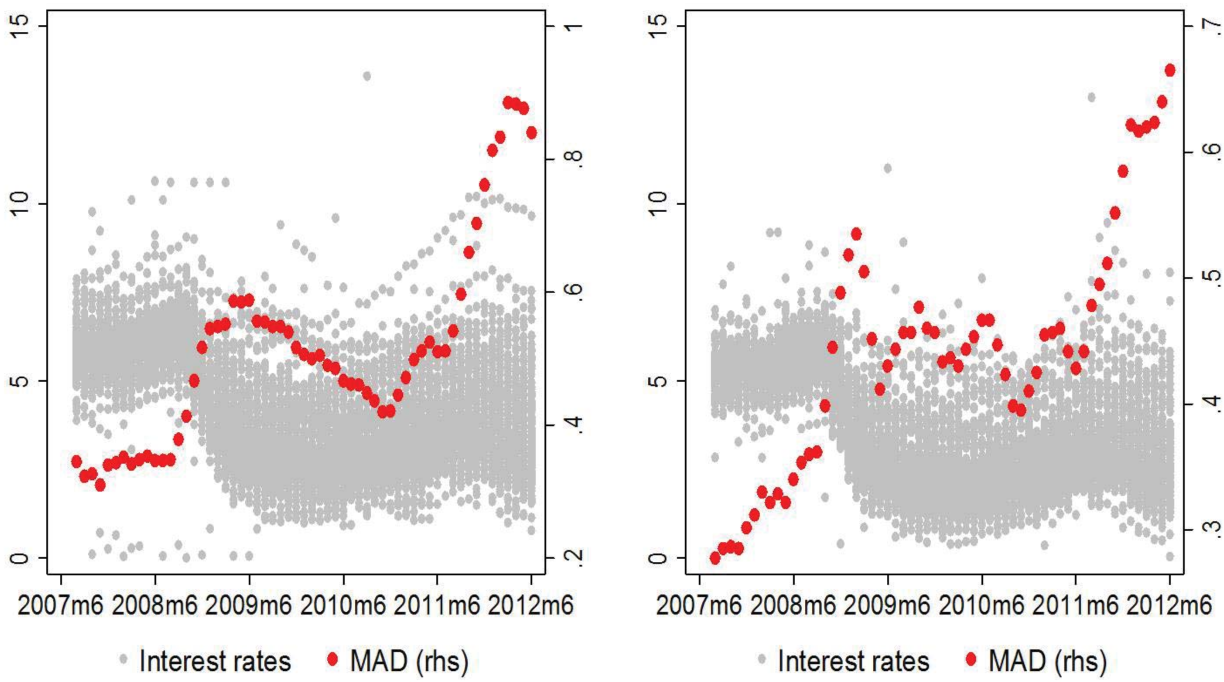


Figure 5: Lending rates on small loans to NFCS by banks with different characteristics

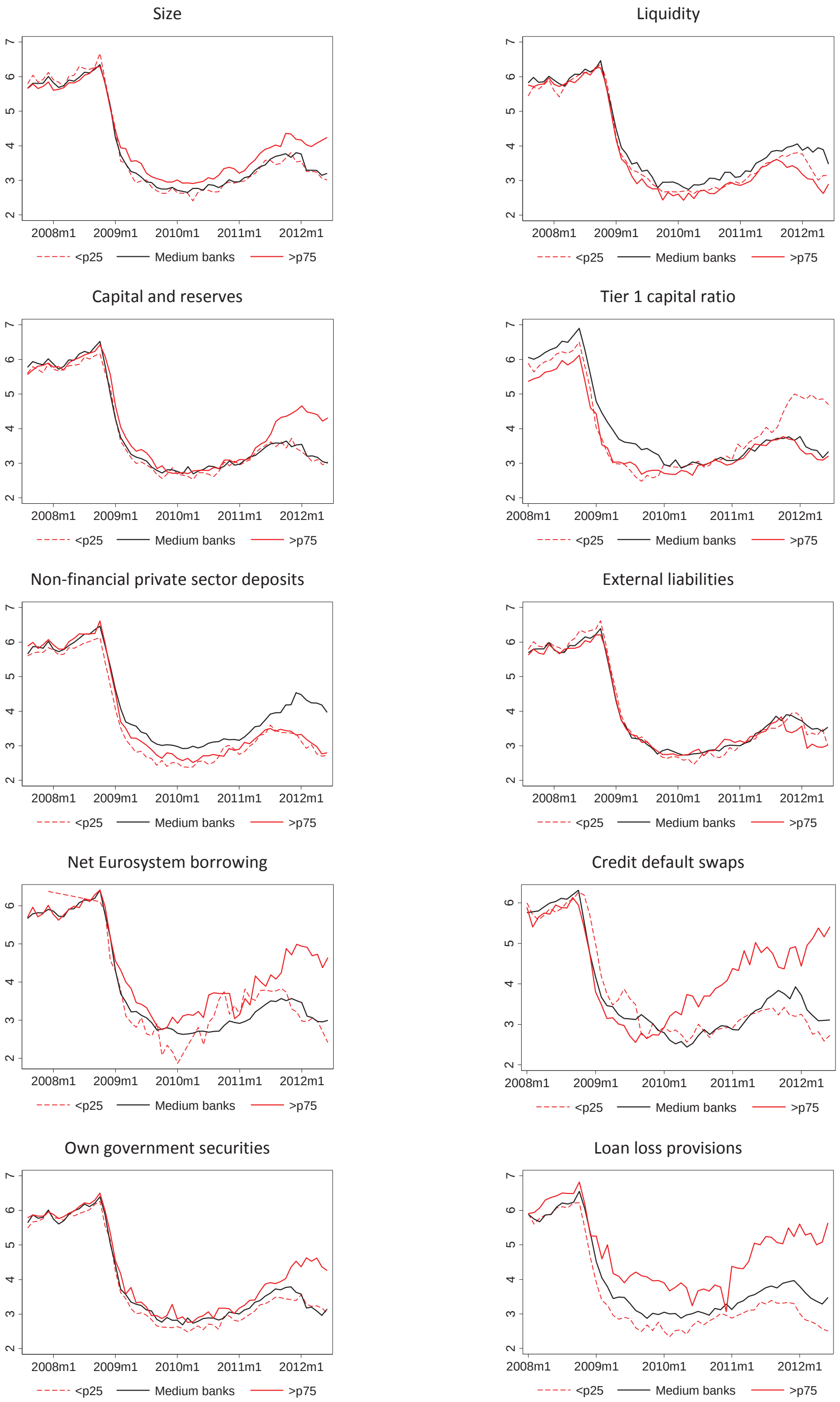


Figure 6: Lending rates on large loans to NFCS by banks with different characterisitics

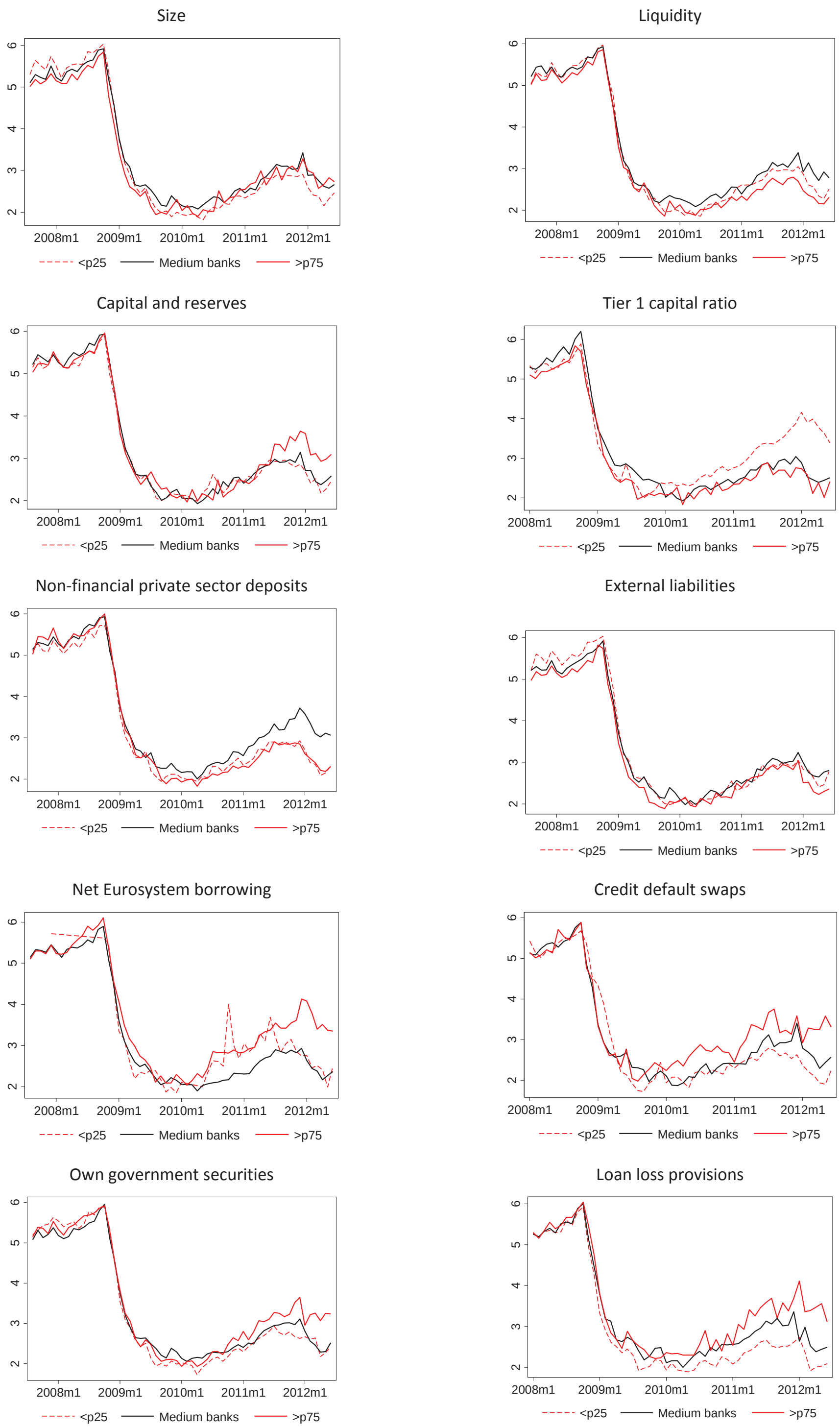


Figure 7: Lending rates on small and large loans in stressed and nonstressed countries by NFPS deposits and liquidity

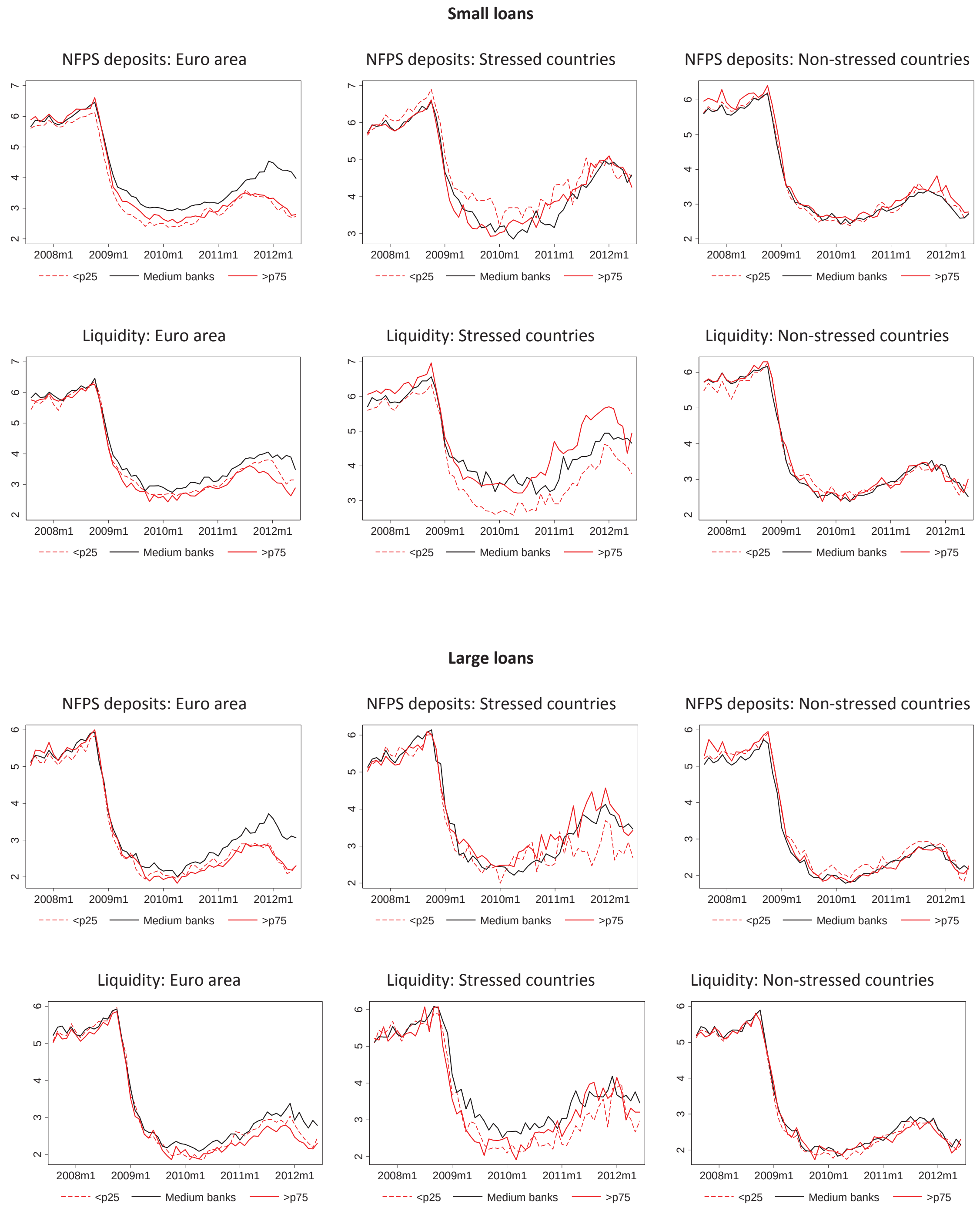


Figure 8: Pass-through coefficients using different estimation methods for small loans

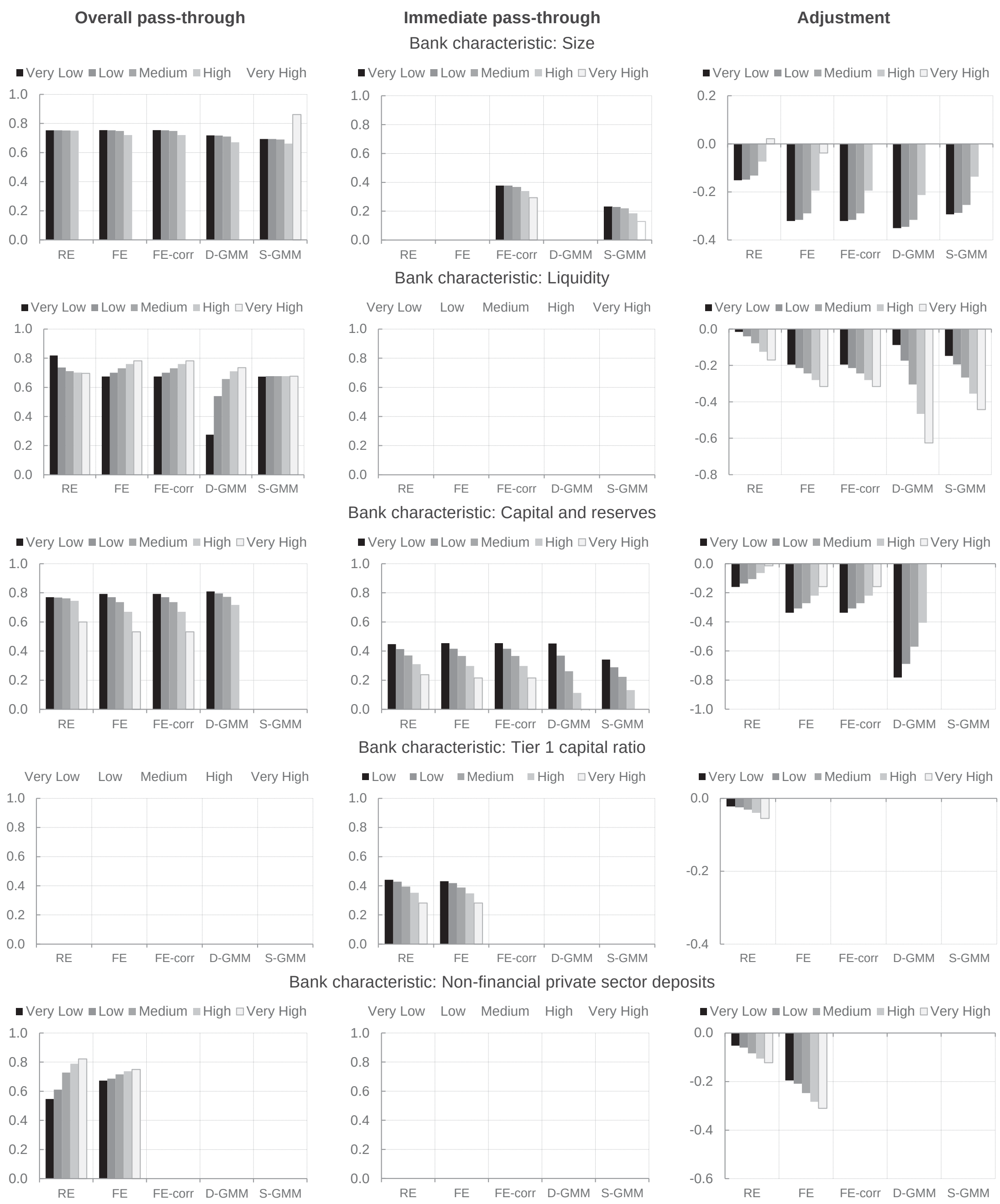


Figure 9: Pass-through coefficients using different estimation methods for small loans (Continued)

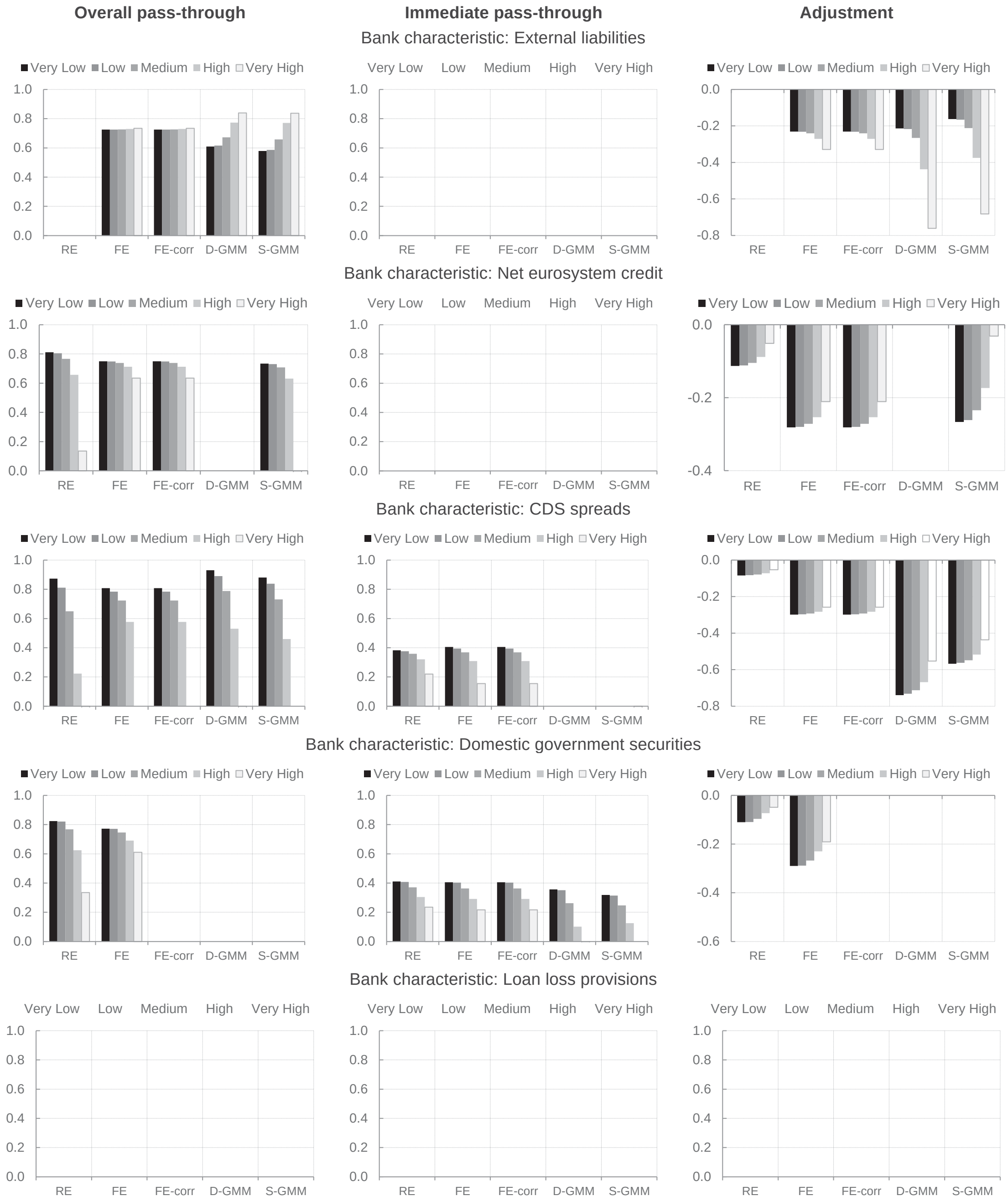


Figure 10: Pass-through coefficients using different estimation methods for large loans

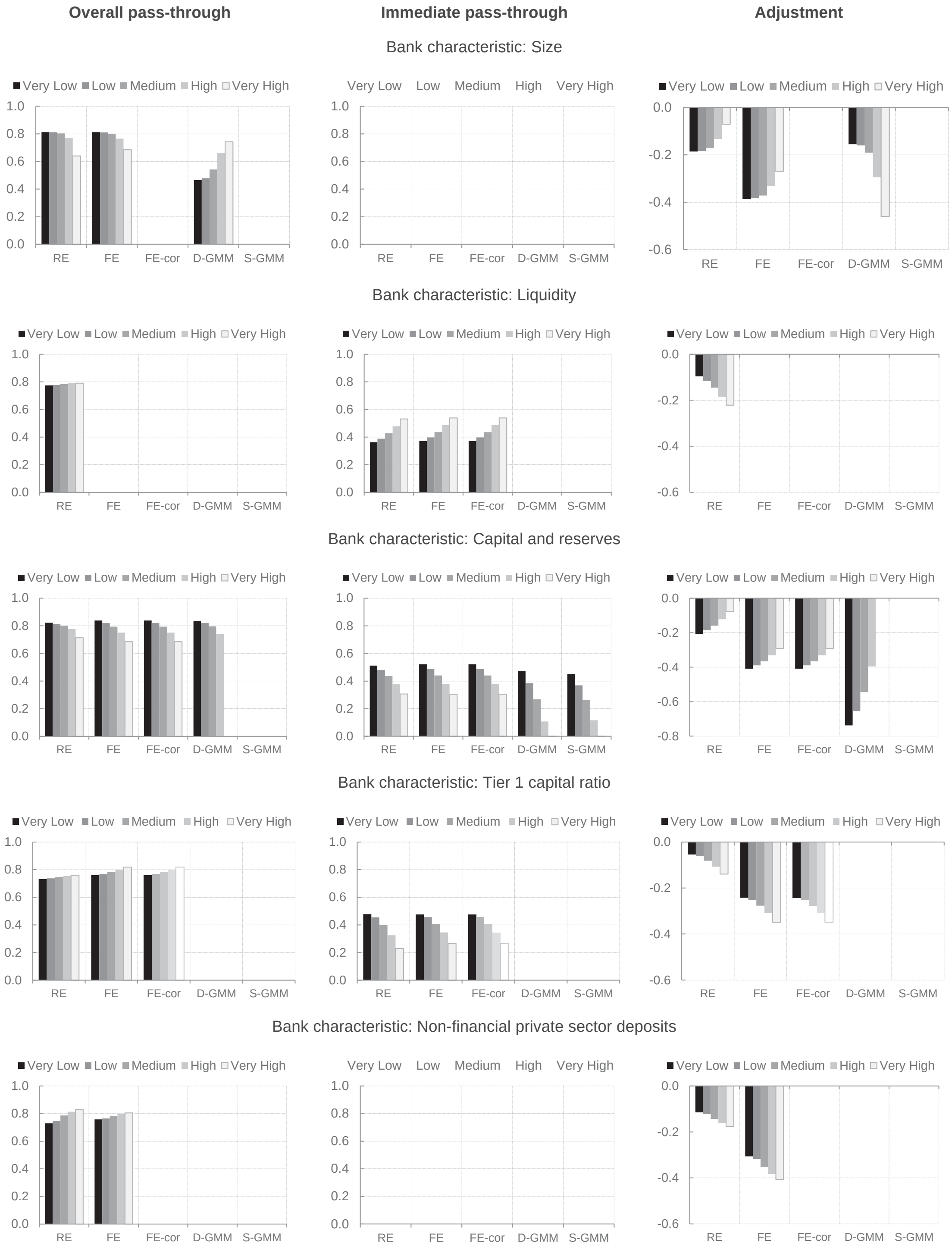
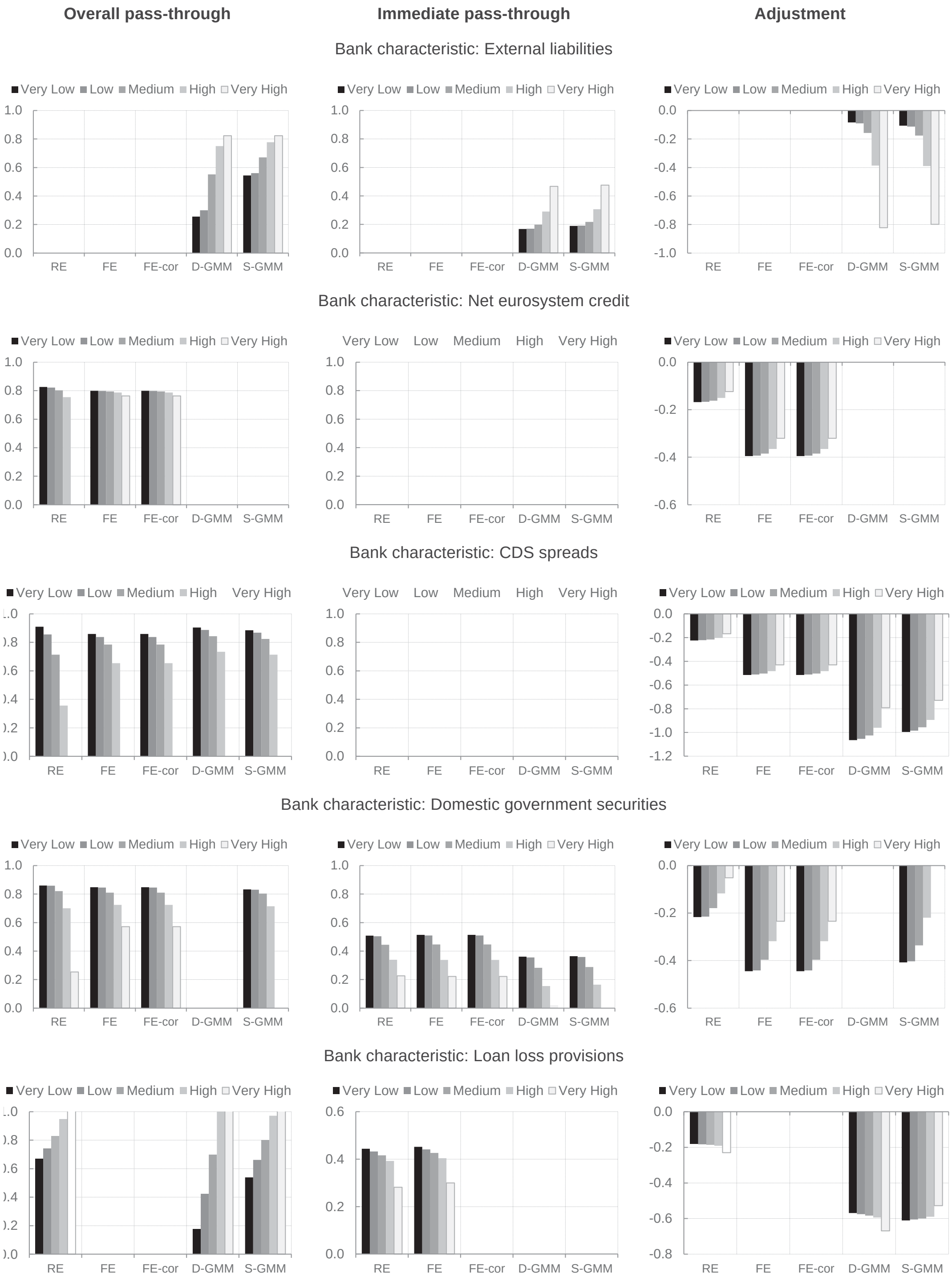


Figure 11: Pass-through coefficients using different estimation methods for large loans (Continued)



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