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### The Transmission Mechanism of Credit Support Policies in the Euro Area

by Jef Boeckx, Maite De Sola Perea and Gert Peersman

No. 3 / June 2017



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Place du Congrès 1, 1000 Brussels, Belgium  
[www.eurocapitalmarkets.org](http://www.eurocapitalmarkets.org)  
[info@eurocapitalmarkets.org](mailto:info@eurocapitalmarkets.org)  
Phone + 32 2 229 39 11

**Editorial Board** Cosmina Amariei, Karel Lannoo, Apostolos Thomadakis

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\* Jef Boeckx and Maite De Sola Perea are Economists at the Research Department of the National Bank of Belgium; Gert Peersman is Professor of Economics at the Department of Financial Economics at Ghent University.

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# The Transmission Mechanism of Credit Support Policies in the Euro Area\*

Jef Boeckx  
*National Bank of Belgium*

Maite De Sola Perea  
*National Bank of Belgium*

Gert Peersman  
*Ghent University*

## Abstract

Using a sample of 131 banks, we find that the Eurosystem's credit support policies have been successful in stimulating bank credit to the private sector: the impact was greater on the loan supply of smaller, less liquid, less capitalized banks and those more dependent on wholesale funding. The role of bank capital is, however, ambiguous. Besides the above favorable direct effect on loan supply, lower levels of bank capitalization at the same time mitigate the size, retail and liquidity effects of these policies. The low capital drag on the other channels has even been dominant during the sample period.

*JEL classification:* E51, E52, E58, G01, G21

*Keywords:* unconventional monetary policy, bank lending, monetary transmission mechanism

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# 1 Introduction

In the wake of the banking and sovereign debt crises, the Eurosystem has used several unprecedented monetary policy tools in response to the impairment and fragmentation of financial markets. A range of these measures made ample liquidity available to the banking system in order to compensate for the lack of market funding possibilities and to enhance the flow of credit to households and firms above and beyond what could be achieved through reductions in policy interest rates alone. The Eurosystem, for example, shifted from a variable rate tender to a fixed rate tender with full allotment, provided liquidity to banks at longer maturities, enlarged the pool of collateral accepted for refinancing operations, implemented a series of targeted operations at attractive conditions (TLTRO) and conducted outright purchases of covered bonds and asset-backed securities. Taken together, these measures are often called *Enhanced Credit Support Policies* (Trichet, 2009) or *Credit Easing Policies* (Draghi, 2015).<sup>1</sup>

A natural question that arises is whether these policies have indeed been effective in stimulating the credit flow of banks to the private sector and, if so, what are the exact transmission mechanisms. Both questions are addressed in this paper. To do so, we have put together an original monthly dataset of 131 individual euro area banks by merging different sources of data. In particular, we use two proprietary databases of monetary financial institutions data compiled by the Eurosystem: the individual balance sheet items (IBSI) database, which is used to construct the aggregate monetary and credit statistics of the euro area (e.g. M3), and the individual interest rate (IMIR) database of lending and deposit rates, which is compiled from the monetary financial institutions monthly interest rate surveys. These datasets are merged with a third source of data, i.e. SNL Financial, which contains several other balance sheet indicators for a subset of the banks included in the Eurosystem datasets.

The analysis proceeds in two steps. In a first step, we examine whether the credit easing policies have been effective in influencing bank lending behavior between the onset of the financial crisis and the start of the *Expanded Asset Purchase Programme*, i.e. over the sample period 2007M7-2014M12.<sup>2</sup> More precisely, we apply Jordà's (2005) local projection

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<sup>1</sup>Besides these policies, the Eurosystem has also implemented several unconventional measures that were rather aimed at stabilizing sovereign debt markets and further reducing long-term interest rates, for example the *Securities Markets Programme*, *Outright Monetary Transactions Programme* and the more recent *Expanded Asset Purchase Programme*.

<sup>2</sup>The *Expanded Asset Purchase Programme* is not included in the estimations because the method that we use to identify exogenous credit easing shocks, i.e. the Boeckx *et al.* (2016) approach, is not appropriate for the period since the start of the programme. Specifically, the volumes of asset purchases are anticipated

methods in a panel setting to estimate the dynamic effects of exogenous policy induced shocks to the balance sheet of the Eurosystem that are unrelated to conventional shifts in the policy rate. These shocks are borrowed from Boeckx *et al.* (2016). As a robustness check, we also estimate the effects of monthly changes in total assets of the Eurosystem. We find that an expansion in the central bank balance sheet lowers bank lending interest rates charged to the private sector, while the volume of bank lending increases significantly. The unconventional credit support measures have thus been successful in boosting credit to the non-financial private sector.

In a second step, we investigate the transmission mechanism in more detail. Specifically, in the spirit of Kashyap and Stein (1995; 2000), we explore whether there are important differences in the way that banks with varying characteristics respond to credit support policies. We test for the existence of four possible channels, which are all related to the conventional "bank lending view" of monetary transmission. The intuition of the empirical exercise can be motivated as follows: in an environment where financial markets are impaired, banks will have more difficulties to raise external funds, in particular unsecured funding, for their lending activities if they i) have greater asymmetric information problems, i.e. they are smaller, ii) have less liquid balance sheets, iii) depend more on the wholesale market to fund their lending activities and iv) are less well-capitalized. Accordingly, policies that enhance the access to central bank liquidity and relax the conditions to obtain such liquidity, should also primarily shift the loan supply schedules of these banks. The advantage of our local projection panel approach in this context is twofold. First, we can consider all these effects simultaneously, rather than the pairwise comparisons (i.e. splitting the sample in two groups based on a specific bank characteristic) that are typically used in the existing literature (see for instance Altavilla *et al.* (2016)). Because the bank characteristics are correlated, this is important. Second, it allows us to consider the state of the bank at the moment that the shocks occur, rather than relying on the averages of the bank characteristics over the whole sample period.

The empirical evidence shows that the credit support policies have indeed stimulated the loan supply of small banks (*size effect*), banks with less liquid balance sheets (*liquidity effect*), banks with a lower degree of retail funding (*retail effect*) and less well-capitalized banks (*capital effect*) significantly more than other banks, four features that are consistent with the "bank lending view". The role of bank capital is, however, ambiguous and turns out to be nonlinear. Besides the favorable direct capital effect on loan supply, lower levels of

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long time before the actual purchases, while the programme can also be considered as a monetary policy regime shift.

bank capitalization appear to mitigate the size, retail and liquidity effects of credit support policies on bank lending. Put differently, higher capital ratios of banks seem to dampen the impact of credit easing on loan supply via the above capital effect, but amplifies the effectiveness of the size, retail and liquidity effects to stimulate bank lending. Overall, we find that the latter amplification mechanism has been dominant during the sample period under consideration, i.e. better capitalized banks have on average responded more to the credit policies of the Eurosystem than low-capitalized banks. Noticeably, this result is almost fully driven by a weak response of low-capitalized banks that are not stimulated via the three other channels.

These results can be related to a growing number of studies that have analyzed the impact of the Eurosystem’s monetary policy measures since the crisis on credit supply. Specifically, de Haan et al. (2016) find that shocks in wholesale funding have a stronger impact on lending activities of large banks, which are typically more dependent on wholesale funding, as well as banks with large exposure to government bonds. They conclude that central bank liquidity provision may be effective because it can offset the impact of wholesale funding shocks. Andrade et al. (2015) find that the three-year LTROs in 2011-2012 had a positive impact on banks’ supply of credit to firms, while financially constrained banks benefited most from the program. Furthermore, Boeckx et al. (2016) find that the effects of the Eurosystem’s credit support policies on output across euro area countries were positively correlated with the degree of capitalization of the national banking sector during the financial crisis. Altavilla et al. (2016) arrive to similar conclusion using individual bank data, i.e. they document a stronger pass-through of unconventional monetary policies to lending rates of banks with a strong capital position.<sup>3</sup> They find that this is also the case for banks with a high level of non-performing loans, or a high share of sovereign exposure. Our study distinguishes itself in several respects from the existing studies on the impact of the ECB’s monetary policy on bank lending since the crisis. First, in contrast to the above studies, we study the impact of exogenous credit easing policy shocks. Second, we allow the impact of these shocks on bank lending to depend on several underlying bank characteristics simultaneously. Third, we allow for nonlinearities, which turn out to be important to understand the transmission mechanism, in particular the role of bank capital. Fourth, we analyse the impact on both bank lending rates and the volume of bank lending.

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<sup>3</sup>Holton and Rodriguez d’Acri (2015) find the opposite result, with banks with higher capital showing lower pass-through of changes in interest rates, though they explain this by considering that other variables may be capturing the underlying capital (i.e. degree of risk of a bank) effect or by the impact of recapitalizations during the crisis.

The results of this paper also relates to the literature on the bank lending and the bank capital channel of conventional monetary policy. In particular, Kashyap and Stein (1995; 2000) and Kishan and Opiela (2000; 2006), amongst others, find that smaller banks, banks with less liquid balance sheets, and low-capitalized banks react more strongly to a standard monetary policy shock. We find similar channels for unconventional credit support policies. Furthermore, Van den Heuvel (2007) argues that the role of bank capital may be nonlinear for the transmission of conventional monetary policy, i.e. poorly capitalised banks are expected to react more to changes in interest rates, at least if their capital position is above a certain threshold. In contrast, when banks have very low capital positions or fear to fall below the threshold in the future, they might not react to a monetary policy change. We confirm the existence of such a nonlinearity for credit easing policies.

The remaining of the paper is structured as follows. In the next section, we describe the empirical approach, the monthly panel dataset of individual banks that we have collected for this study, the type of policy shocks that we consider, and the results of the overall effectiveness of credit support policies. Section 3 investigates the transmission mechanisms, while section 4 concludes and discusses some policy implications.

## **2 Effectiveness of Credit Support Policies**

### **2.1 Estimation method**

In this section, we explore whether the credit support policies of the Eurosystem have been effective in stimulating the flow of bank credit to the private sector. More precisely, we estimate the dynamic effects of such policies on the volume of bank lending to households and firms, as well as the corresponding lending rates. To do this, we use Jordà's (2005) local projection method for estimating impulse responses in a panel setting. Using local projections has several advantages for our purposes. First, in contrast to conventional panel estimation methods, this approach estimates the effects of policy shocks at different horizons, which is very convenient to examine the timing and dynamics of the effects of policy measures. Second, in contrast to e.g. structural VARs, it is easy to allow the impulse responses to be dependent on several bank characteristics simultaneously and to accommodate nonlinearities, which is what we will do in the next section. Another advantage compared to VARs is that it is more robust to misspecification, while also a more parsimonious specification can be used since not all variables need to be included in all equations. On the other hand, a disadvantage of this method is that sometimes quite

erratic patterns are found for the dynamic effects at longer horizons because of a loss of efficiency, while the standard errors of the estimates are typically larger.

For each horizon, we estimate the following linear panel regression model with fixed effects:

$$Z_{i,t+h} = \alpha_{i,h} + \delta_{i,h}(L) Z_{i,t-1} + \rho_{i,h}(L) X_{t-1} + \theta_h MPshock_t + \varepsilon_{i,t+h} \quad (1)$$

where  $Z_{i,t+h}$  is respectively the volume of lending and lending rate of bank  $i$  at horizon  $h$ ,  $X_t$  a vector of control variables,  $\delta_{i,h}(L)$  and  $\rho_{i,h}(L)$  are bank-specific polynomials in the lag operator ( $L = 3$ ), while  $MPshock_t$  represents the credit support policy shocks. Accordingly,  $\theta_h$  is the estimated response of  $Z$  at horizon  $h$  to the unconventional monetary policy shock at time  $t$ .

For a description of the dataset of individual bank lending rates and the volume of lending, and the credit support policy shocks, we refer to respectively section 2.2 and 2.3. The set of control variables that we include in all the estimations throughout this paper are i) the log of seasonally adjusted real GDP, ii) the log of seasonally adjusted HICP, iii) the log of central bank total assets, iv) the level of financial stress as measured by the Composite Indicator of Systematic Stress (CISS), v) the main refinancing operations (MRO) policy rate, vi) the spread between EONIA and the MRO-rate, and vii) respectively the euro area aggregate volume of lending and the lending rate. These variables should capture the main macroeconomic, financial and monetary policy fluctuations during the sample period that may influence lending behavior of individual banks.<sup>4</sup> The results reported in this paper are, however, not very sensitive to the choice of the control variables.

## 2.2 Panel dataset of bank lending activities

The dataset that we use to examine the pass-through of credit support policies has been collected by merging different sources of data. Specifically, we use two proprietary databases compiled by the Eurosystem. For the volume of lending to households and firms (non-financial corporations), we use the individual balance sheet items (IBSI) database, which contains 29 balance sheet indicators for a sample of 281 euro area monetary financial institutions (MFIs). These bank level data, collected at a monthly frequency, account for approximately 70% of total assets of the euro area banking sector, and follow the

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<sup>4</sup>In essence, these are the variables of the benchmark VAR model of Boeckx *et al.* (2016). The series are obtained from Datastream and the ECB's Statistical Data Warehouse. For more details on the way they have been constructed, we refer to Boeckx *et al.* (2016).

same template and definitions as those used by the Eurosystem to construct the aggregate euro area money and credit data (e.g. M3). The IBSI database includes end-of-month outstanding amounts and monthly transactions, i.e. the change in outstanding amounts corrected for non-economic factors (e.g. reclassifications, revaluations and other effects).<sup>5</sup> Based on the outstanding amounts and monthly transactions, we construct chain-linked multiplicative notional stocks for the volume of lending to households and non-financial corporations according to the ECB methodology.<sup>6</sup> Prior to the estimations, we have also conducted a double cleaning procedure on the data. In a first step, using publicly available information (including annual reports of financial institutions and websites), we corrected movements in flows when they did not adequately reflect the true transactions to avoid spurious movements in banks' balance sheets (e.g. mergers and acquisitions were not always reflected appropriately in the data). In a second step, we subjected the data to outlier correction, by replacing monthly growth rates exceeding a threshold, which corresponds to the median plus or minus five interquartile ranges (calculated for all banks in the previous 12 months) by that threshold.<sup>7</sup> The new monthly growth rate is then used to re-calculate the series of notional stocks. Finally, we apply a seasonal adjustment method to the notional stock series.

For the individual bank lending interest rates, we use the Eurosystem's individual monetary and financial institutions interest rate (IMIR) database, which contains monthly data on interest rates of new lending (and deposits) collected via the MIR survey. The IMIR database covers a large subsample of the IBSI banks, i.e. lending rates of 223 banks. For each bank, we computed a weighted aggregate interest rate series for lending to households for house purchases and to non-financial corporations.<sup>8</sup> The interest rate series have also been subject to outlier correction. We considered that a rate charged by a bank in a specific month is an outlier when it is more than 75 basis points higher (or lower) than the rates charged in both the previous and subsequent month. These outliers have been replaced by the average of the rates charged in the previous and subsequent month.

The IBSI and IMIR data are based on a residential definition of the banks operating in each country. They refer to non-consolidated data, and hence include subsidiaries of

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<sup>5</sup>Sales and securitisations are not systematically taken into account for the calculation of the transactions, nor for the outstanding amounts. This is a caveat when using the dataset, in particular for the data on lending to the non-financial private sector.

<sup>6</sup>For a detailed explanation of this methodology, see ECB (2012) and Colangelo and Lenza (2013).

<sup>7</sup>Overall, about 16% of the observations have been cleaned based on this procedure.

<sup>8</sup>The weights are calculated as a 12-month average of the volumes of lending to households and firms to avoid creating artificial volatility in the series due to composition changes.

foreign-owned banks. The panel is unbalanced as the time series start when the bank is created and/or the country has joined the euro area (if relevant), and are discontinued after mergers and failures.

The final dataset used in this paper covers a sample of 131 banks operating in the 19 euro area countries, with observations from August 2007 to October 2015 (though exact data of start and end of the series depend on the bank). Overall, we have more than 10,000 monthly observations for the estimations. The reason for the lower number of banks compared to the source dataset is the availability of the bank characteristics that will be used in section 3, for which also data from SNL Financial are used. The latter database contains consolidated and unconsolidated balance sheet and regulatory data from banks' public reports for fewer banks than the IBSI and IMIR databases. Moreover, we have dropped a number of banks prior to the estimations due to the presence of considerable noise in the series, the lack of significance for our analysis (e.g. no or very low volume of lending to the retail sector) or frequent gaps in the series.

The sample of banks used in the analysis represents 37% of total assets of the euro area banking sector, and 43% of the lending to non-financial corporations and households in October 2015. Table 1 shows the distribution and representativeness of the sample by country. Figure 1 depicts the co-movement with the euro area aggregates of the volume of lending and lending rates. A few observations are worth mentioning. First, the correlation with the euro area aggregates is relatively high, which indicates that our dataset is quite representative for the euro area banking sector. Specifically, the correlation between monthly growth rates of aggregate euro area lending to households and firms constructed using our dataset, and the official numbers published by the ECB is 0.73, while the correlation between monthly changes in officially published euro area bank lending rates and those constructed based on the bank-level data is 0.88. Another interesting observation from the figures is the considerable dispersion between individual banks, which suggests that banks behaved very differently during the sample period and that the responses to common shocks have been very diverse.

### 2.3 Credit support policy shocks

A crucial issue for the analysis is the unconventional monetary policy indicator used for the estimations, i.e. the variable  $MPshock_t$  in equation (1). In this paper, we consider the effectiveness of the Eurosystem's credit support policy measures, which were aimed to provide ample liquidity to the banking sector in order to restore the monetary trans-

mission mechanism and boost the supply of bank loans.<sup>9</sup> Examples of such policies are several fine-tuning liquidity providing operations in the second half of 2007, the shift from a variable rate tender to a fixed rate tender with full allotment in October 2008, various ameliorations to the collateral requirements, and the maturity extensions of the liquidity-providing operations. The Eurosystem has also conducted outright purchases of financial assets like covered bonds, asset-backed securities and government bonds to provide extra liquidity to the banking sector. In essence, all these measures have expanded the balance sheet of the Eurosystem for a given policy rate. The balance sheet of the Eurosystem can thus be considered as a reasonable indicator of the credit support policies. To properly estimate the consequences of the policies on bank lending, however, it is crucial to disentangle exogenous shifts in the central bank balance sheet from endogenous responses to fluctuations in the economy and financial markets. Failing to account for the fact that the policy measures and central bank balance sheet, just like loan demand and supply, react to the business cycle and financial gyrations, can bias the estimated effects considerably. In fact, this problem is often ignored in the literature investigating the effects of conventional monetary policy on bank lending, as many studies simply use the observed short term interest rate as an indicator of monetary policy.<sup>10</sup>

As the monetary policy indicator, we therefore use the series of exogenous balance sheet shocks of Boeckx *et al.* (2016), who apply a structural VAR methodology to identify shocks to the Eurosystem's balance sheet that are orthogonal to real economy fluctuations, disturbances in financial markets, changes in the demand for central bank liquidity and conventional shifts in the monetary policy rate. Boeckx *et al.* (2016) use a mixture of plausible zero and sign restrictions to identify exogenous policy induced innovations to the central bank balance sheet.<sup>11</sup> Notice that there exist other studies that estimate the macro consequences on the euro area economy of unconventional monetary policies during the crisis period, but none of these studies identify shocks that (solely) capture the credit

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<sup>9</sup>Notice that the Eurosystem has conducted several types of non-standard monetary policy measures in response to the crisis, including communication policies and large-scale asset purchases. However, in this paper, we only investigate the effectiveness of liquidity support measures to stimulate bank lending.

<sup>10</sup>Papers examining the transmission of conventional monetary policy at the bank level that do consider exogenous policy shocks have used different approaches to do so. Bluedorn, Bowdler and Koch (2013), for instance, use an exogenous policy measure akin to the Romer and Romer (2004) methodology, and find much stronger dynamic effects and greater heterogeneity in lending across US banks compared to papers that consider plain interest rate movements, which can be prone to endogeneity. Others, e.g. Gambacorta and Marqués-Ibáñez (2011), have used deviations from the Taylor rule as a proxy for conventional monetary policy shocks.

<sup>11</sup>Specifically, it is assumed that expansionary balance sheet shocks have only a lagged impact on GDP and consumer prices, are orthogonal to changes in the MRO policy rate, and do not increase the CISS indicator and the EONIA-MRO spread on impact.

support policies.<sup>12</sup> As a (simple) robustness check, we also estimate the dynamic effects of monthly changes in the log of central bank total assets. A caveat of this indicator is that it also captures demand-driven changes in the balance sheet of the Eurosystem, endogenous policy responses to fluctuations in the real economy, as well as innovations to the balance sheet that are the result of shifts in the policy rate. These results should hence be taken with more than the usual degree of caution.

The cumulative time series of the Boeckx *et al.* (2016) shocks are shown in Figure 2. The scale is measured in standard deviations of the shocks. A rise in the cumulative series corresponds to expansionary balance sheet shocks, while a decline reflects a tightening relative to the average endogenous response of the balance sheet to the shocks hitting the economy. Since the shocks are on average zero, the sum of the shocks over the whole period is by construction also zero. As can be observed, the shocks capture very well several important credit support measures of the Eurosystem, such as the one-year and three-year LTROs, the shift to a fixed-interest rate full allotment strategy and the *Covered Bonds Purchase Programmes*.

Figure 3 depicts the macroeconomic effects of the balance sheet innovations based on the VAR model. The full (blue) lines are the median impulse responses for a one-standard deviation shock, while the shaded (grey) areas represent the 68% credible sets of the estimated responses. An expansionary balance sheet innovation corresponds to a rise in central bank total assets by approximately 1.5%. Overall, the balance sheet shocks have been successful in stimulating the economy. An open question is whether at least part of the stimulus came from a rise in credit supply of banks. This is what we assess in the next subsection.

## 2.4 Empirical results

The benchmark estimation results are reported in Figure 4. More specifically, the figures show the estimated values of  $\theta_h$  for up to 24 months after the exogenous balance sheet shocks.<sup>13</sup> The grey areas are 90% confidence bands that are adjusted for possible correlations between the residuals of the banks at a moment in time (e.g. as a consequence of

<sup>12</sup>For example, Altavilla *et al.* (2015) use high frequency data to assess how the announcements of the ECB's asset purchases programme have affected financial variables, while Jardet and Monks (2014) use high frequency intraday interest rate data to identify shocks to respectively the current and expected future path of the interest rate.

<sup>13</sup>For the bank lending rates, we only show the responses for the first 12 months because the effects become positive at longer horizons. An explanation for this reversed pattern after a couple of months is the (endogenous) tightening in the policy rate as the economy improves after a balance sheet expansion (which can be seen in Figure 3).

common shocks), as well as serial correlation between the residuals over time (e.g. when common shocks are persistent). These are calculated as discussed in Thompson (2011). Overall, the adjustments increase the standard errors relative to conventional robust standard errors.<sup>14</sup>

The top row of Figure 4 shows the panel results for respectively the volume of lending and the lending rate. As can be observed, exogenous innovations to the Eurosystem's balance sheet did stimulate bank lending during the crisis period, both by increasing lending volumes and by reducing rates. Specifically, a credit support policy shock which expands the balance sheet of the Eurosystem by 1.5% leads to a decline in bank lending rates by roughly 4 basis points after one month, which lasts for about four months. On the other hand, there is a persistent (up to two years) rise in the volume of lending to households and firms, which reaches a peak of approximately 6 basis points. The opposite co-movement of the volume of lending and the lending rates denotes that the expansion of bank credit is essentially supply-driven. The (insignificant) rise of bank lending rates after six months can be explained by the response of the policy rate documented in Figure 3, which, in turn, is a consequence of the improved macroeconomic conditions after an expansionary credit easing shock (or a decline of the policy rate in response to deteriorating macroeconomic conditions after a negative shock). The immediate reaction of lending rates, whose decline lasts only a few months, stresses the importance of using monthly data to estimate the consequences of the shock on bank lending rates. For example, studies that use data with a lower frequency, e.g. annual data, probably miss such effects.

Noticeably, the panel results turn out to be very similar to estimates obtained from euro area aggregate lending behavior, both in sign and magnitude. More precisely, the bottom row of Figure 4 shows the results of local projections applied to the aggregate volume of lending and lending rates, respectively. The similarity between the panel and aggregate results supports the representativeness of our sample of banks for the whole euro area. The magnitudes are also in line with the area-wide VAR estimates of Boeckx et al. (2016).

As another robustness check, Figure 5 shows the results when we use total asset growth of the Eurosystem as the monetary policy shock measure. Again, we find a positive impact

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<sup>14</sup>Given that the credit support policy shocks are common and not correlated across time, also clustering by banks would not reduce a possible bias of the standard errors of the impulse responses, even if the residuals have significant bank components. On the other hand, clustering typically increases the variance of the standard errors, which implies that we could find statistical significance even when it does not exist. Accordingly, it is better not to cluster by banks for (common) regressors that are not correlated across time. See Thompson (2011) for a more detailed explanation.

of a balance sheet expansion on the volume of bank credit, and a decline in bank lending rates. The latter is more persistent compared to the exogenous policy shocks. In sum, we can conclude that the Eurosystem credit support policies did stimulate bank lending to the private sector.

### 3 Transmission mechanism of credit easing policies

So far, we have shown that the non-standard monetary policy measures which have expanded the balance sheet of the Eurosystem in the aftermath of the financial crisis have been effective in stimulating bank lending to households and firms. In this section, we investigate the transmission mechanism in more detail. More precisely, in section 3.1, we extend the baseline empirical specification allowing for an influence of bank characteristics on the effectiveness. Section 3.2 discusses the potential channels and the indicators we use to proxy these channels, while section 3.3 report the estimation results. Finally, in section 3.4, we re-examine the role of bank capital taking into account possible nonlinearities.

#### 3.1 Empirical specification

We examine the transmission mechanism by exploring whether there are significant differences in the way that banks with distinct characteristics respond to the Eurosystem's balance sheet shocks. To do this, we extend the baseline local projections of section 2 as follows:

$$\begin{aligned}
 Z_{i,t+h} = & \alpha_{i,h} + \delta_{i,h}(L) Z_{i,t-1} + \rho_{i,h}(L) X_{t-1} \\
 & + \left( \gamma_{0,h} + \sum_j \gamma_{j,h} DUMC_j + \sum_k \gamma_{k,h} characteristic(k)_{i,t-1} \right) MPshock_t + \varepsilon_{i,t+h}
 \end{aligned} \tag{2}$$

where  $DUMC_j$  are 19 country dummies, and  $characteristic(k)_{i,t-1}$  a vector of  $k$  individual bank characteristics. All other variables are the same as in the baseline specification. We include the country dummies to capture country-specific demand or other country-specific effects that may influence the impact of the policy measures on bank lending activities. Boeckx *et al.* (2016) find very diverse output consequences of the balance sheets shocks in individual euro area countries, in particular more subdued effects in the countries that have been more affected by the financial crisis. It is not clear whether this is the consequence of different national banking sectors (e.g. these countries typically have

low-capitalized banks), or other country-specific features. For example, there may be less appetite (demand) for bank loans when households and firms are deleveraging their balance sheets, or countries may benefit differently from the exchange rate depreciation induced by the monetary expansion. Put differently, we explore the differences of bank characteristics within countries to assess the relevance for the effectiveness of credit support policies. To avoid endogeneity problems, we take the characteristics at  $t - 1$ . The choice of the bank characteristics and motivation are discussed in the next subsection.

### 3.2 Bank lending view of monetary transmission

The bank characteristics that we consider in the empirical analysis can all be motivated by the so-called "bank lending view" of monetary transmission. The central idea of the lending view is the proposition that monetary policy actions can trigger an independent shift in the supply of bank loans (Bernanke and Blinder 1988). In essence, this view relies on the failure of the Modigliani-Miller proposition for banks, i.e. not all sources of funding are alike. In such an environment, a policy induced decrease in bank reserves (and hence in insured deposits, i.e. covered by deposit insurance) forces banks to shift to non-reservable uninsured deposits to finance their lending activities. Due to agency costs and adverse selection problems associated with depositors lending to banks, these alternative sources of funding are more expensive, which results in a contraction of banks' loan supply.

It is usually argued that the decline of loan supply is greater for constrained banks, while having little or no effect on the supply of loans of unconstrained banks, i.e. banks that can relatively easily obtain alternative (uninsured) external funds. Accordingly, the existence of the bank lending view is typically examined based on what the lending view has to say about the cross-sectional effects of monetary policy. Kashyap and Stein (1995), for example, argue that smaller banks are typically more exposed to asymmetric information problems, and have therefore more difficulties to substitute to non-deposit sources of funding. If the lending channel exists, a conventional monetary policy tightening, which is assumed to reduce bank reserves in this literature, should hence have a larger impact on the lending behavior of small banks.<sup>15</sup> Similarly, several studies emphasize bank capital as an important constraint to obtain external funding, i.e. monetary policy is argued to have greater effects on loan supply of capital-constrained banks relative to banks with sufficient capital buffers (e.g. Kishan and Opiela 2000).

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<sup>15</sup>See Disyatat (2010) for a reformulation of the bank lending channel, emphasizing more how monetary policy affects banks' balance sheet strength and risk perception, which in turn affects their ability to obtain external funding, rather than focus on alterations to bank reserves.

In this paper, we use a similar approach to examine the pass-through of the credit support policy measures implemented in the aftermath of the financial crisis. The starting point is not a policy-induced shift in insured bank deposits that forces banks to substitute towards more expensive forms of funding, but a situation where banking markets are severely impaired and banks have difficulties to obtain unsecured external sources of funds, unless they pay a significant risk premium. As argued by the proponents of the bank lending view, the borrowing constraints and external finance premium depend on the underlying balance sheet characteristics of banks. Those banks that are more constrained to obtain external funding should therefore also respond more to changes in credit support policies. For example, an enlargement of the pool of collateral accepted for refinancing operations will benefit constrained banks more than banks that have little difficulties to obtain unsecured sources of funding. Similarly, the launch of three-year LTROs will reduce the marginal cost of funding more for those banks that otherwise have to pay a relatively high external finance premium for non-secured long-term funding (e.g. bank bonds). Accordingly, constrained banks are expected to also increase the supply of credit to households and firms more than banks that are less constrained. Conversely, constrained banks likely curtail their lending activities more in the wake of restrictive balance sheet shocks. In contrast to the conventional bank lending view, in which monetary policy induces a shift in the volume of insured retail deposits, the transmission mechanism of the credit support policies to bank lending implies a shift in the availability and conditions (e.g. maturity, collateral, ...) of central bank liquidity to the banking sector. Put differently, the Eurosystem's credit easing measures allow banks to substitute market funding with central bank money, reducing the marginal cost for their lending activities. Below, we discuss a set of frictions at the level of financial intermediaries that should reflect the borrowing constraints and access to external sources of funding, and the corresponding bank characteristics that make banks' marginal cost of funding and lending behavior more or less sensitive to credit support policies.

**Size effect** As we have discussed above, banks that are more constrained to raise uninsured external funding, are expected to respond more to credit support policies that increase the availability of central bank liquidity. In the bank lending view, the access to uninsured debt is typically proxied by bank size. In particular, this literature postulates that large banks have less difficulties to raise such funding because information costs are lower and there is more asset diversification compared to small banks. In addition, there might be an implicit "too big too fail" put option provided by the government. Building

on this proposition, Kashyap and Stein (1995; 2000) separate banks by asset size and find that small banks are more responsive to conventional monetary policy. If the lending view also applies to the credit support measures, one should expect the loan portfolio and lending rates of large banks to respond less to the balance sheet innovations of the Eurosystem. In the empirical analysis we include the 100 times natural logarithm of banks' total assets as one of the bank characteristics in equation (2), and label this channel as a *size effect* of the policies. The data for this measure is collected from the IBSI database, and hence available at a monthly frequency. For each bank we use the outstanding amount at the end of the month of total main assets.

**Retail deposits effect** A second bank characteristic that we include in the estimations is the ratio of retail deposits to total lending to households and firms. This series is also constructed based on the IBSI balance sheet items, and available at a monthly frequency. The reason we consider this variable is that a large share of retail deposits are covered by the deposit insurance schemes of the government, in contrast to market-based funding where credit risk matters. Banks with lower retail to total lending ratios are therefore more exposed to asymmetric information problems and are relatively more influenced by funding conditions in the market. Thus, a greater dependence on market-based sources of funds should be associated with more responsive loan supply schedules to shifts in the availability of liquidity, while banks that predominantly fund their lending activities with insured retail deposits should be more insulated from impaired financial markets and are probably less sensitive to credit support policies.<sup>16</sup> Ivashina and Scharfstein (2010) show, for example, that banks which had better access to deposit funding and were less dependent on short-term debt, have reduced their lending activities less during the crisis. Also Dagher and Kazimov (2015) find that banks which are heavily reliant on wholesale funding curtail their lending more than other banks during crises. Notice also that retail deposits have been much more stable than market-based funding during the financial crisis.

**Liquidity effect** Kashyap and Stein (2000) assert that less liquid banks should respond more to monetary policy actions in an environment where there are limitations in raising unsecured external debt because more liquid banks can relatively easily protect their loan portfolios by adjusting the stock of securities or by using them as collateral to obtain

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<sup>16</sup>A similar point has been made by Disyatat (2010) in the context of conventional monetary policy. Specifically, Disyatat (2010) argues that monetary policy affects bank lending mainly through variations in banks' external finance premium, rather than the availability of deposits, i.e. through prices rather than quantities.

external funding. For the same reason, banks with sufficient liquidity buffers are likely less sensitive to changes in the volume of liquidity offered by the Eurosystem to the banking system. In contrast, less liquid banks can, for instance, not as easily make up for the funding shortfall of a restrictive balance sheet shock by raising external finance. These banks are essentially liquidity constrained for their lending activities, and are probably more sensitive to unconventional liquidity operations of the central bank. As a third balance sheet characteristic, we therefore include the ratio of liquid assets over total assets in the estimations to proxy a possible *liquidity effect* of the credit support measures. The data are obtained from the SNL Financial database. Liquid assets are cash and cash related equivalents such as securities held for trading. Notice that the frequency of SNL Financial is annual, which implies that the bank characteristics at  $t - 1$  always reflect the situation in December of the previous year. A caveat in the context of our analysis is that the liquidity ratio is not available for all banks over the entire sample period, i.e. there are a large number of missing observations. For this reason, we will systematically also report the estimation results without taking into account this characteristic.

**Capital effect** Finally, a large number of studies have emphasized the role of bank capital as an important constraint for bank lending activities. Specifically, it is argued that contractionary monetary policy has severe adverse effects on the volume of loans of capital-constrained banks relative to unconstrained banks because banks with higher capitalization have easier access to uninsured and unsecured funds. The reason is that the amount of capital acts as a signaling mechanism to alleviate informational asymmetries between banks and their creditors, mitigating adverse selection and moral hazard problems in the market for unsecured bank liabilities. Put differently, from the perspective of banks' creditors, bank capital provides a buffer to absorb future losses, which, in turn, determines the extent of their willingness to lend to banks. Several empirical studies (e.g. Bernanke and Lown 1991; Kishan and Opiela 2000; Gambacorta and Mistrulli 2004; Albertazzi and Marchetti 2010; Jiménez *et al.* 2012, among others) find a positive relationship between capitalization and loan supply, with better capitalized banks reducing lending supply less than other banks in case of negative shocks, including contractionary monetary policy. Furthermore, Maechler and McDill (2006) find that banks in poorer conditions have to pay a risk premium on their uninsured deposits, while Gambacorta and Shin (2016) provide evidence that bank equity is an important determinant of the funding costs of banks.

To capture the role of bank capital for the transmission of the credit support policies, we use the (annual) equity to total assets ratio from SNL Financial, which is the ratio of

total equity to total assets. We select this simple accounting measure of capital rather than a capital ratio based on risk-weighted assets, because this series is available for many more banks in our sample period. Notice, however, that the conclusions are qualitatively similar when we use the Tier-1 or CET-1 capital ratios for fewer banks.<sup>17</sup>

Table 2 summarizes the characteristics of the banks that are included in the estimations. The average bank in our sample had a size of € 91 bn over the period 2007-2015, with substantial dispersion across banks. The distribution of total assets is quite skewed, with a median value of € 36 bn, indicating the presence of a large number of relatively small banks and a limited number of very large institutions. The skewness, however, vanishes for the 100 times natural logarithm of total assets, which is the variable used in the estimations.

The share of liquid assets over total assets decreased somewhat over the same period. On average over the entire sample, liquid assets held by banks amounted to 31% of their total assets. While the median (28%) is quite close to the mean, there is a non-negligible right-side tail, indicating a sizable proportion of highly liquid banks. The average equity-to-assets ratio stood just below 6%, with dispersion relatively limited. After the crisis and especially in recent years, particularly due to changes in regulation and supervision but also increased market scrutiny, banks increased their capital ratios, while dispersion in the degree of capitalization rose. Retail deposits amounted to 82% of retail lending in our sample on average, increasing notably over the sample period. Although the values are relatively low, some of the bank characteristics appear to be correlated: better capitalized banks seem to be typically smaller, less liquid and more funded by retail deposits. Smaller banks are less liquid, while retail-funded banks are more liquid. Given the presence of these correlations, it is important to disentangle the effects of all the channels, and consider the characteristics simultaneously in the estimations. Our local projections framework allows to do so.

### 3.3 Results

Figure 6 shows the benchmark results for the impact of the bank characteristics on the effectiveness of credit support policies to stimulate bank lending, i.e. the estimated values of  $\gamma_{k,h}$  for each bank characteristic  $k$  at horizon  $h$  after the Eurosystem's balance sheet shocks (see equation 2). Figure 7 shows the results without the liquidity effect, which are based on more observations. All coefficients have been normalized by one standard

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<sup>17</sup>These results are available upon request.

deviation of the corresponding bank characteristic, and can be interpreted as the additional impact of the balance sheet shock on respectively the volume of lending and lending rates when the bank characteristic deviates by one standard deviation from its sample mean. Notice that the average effects (overall sample mean) are essentially the impulse responses reported in Figure 4 and discussed in section 2.

The results reveal that the volume of lending of large (small) banks responds less (more) to credit easing shocks, which confirms the existence of a size effect: a bank that is one standard deviation smaller increases its volume of lending up to 5 basis points more one year after the policy shock. Compared to the average effects that we have obtained, i.e. a peak effect of 6 basis points, the influence of the size effect is economically very important for the transmission of credit support policies. Also the retail funding effect has the expected negative sign, and is economically relevant. Specifically, banks that are less dependent on the wholesale market and mainly fund their lending activities with retail funding turn out to be less responsive to credit easing policy shocks. A one-standard-deviation rise in the retail funding to total lending ratio reduces the response of bank lending between 2 and 4 basis points. The retail funding effect is, however, only statistically significant for the estimations based on more observations reported in Figure 7.

On the other hand, we find a positive impact on both the capital and liquidity ratios on loan provision. Both results are surprising and clearly at odds with the bank lending view. In particular, better capitalized and more liquid banks are expected to be less dependent on central bank liquidity for their lending activities, and hence also less sensitive to the credit support measures of the Eurosystem. Only in the very short run, we find the expected sign for the capital effect. Although these results are consistent with other studies, e.g. Boeckx *et al.* (2016) and Altavilla *et al.* (2016), this finding remains puzzling. It will be analyzed in more detail in section 3.4.

Overall, the results for the bank lending rates turn out to be less pronounced than the results for the volumes of lending. A possible explanation is that banks can also increase credit supply without lowering their lending rates. For example, they could engage in riskier lending activities at the same lending rate.<sup>18</sup> Such behavior and effects of credit easing policies are only observable in the volumes of lending, and not in the

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<sup>18</sup>Literature on the financial accelerator and the search for yield coincides on identifying mechanisms by which expansionary monetary policy may induce banks into engaging in higher risk taking (see Borio and Zhu, 2012). Empirical analyses seem to support this conclusion (Maddaloni and Peydrò, 2010; Ioannidou *et al.*, 2009). Dell’Ariccia *et al.* (2011) propose a theoretical framework where banks’ capital structure would influence the risk-taking of banks after a monetary policy shock.

lending rates. This caveat and limitation of our dataset should be taken into account when interpreting the results. Nevertheless, the results for the lending rates are broadly in line with those based on the volume of lending. In particular, we find that the lending rates charged to households and firms of larger banks, and banks that are less dependent on the wholesale market, are also less responsive to credit policy shocks. This is statistically more pronounced for the results based on more observations (Figure 7). In addition, we find that highly capitalized banks lower their rates much more strongly than other banks, while differences in the liquidity ratio do not seem to have any impact on bank lending rates. Finally, a similar picture emerges for the results based on the growth rate of total assets, which are shown in Figure 8.

### 3.4 The role of bank capital

The results in section 3.3 have revealed that lending activities of better capitalized banks tend to react more to the credit support policies of the Eurosystem. In fact, also Boeckx *et al.* (2016) document a strong positive correlation between the effects of central bank balance sheet innovations on economic activity in individual euro area countries and the Tier 1 capital ratio of the consolidated national banking system. Furthermore, Altavilla *et al.* (2016) find a stronger pass-through of unconventional monetary policy on lending rates of high-capitalized banks. These findings are striking in the light of the existing evidence on monetary policy and bank capital in normal times. In particular, given the role of capital as a sign of bank balance sheet strength and access to non-secured market funding, several studies find that low-capitalized banks typically respond more to changes in the policy rate, whereas higher bank capital ratios mitigate the effects on lending during periods of contractionary monetary policy.

Why do low-capitalized banks respond less to policy measures that raise their access to liquidity? A possible explanation is that bank capital also encompasses a drag on the ability to increase loan supply. More precisely, a bank can extend loans up to a certain multiple of its capital, which is determined by regulatory capital requirements (first and foremost the Basle Agreements) or by market discipline. When banks are close to the regulatory minimum, they cannot expand lending without additional capital, which was very difficult and costly to raise during the sample period. Van den Heuvel (2007) shows that it is not even necessary for the capital constraint to bind today in order to influence bank lending behavior. In other words, to avoid a binding constraint in the future, banks might already act as if the constraint is binding today. An expected higher risk embedded

in lending over the period of the sample (due to adverse economic conditions) could amplify the problem, as their capital buffer could need to be larger in order to be able to absorb more substantial expected losses.

The role of bank capital for lending activities through regulatory requirements rather than serving as a buffer for potential losses of uninsured depositors has also been postulated in the literature on conventional monetary policy. For example, Bernanke and Lown (1991) argue that the bank lending channel will be shut down, and the real effects of a given monetary policy expansion will be smaller when bank capital hits the regulatory minimum for a sizeable fraction of banks. Albertazzi and Marchetti (2010) provide empirical evidence supporting such a "capital crunch".

If capital serves as a fundamental constraint on credit supply of banks, it may hence also limit the effectiveness of the credit support policies, in particular the size, liquidity and retail deposits effects. To investigate whether this is the case, we extend the set of bank characteristics in equation (2) by allowing for interaction of bank capital with the other characteristics. Specifically, we also include size\*capital, liquidity\*capital and retail\*capital as explanatory variables in the vector of bank characteristics. If capital indeed imposes a constraint on the effectiveness of the other channels, the estimated coefficients should be positive (negative) for the coefficients in the volumes (rates) equations.

Figure 9 shows the estimation results for the benchmark specification. The coefficients for size, retail funding, liquidity and capital are again normalized by one standard deviation of the characteristics within the sample period. The coefficients of the interactions, for example size\*capital, have been normalized and should be interpreted as follows: if size (total assets of a bank) deviates by one standard deviation from the sample mean, what is the effect of credit support policies on the volume of lending and lending rates if, at the same time, also capital deviates by one standard deviation of its sample mean?

The impact of size, retail funding, liquidity and capital on the volume of lending now all have the expected sign as postulated in the bank lending view. All coefficients are significantly negative, indicating that banks that have more difficulties to raise uninsured or unsecured external funding react more to the credit support measures of the Eurosystem. The magnitudes of the effects are also larger than in the specification without interaction effects, and especially the direct effect of capital is large. Furthermore, also the coefficients of the interaction terms are all significant, and have the expected sign (although retail\*capital only at longer horizons). This finding confirms that the degree of capitalization of banks is a constraint for the strength of the other effects, i.e. poorly capitalized

banks are much less able to increase their lending activities when the Eurosystem increases the volume of liquidity available to the banking system. The capital drag is economically important. For example, banks that are one standard deviation smaller than the sample mean, increase the volume of lending by 10 basis points more than average after an expansionary credit policy shock. However, if at the same time the capital ratio is also one standard deviation below average, the rise in lending is roughly 5 basis points less. Also the retail funding and liquidity effects are only half as strong when the capital ratio of a bank is one standard deviation below the sample mean.

The results are broadly confirmed for the effects of credit support policy shocks on bank lending rates, although less clear and significant. This is also the case for the specification without liquidity (Figure 10), and when we use the growth rate of the Eurosystem's total assets as the policy measures (Figure 11). For the latter specification, however, we do find a puzzling sign for the retail funding effect, as well as the capital drag on this effect. A possible explanation is that changes in total assets also capture endogenous fluctuations in the Eurosystem's balance sheet. Overall, we can conclude that banks having more difficulties to obtain unsecured external funding respond more to credit easing compared to other banks, but that the responsiveness vanishes when the banks have relatively low capital ratios.<sup>19</sup>

As a final test to investigate whether capital constraints for low-capitalized banks are important for the effectiveness of the unconventional monetary policies, Figures 12-14 show the results when we extend the baseline bank characteristics with a dummy, which is equal to one for banks that have a capital ratio which is in the lowest quartile (Q4) of the whole sample. These banks should have most difficulties to increase credit supply. As can be observed in the figures, (very) low-capitalized banks seem to have responded considerably less to the policies than the other banks, with persistently lower (up to 15 basis points) lending volumes and higher (over 3 basis points) lending rates. At the same time, when we control for these low-capitalized banks, and in contrast with the benchmark results, also the coefficients for capital have the expected sign for the volume of lending: better capitalized banks, which typically have easier access to unsecured external funding, respond less to the credit support measures.<sup>20</sup> This is, however, not the case for the capital effect on bank lending rates, which is still negative. Using less observations or using the

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<sup>19</sup>Notice that in principle one could also interpret the results as a bank capital effect of the policies, which mitigates when banks are larger, depend less on unsecured funding for their lending activities and have higher levels of liquidity. Although we cannot exclude this, such a mechanism is hard to motivate theoretically, in particular for the period under consideration.

<sup>20</sup>For banks in the lowest quartile, the negative dummy effect dominates the positive "direct" capital effect so that the overall response to credit support shocks is weaker.

growth of total assets as the monetary policy indicator yields broadly similar results.

## 4 Conclusions

In response to the financial crisis, the Eurosystem has introduced a number of new policy tools that have expanded the size of the central bank balance sheet. The purpose of these tools was to support the functioning of financial markets and to provide additional stimulus to the economy when the policy rate was constrained near zero. Whereas the literature on the macroeconomic consequences of changes in the policy rate is vast, little is known about the effects of these alternative policy measures to stimulate the flow of credit to the private sector. Even less is known about the transmission mechanism. This paper is an attempt to fill this gap. To do this, we have estimated the effects of credit support policies on lending behavior for a panel of 131 euro area banks using Jordà's (2005) local projection methods.

In a first step, we show that such policy measures have been effective in stimulating bank lending to households and firms since the start of the financial crisis. Specifically, an expansion in the Eurosystem's balance sheet leads to a fall of bank lending rates, and a rise in the volume of lending. In a second step, we investigate the role of different bank characteristics in explaining the pass-through to credit supply. Consistent with the bank lending view, we find that banks that are more constrained to obtain unsecured external funding during the crisis, responded also more to the policy measures. Liquidity policies by the central bank may thus alleviate funding constraints for banks. This is, however, much less the case for banks that have very low levels of capitalization. More precisely, we find that lending activities of banks that are smaller, have less liquid assets, fund themselves less by retail deposits and are less well capitalized respond more to credit support measures. However, these effects are mitigated when a bank's capital position is weaker. As has been argued by Bernanke and Lown (1991) and Van den Heuvel (2007) for conventional monetary policy, a minimum level of capitalization (imposed by regulation or the market) appears to be a crucial condition for the other channels to be operative, as if capital acts like the ultimate constraint.

The implications of these findings are twofold. First, credit support measures, and the role of the central bank as lender of last resort, are effective to prevent a liquidity-driven credit crunch, but banks need to have a sufficient buffer over their minimum capital requirements to be able to transmit the easier financial conditions to the rest of the economy. From this perspective, the recent efforts to recapitalise euro area banks should enhance

the effectiveness of such policies. Second, this also pleads in favor of countercyclical regulation, including sufficiently high countercyclical capital buffers, in order to avoid that binding capital requirements contribute to an even more severe reduction in credit.

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**Table 1 - Sample representativeness (October 2015)**

<b>Country</b>	<b>Number of banks</b>	<b>Share of total assets (%)</b>	<b>Share of retail lending (%)</b>
Austria	6	28	30
Belgium	6	40	64
Cyprus	2	41	56
Germany	41	37	36
Estonia	2	62	64
Spain	14	69	78
Finland	1	7	7
France	12	28	26
Greece	1	21	21
Ireland	2	10	28
Italy	14	33	40
Lithuania	1	27	32
Luxembourg	5	12	41
Latvia	2	28	42
Malta	4	38	86
Netherlands	6	60	68
Portugal	5	63	70
Slovenia	4	48	47
Slovakia	3	53	58
<b>Total euro area</b>	<b>131</b>	<b>37</b>	<b>43</b>

Table 2 - Bank characteristics

	2008				2014				Overall			
	Obs	Average	Median	Stdev	Obs	Average	Median	Stdev	Obs	Average	Median	Stdev
Size (€ bn)	1398	92.6	34.9	138.6	1560	87.1	35.7	137.9	12445	91.1	36.0	140.0
Size (100*log)	1398	360.4	355.1	148.0	1560	355.6	357.4	140.7	12445	360.4	358.5	142.9
Equity over total assets	99	4.9	5.1	2.4	129	7.2	6.7	3.7	1006	5.9	5.8	3.2
Deposit to loan ratio	1398	72.7	69.0	47.9	1560	88.6	83.3	75.6	12445	81.8	75.1	72.7
Liquidity ratio	81	33.1	29.6	16.5	97	30.4	27.4	14.5	781	31.1	27.9	15.8

Correlations	Size	Equity over total assets	Deposit to loan ratio
Size (€ bn)	1		
Equity over total assets	-0.1863	1	
Deposit to loan ratio	-0.0263	0.3386	1
Liquidity ratio	0.3606	-0.2084	0.2106

Figure 1 - Time series of annual growth rate of bank lending and bank lending rate in the euro area and sample of individual bank:

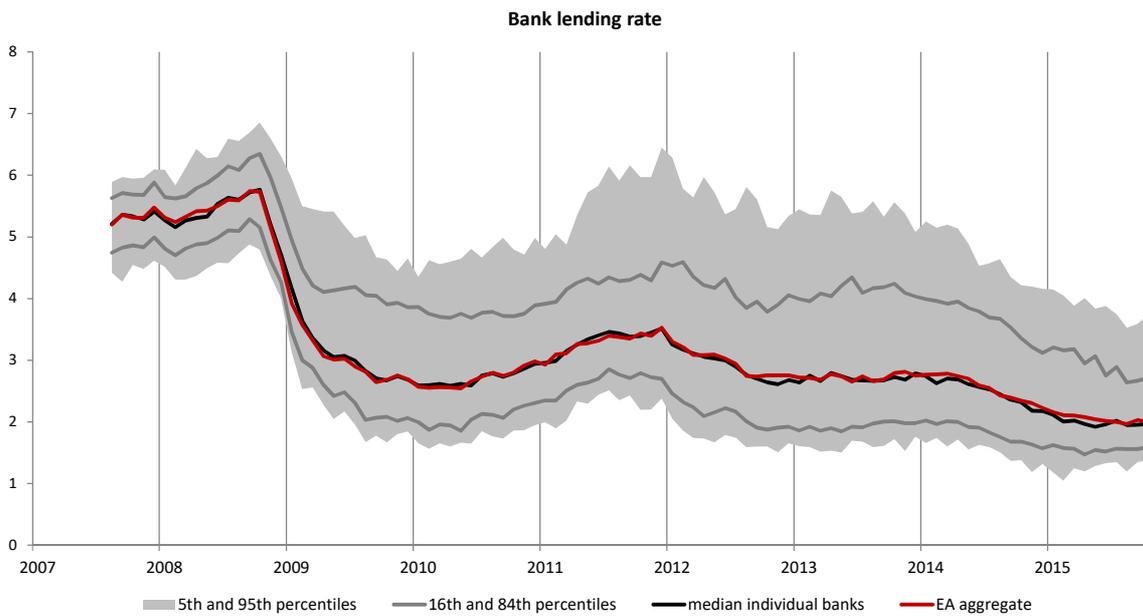
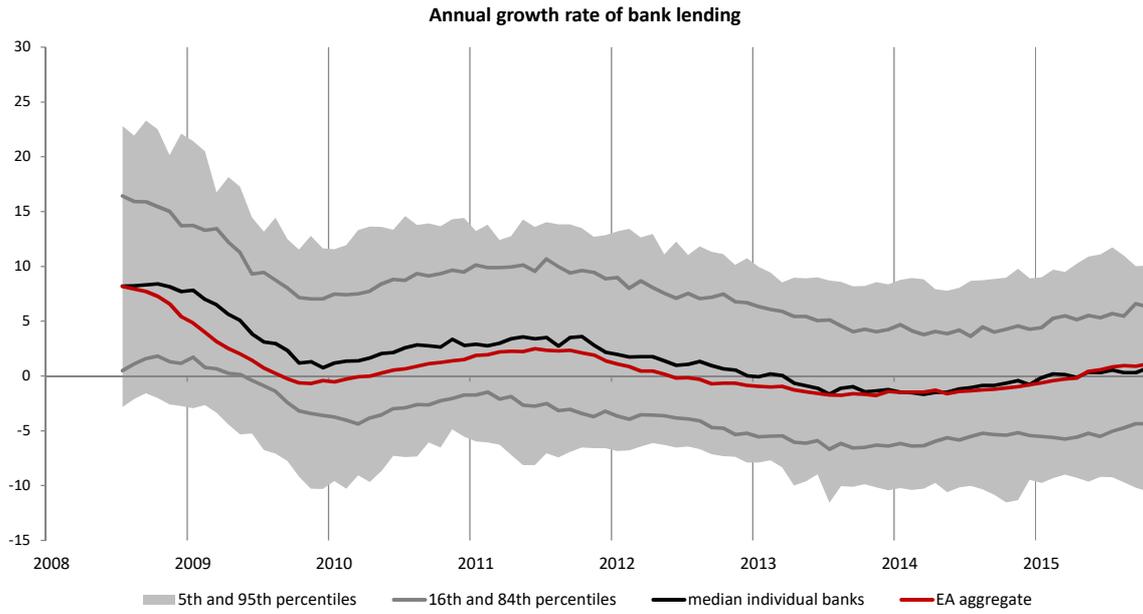
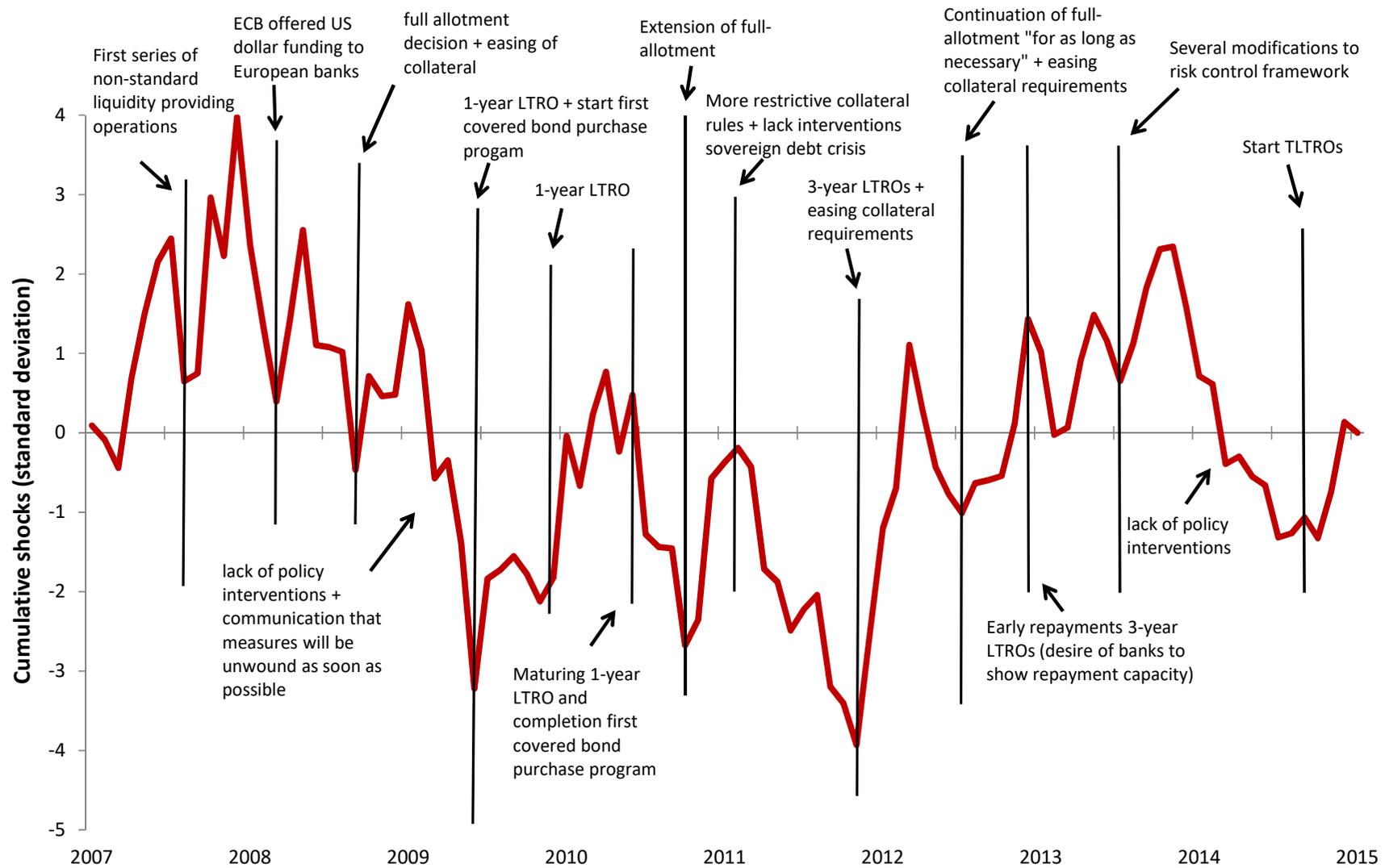
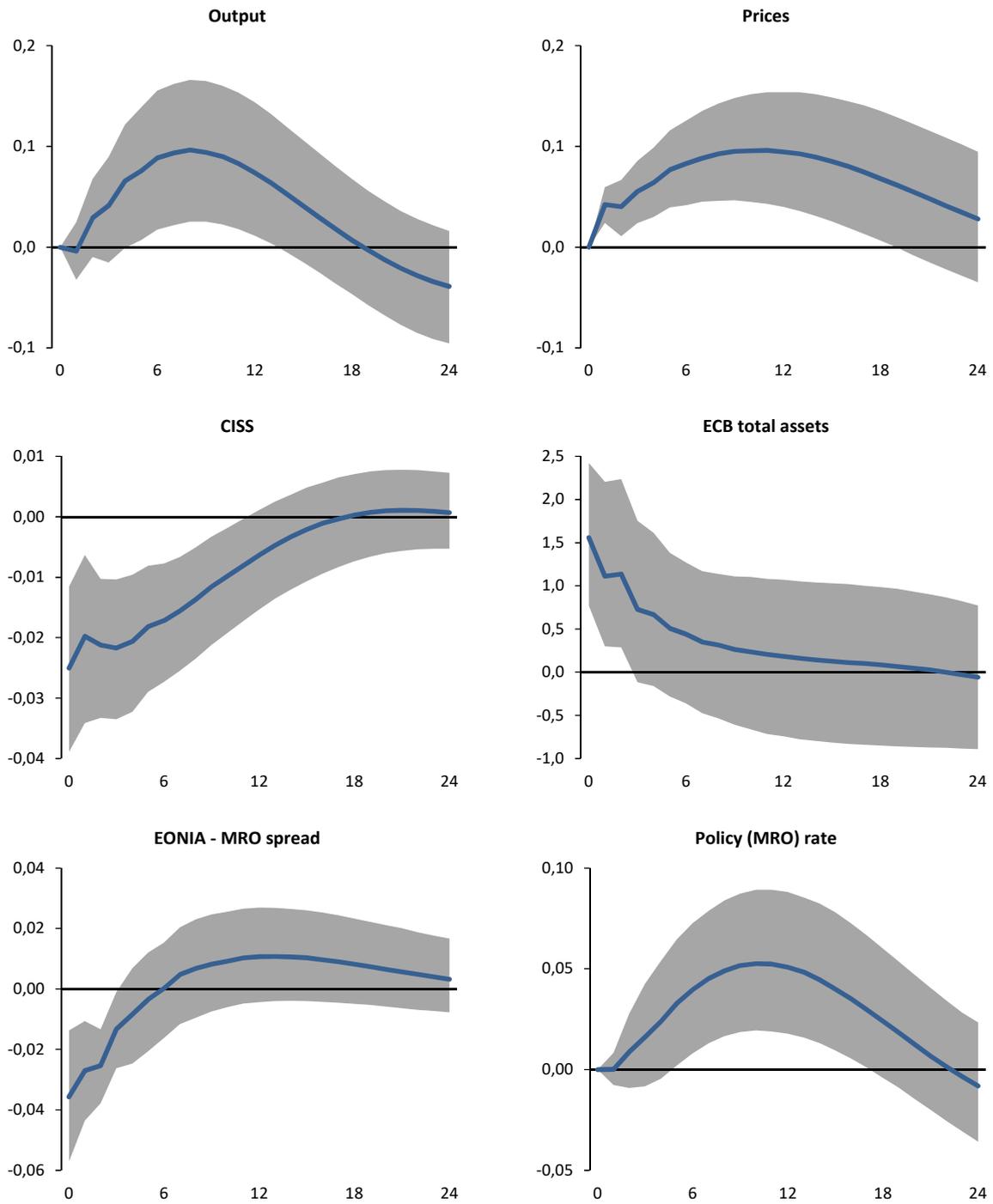


Figure 2 - Time series of cumulative identified balance sheet shocks (Boeckx et al. 2016)

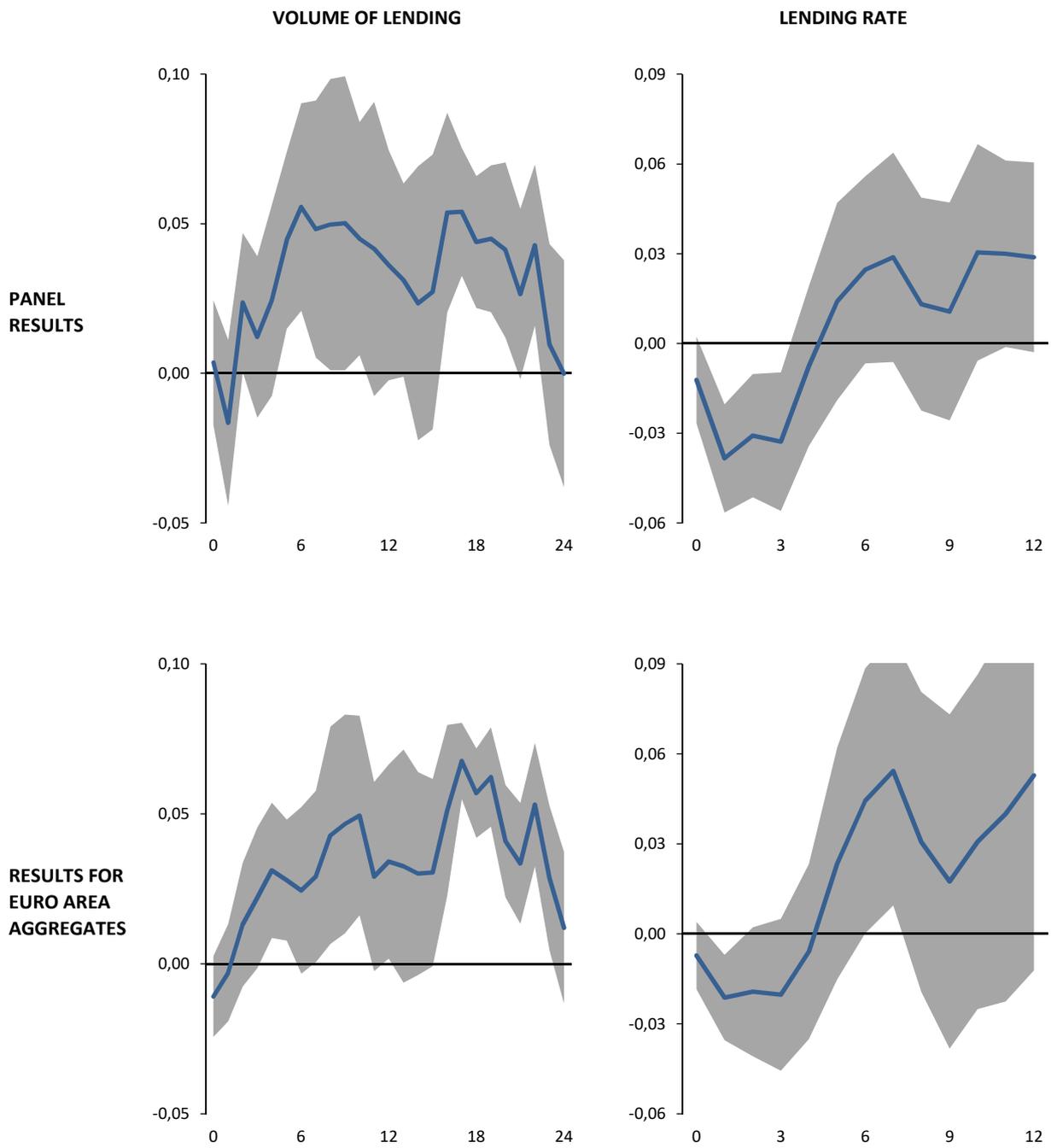


**Figure 3 - Impulse responses to balance sheet shocks in the euro area (Boeckx et al. 2016)**



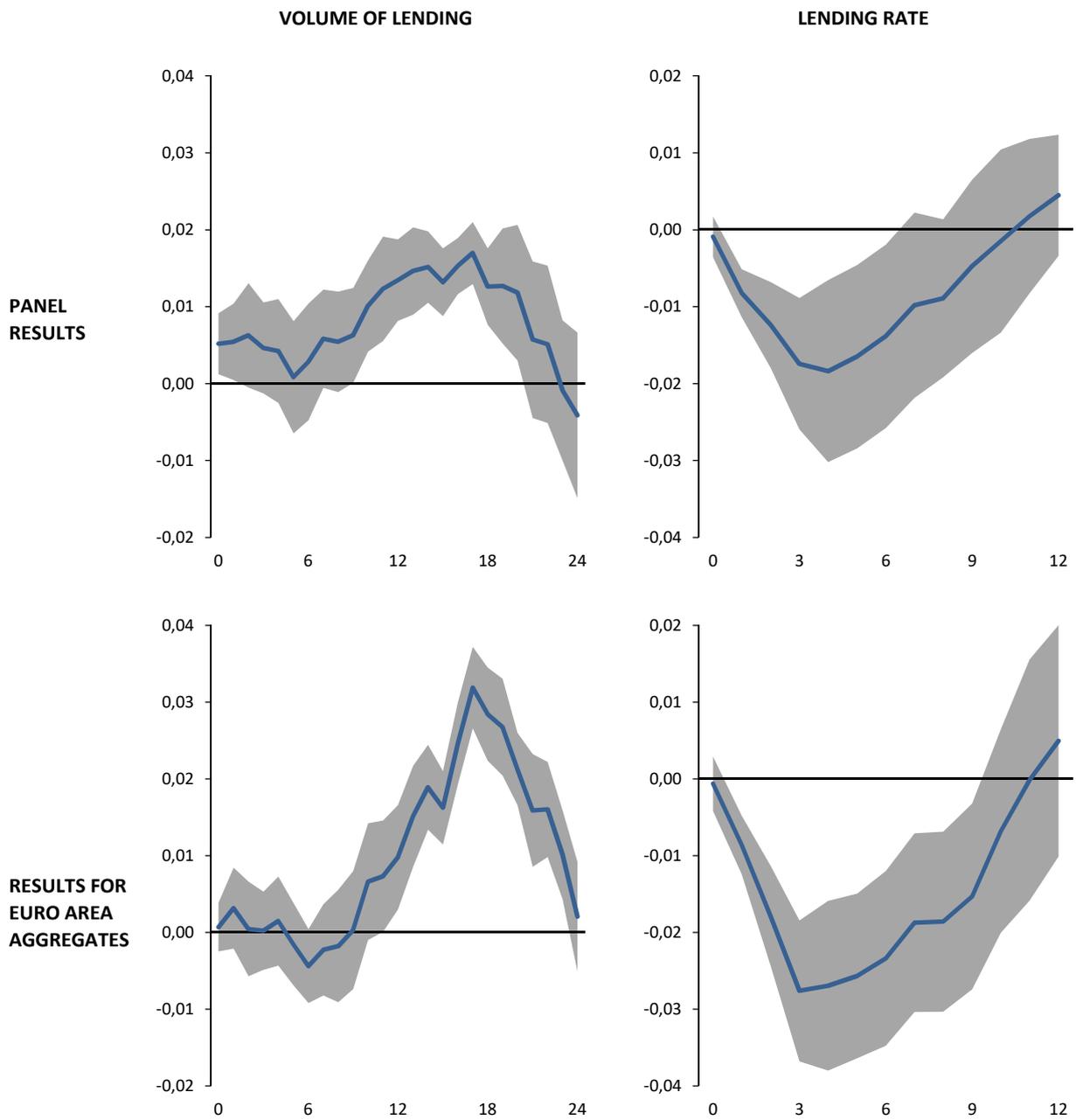
Note: figures show median responses, together with 16th and 84th percentiles of the posterior distribution; horizon is monthly

**Figure 4 - Impact of credit support policies on bank lending in the euro area: benchmark results**



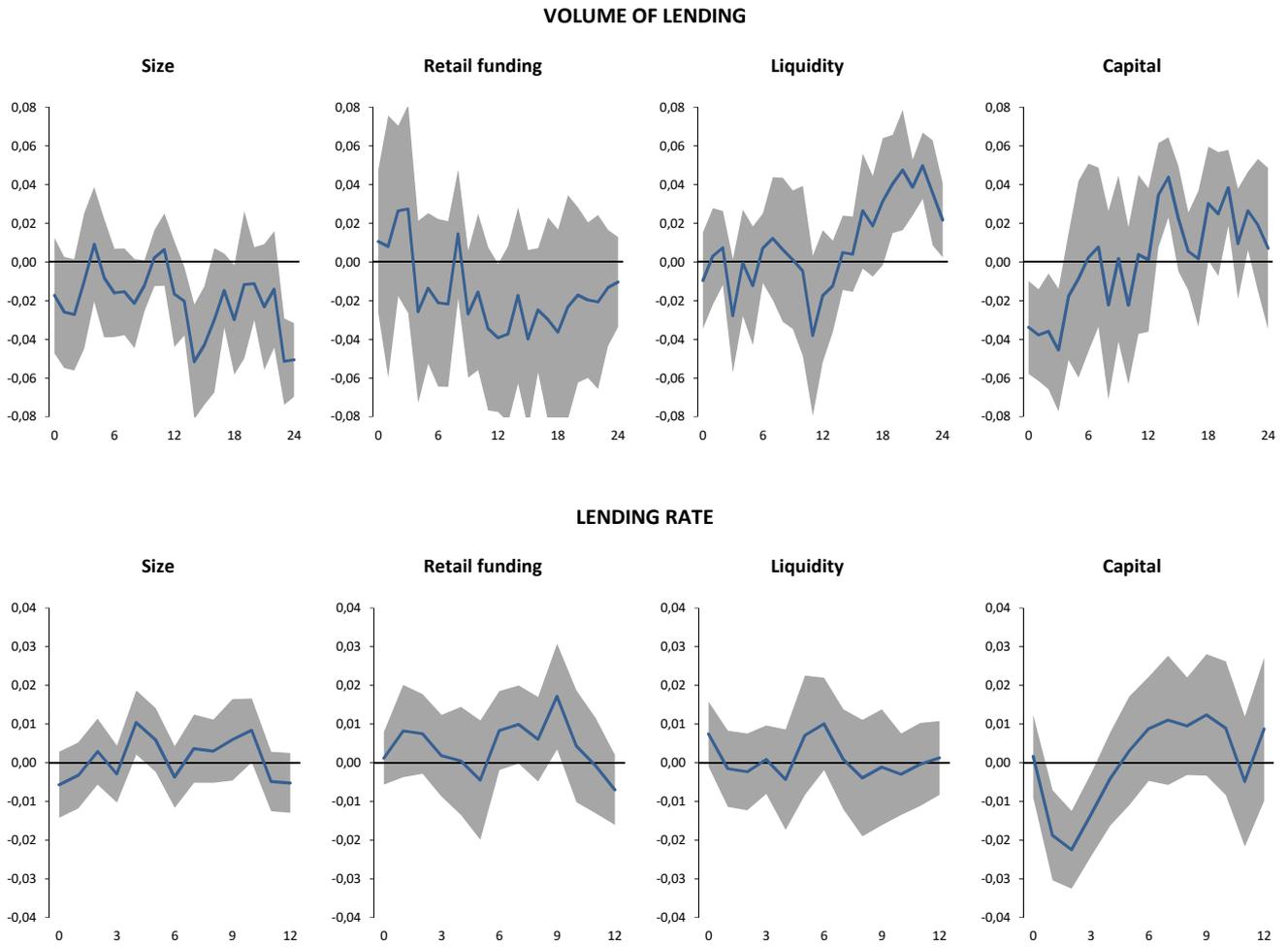
Note: horizon is monthly; 90 percent confidence bands are clustered by time and adjusted for persistent common shocks

**Figure 5 - Impact of credit support policies on bank lending: results for total assets growth Eurosystem**



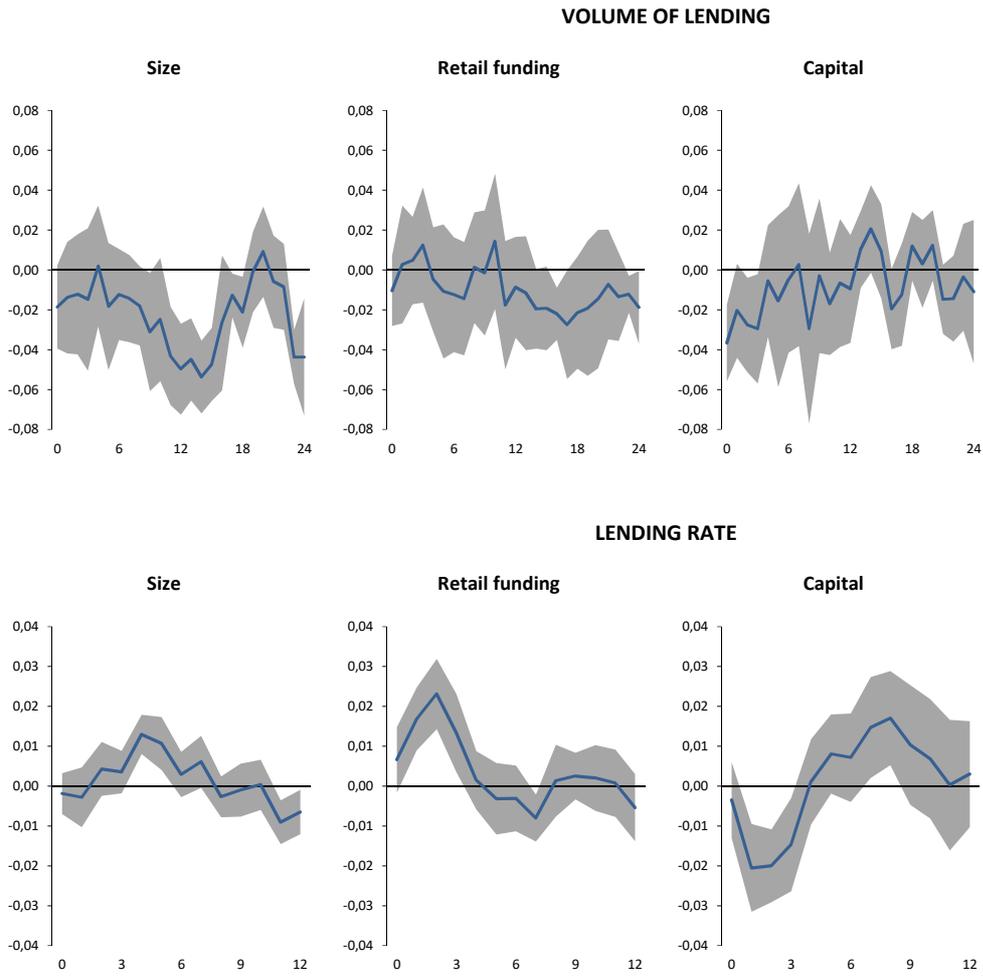
Note: horizon is monthly; 90 percent confidence bands are clustered by time and adjusted for persistent common shocks

Figure 6 - Bank characteristics and impact of credit support policies: benchmark results



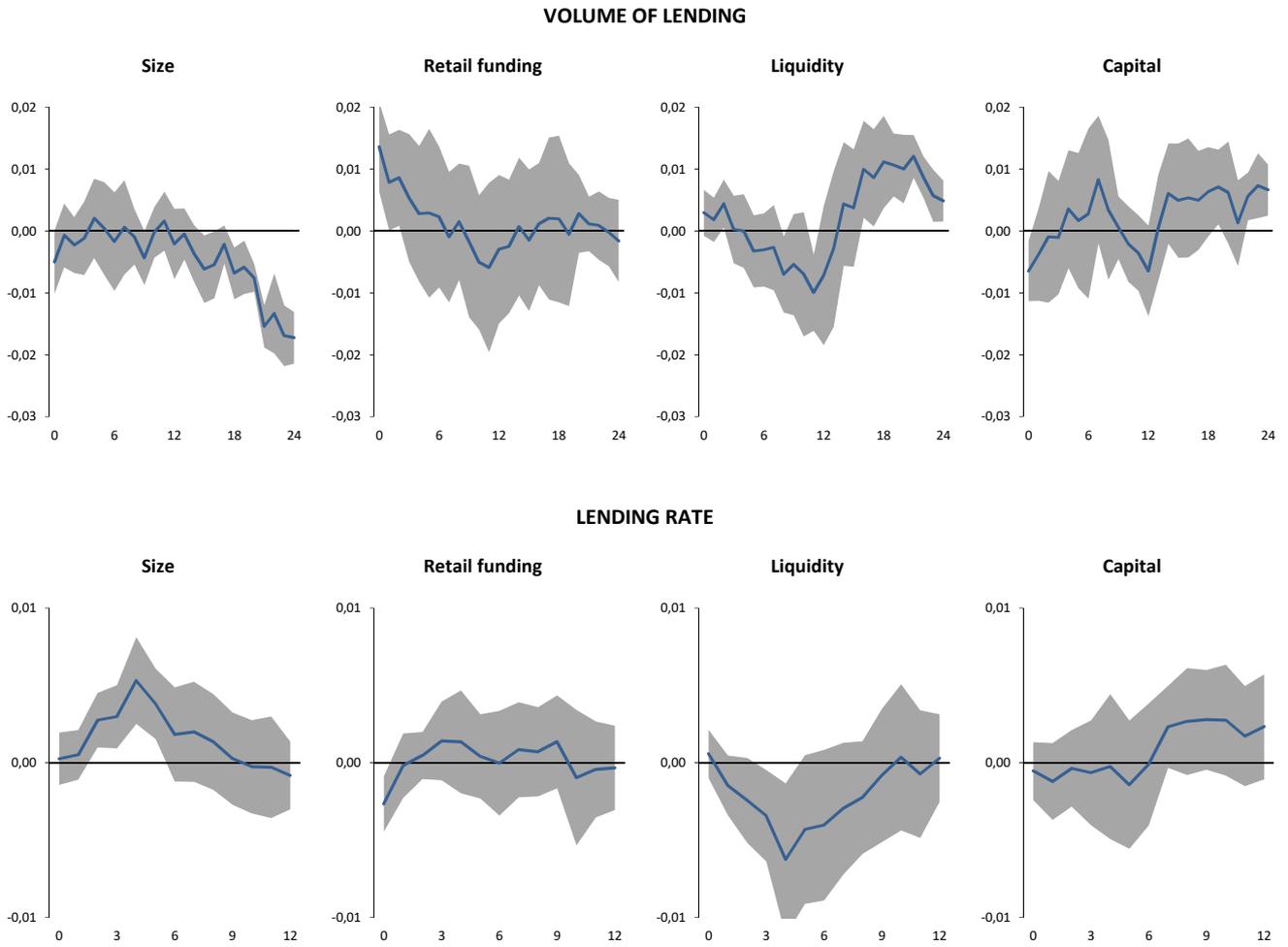
Note: horizon is monthly; 90 percent confidence bands are clustered by time and adjusted for persistent common shocks

**Figure 7 - Bank characteristics and impact of credit support policies: results based on more observations**



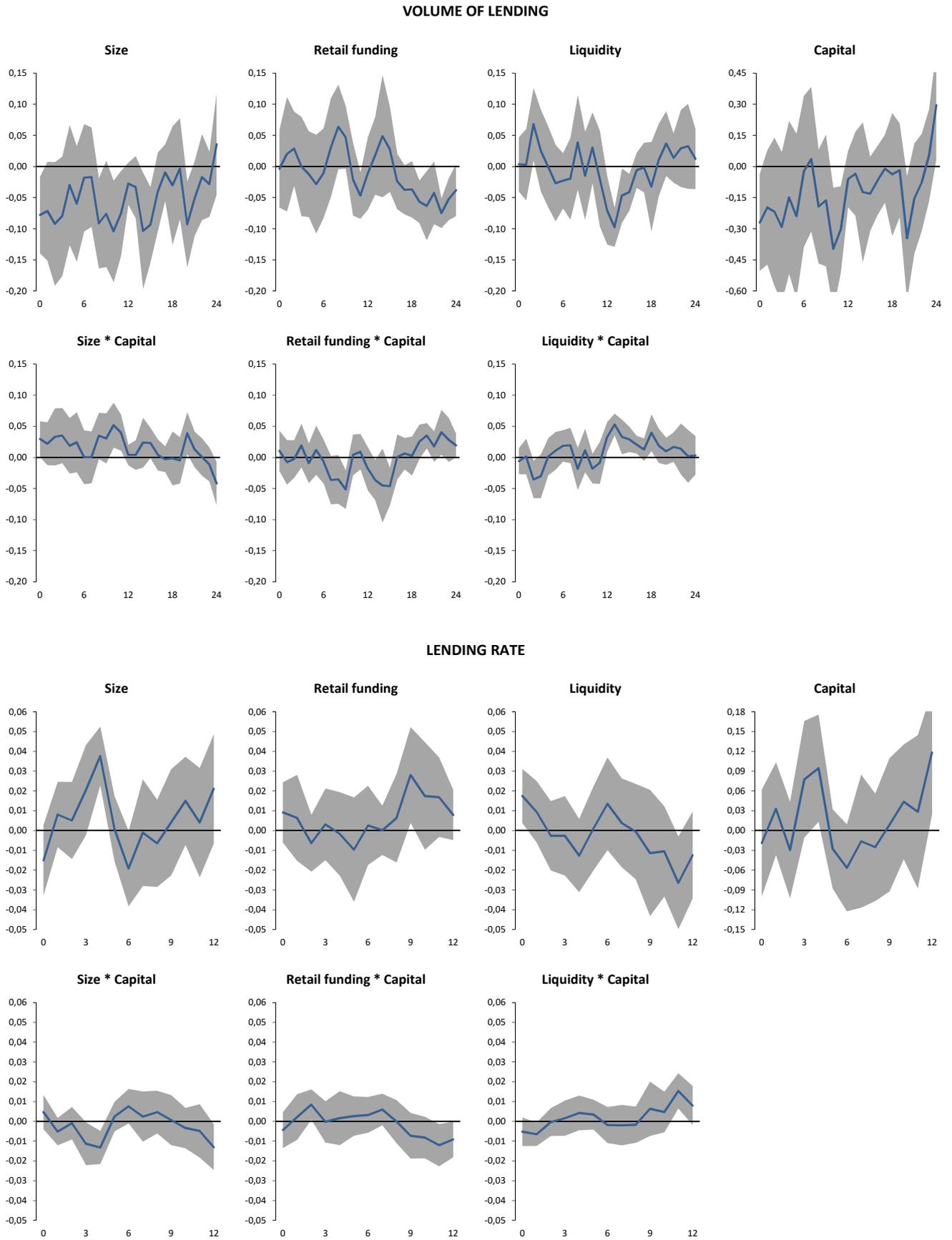
Note: horizon is monthly; 90 percent confidence bands are clustered by time and adjusted for persistent common shocks

Figure 8 - Bank characteristics and impact of credit support policies: results for total assets growth Eurosystem



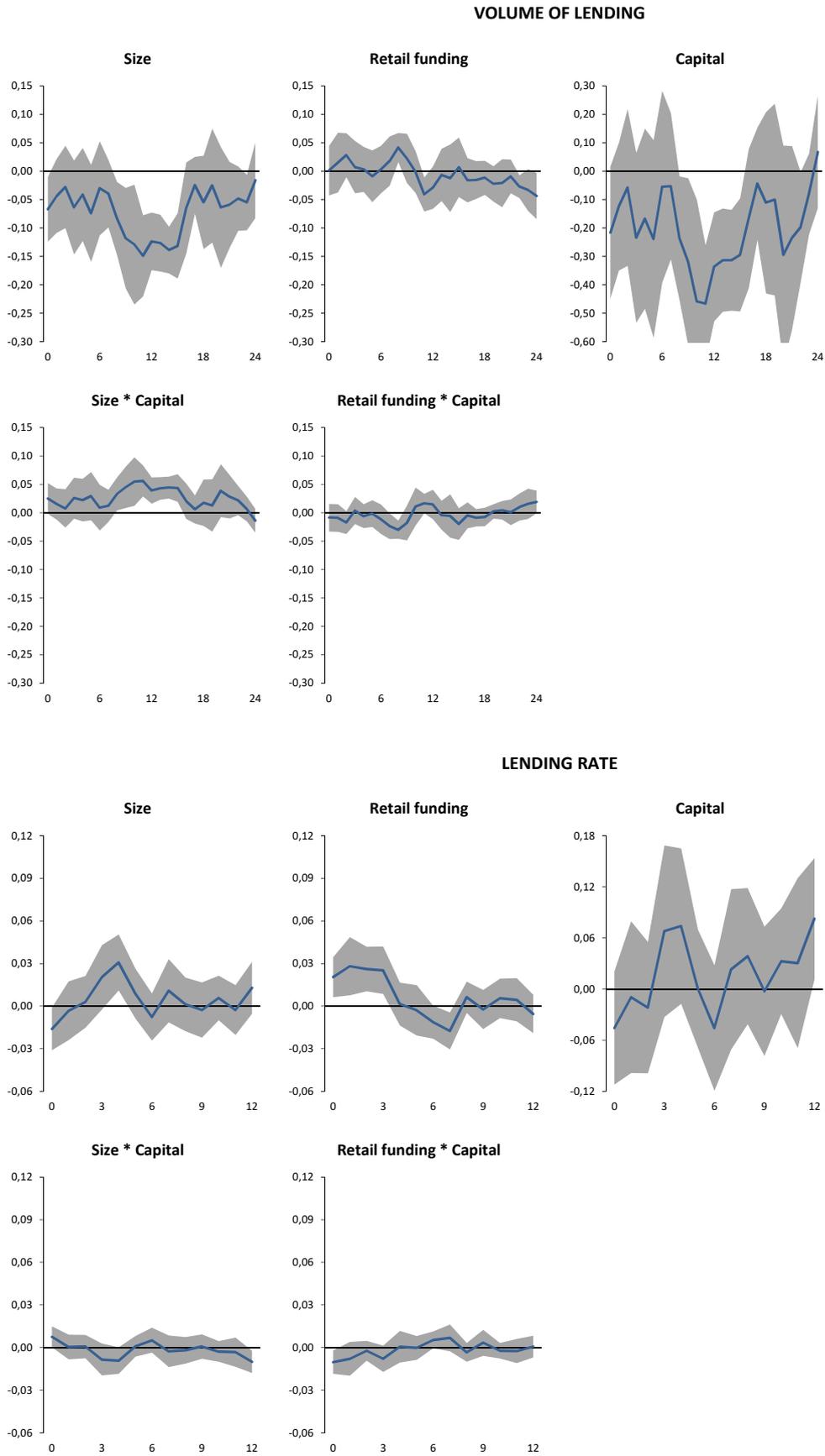
Note: horizon is monthly; 90 percent confidence bands are clustered by time and adjusted for persistent common shocks

**Figure 9 - Bank characteristics and impact of credit support policies: the role of bank capital**



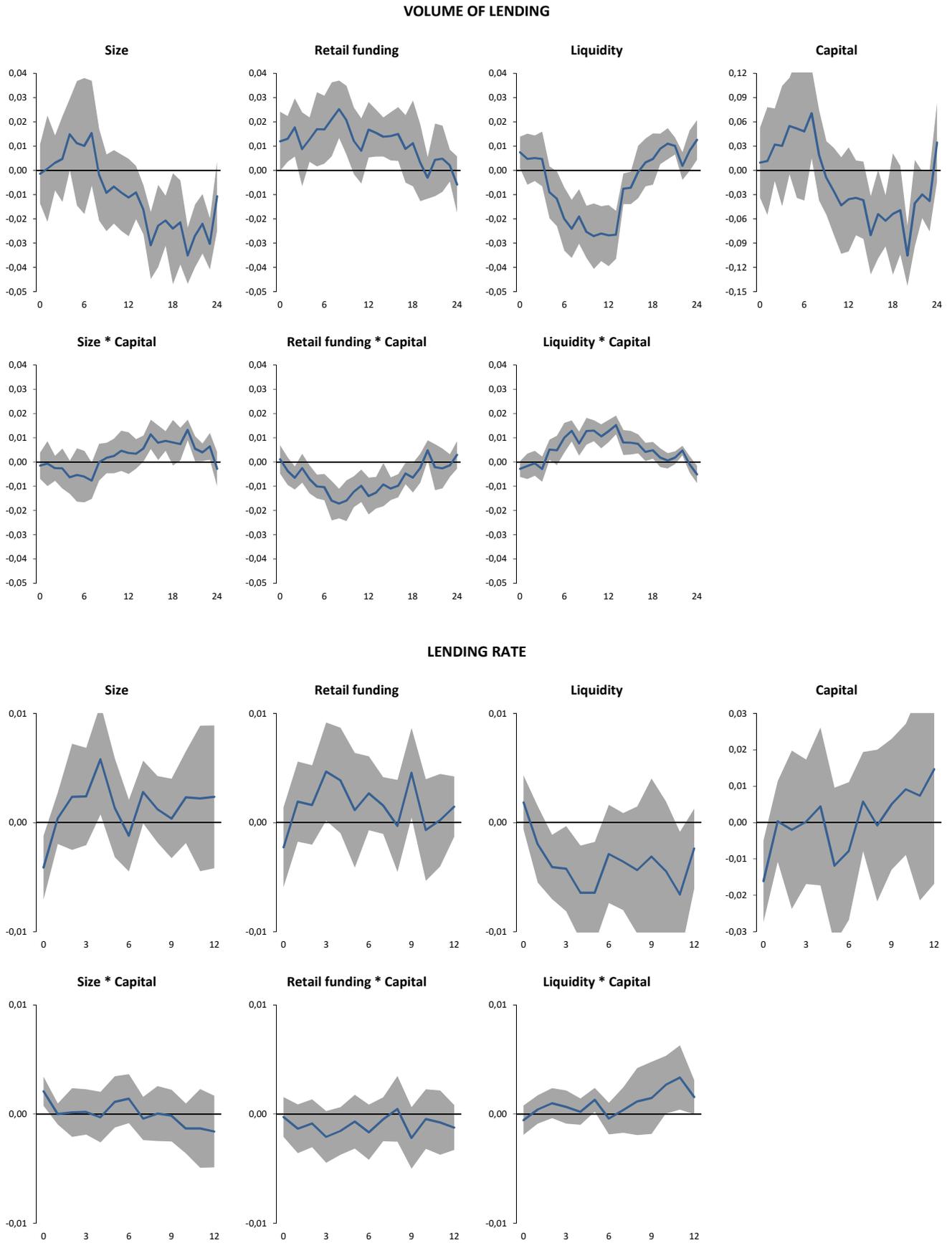
Note: horizon is monthly; 90 percent confidence bands are clustered by time and adjusted for persistent common shocks

**Figure 10 - The role of bank capital: results based on more observations**



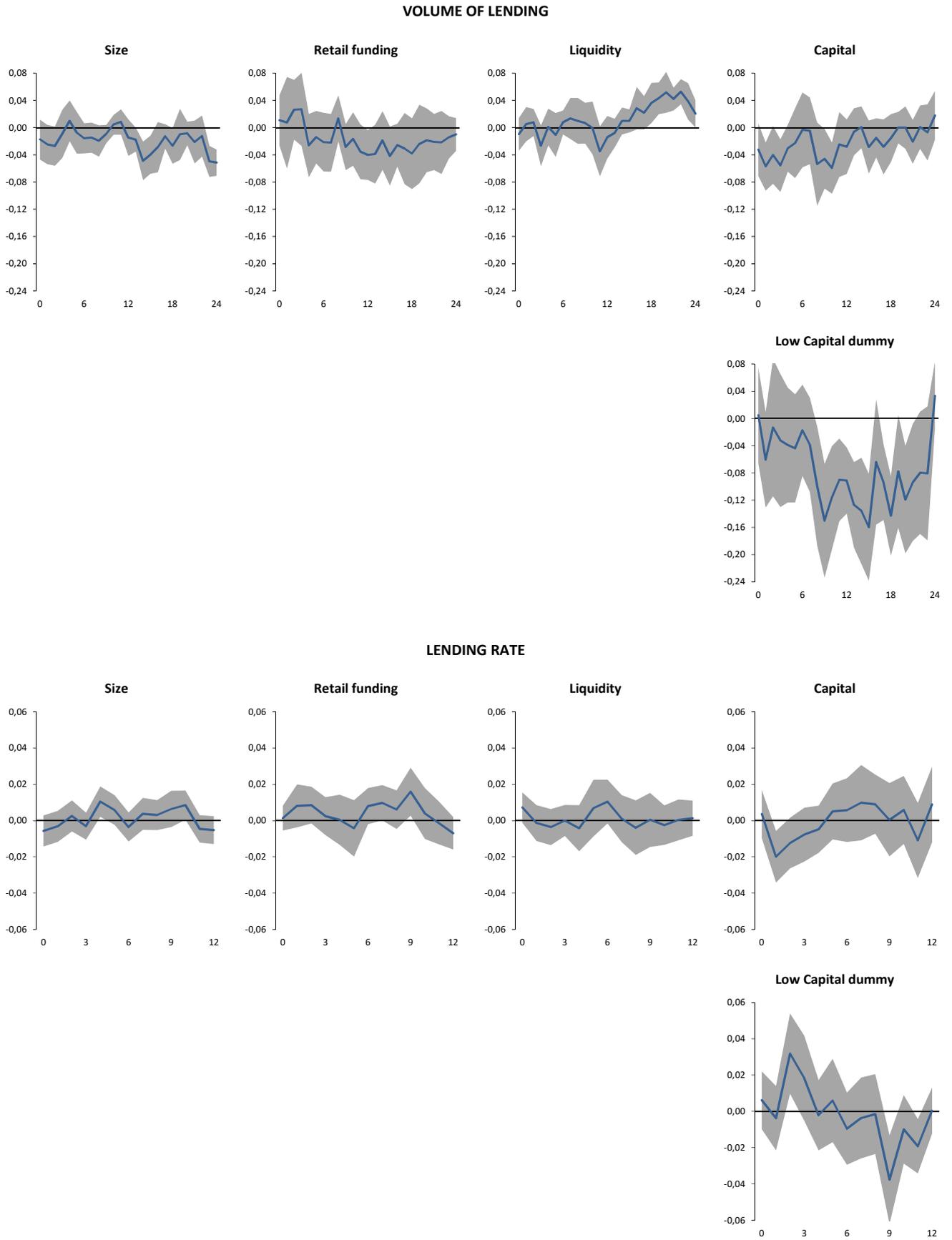
Note: horizon is monthly; 90 percent confidence bands are clustered by time and adjusted for persistent common shocks

**Figure 11 - The role of bank capital: results for total assets growth Eurosystem**



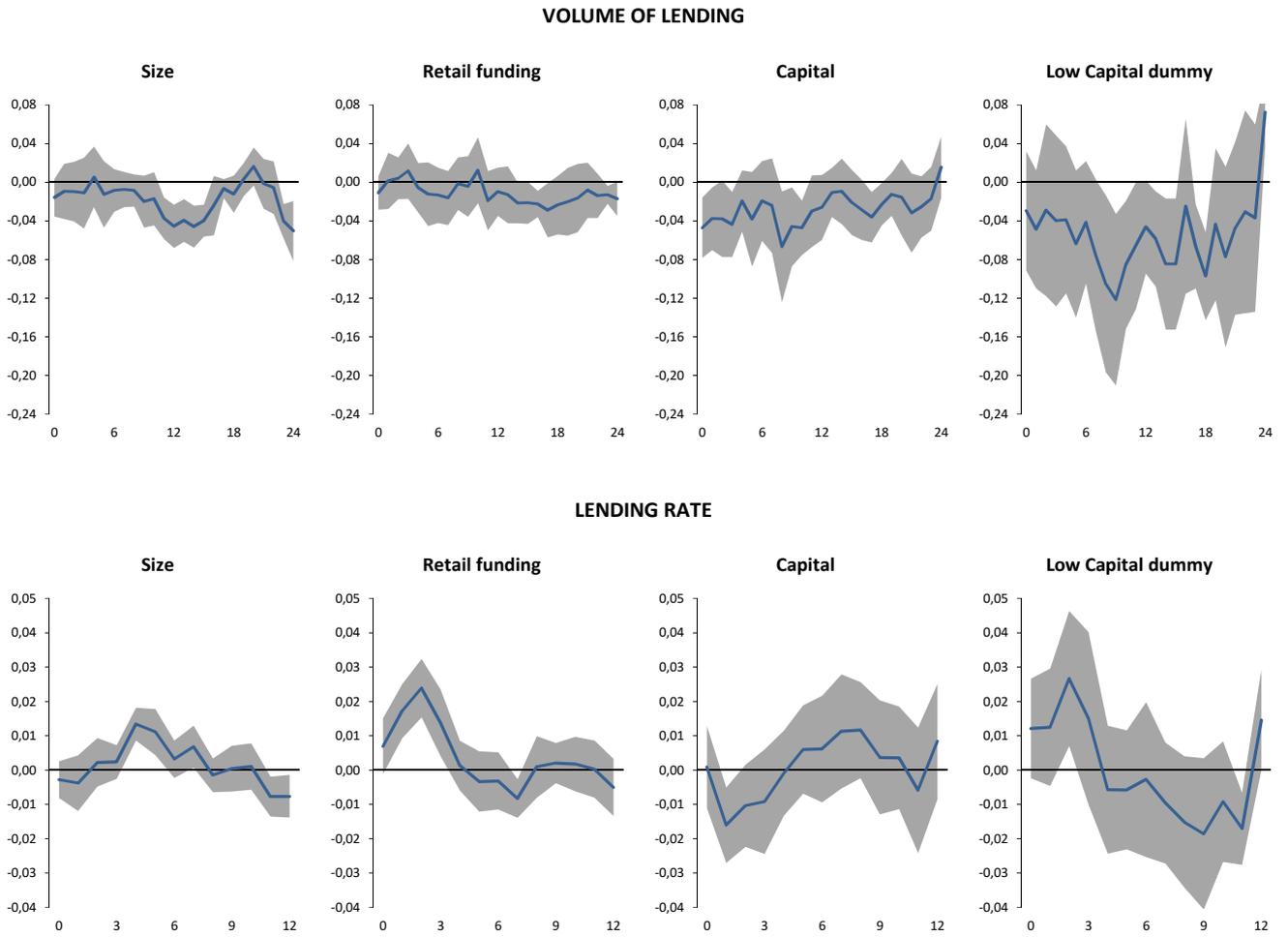
Note: horizon is monthly; 90 percent confidence bands are clustered by time and adjusted for persistent common shocks

**Figure 12 - The role of bank capital: results with dummy for low-capitalized banks**



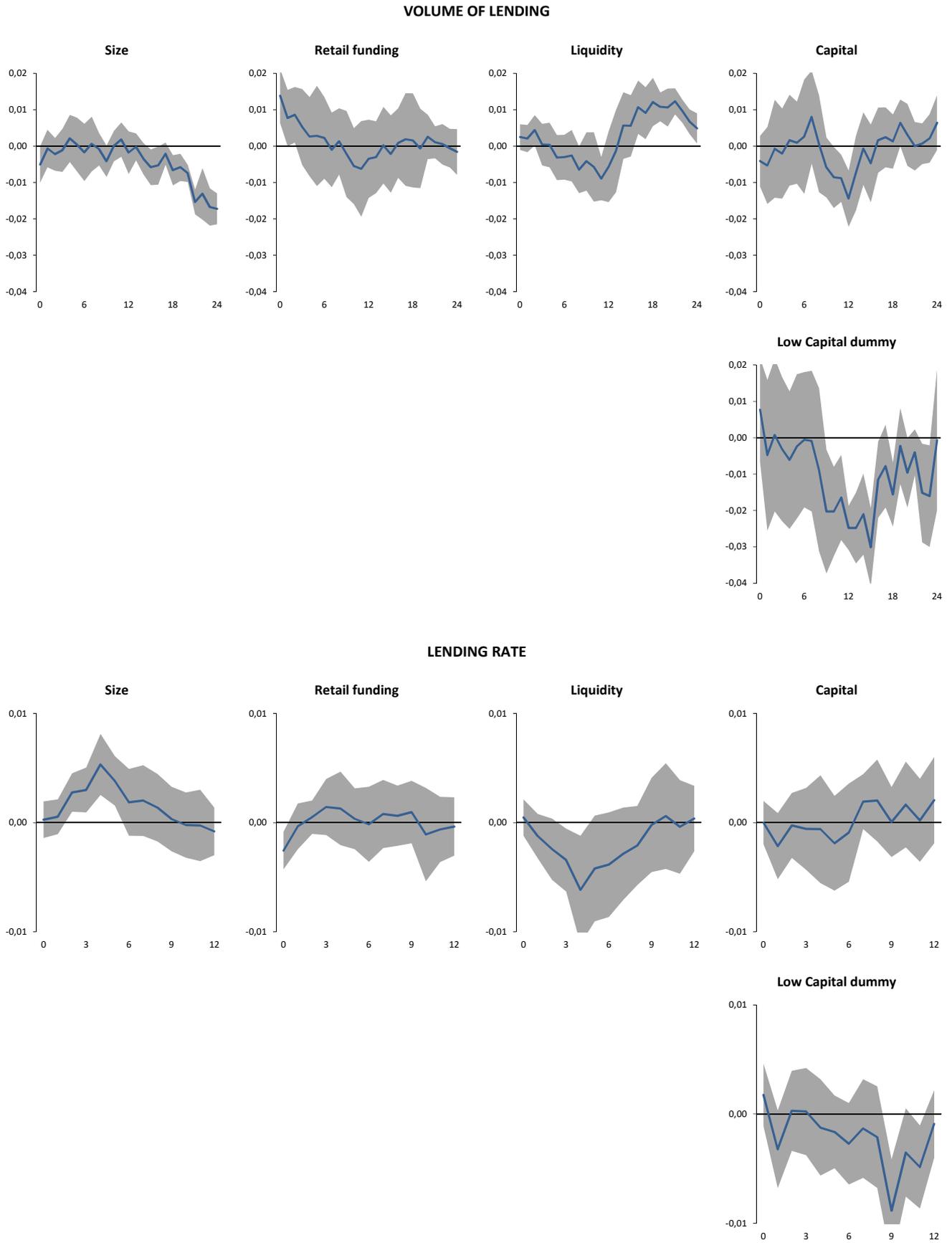
Note: horizon is monthly; 90 percent confidence bands are clustered by time and adjusted for persistent common shocks

**Figure 13 - The role of bank capital: results with dummy for low-capitalized banks and more observations**



Note: horizon is monthly; 90 percent confidence bands are clustered by time and adjusted for persistent common shocks

**Figure 14 - The role of bank capital: results with dummy for low-capitalized banks and TA growth Eurosystem**



Note: horizon is monthly; 90 percent confidence bands are clustered by time and adjusted for persistent common shocks

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[www.eurocapitalmarkets.org](http://www.eurocapitalmarkets.org) | [info@eurocapitalmarkets.org](mailto:info@eurocapitalmarkets.org)  
Place du Congrès 1 | 1000 Brussels | Tel: + 32 2 229 39 11

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