The bank lending channel of conventional and unconventional monetary policy[1]

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Abstract

Using a new monthly dataset on bank-level lending rates, we study the transmission of conventional and unconventional monetary policy in the euro area via shifts in the supply of credit. We find that a bank lending channel is operational for both types of measures, though its functioning differs: for standard operations the transmission is weaker for banks with more capital and a more solid funding structure, in line with an important role of asymmetric information. However, in response to non-standard measures lending supply expands by more at banks with stronger capital and funding positions, suggesting a crucial role for regulatory and economic constraints. We also find that the transmission of unconventional measures is attenuated by their negative effect on future bank's capital position via the net interest income (*reverse bank capital channel*). Finally, we find that large sovereign exposures mute the response of lending rates to conventional policy, but amplify the transmission of unconventional measures.

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1. Introduction

The interest in the role of the supply of credit in the transmission of monetary policy, dating back to the seminal contributions of Bernanke and Blinder (1988) and Kashyap and Stein (1995), has recently resurged, reflecting the prominent role of credit developments in the financial crisis. At the same time, since Lehman's collapse in September 2008, the conduct of monetary policy has significantly changed, with all major central banks undertaking a wide array of unprecedented actions, often referred under the general label of "unconventional monetary policy measures". Surprisingly, no much effort has been devoted in analyzing the bank lending channel of such measures, which is what we do in this paper, looking at the euro area experience and exploiting a confidential bank-level monthly database with information on the interest rates applied on new loans by a representative sample of credit institutions.[2]

More specifically, we ask the following questions: To what extent have unconventional measures transmitted to the cost of loans to non-financial corporations? Was a bank-lending channel (BLC) operational during the crisis? If yes, what are the main bank-specific factors affecting the BLC? Is the BLC different from conventional and unconventional monetary policy?

The importance of analyzing the bank-lending channel for unconventional monetary policy measures, as opposed to conventional ones, is related to different motivations. Unconventional operations are typically undertaken in conditions of severe market stress and when the transmission channels of conventional policy are considered impaired; stimulating bank lending supply is, in many cases, one explicit objective of these measures. In this context, it is well possible that the empirical predictions of the bank lending channel are overturned. Namely, the standard prediction in the BLC literature is that transmission is *stronger* for less-capitalized banks, which are more exposed to asymmetric information problems (Kishan and Opiela, 2000; Jayaratne and Morgan, 2000). However, in times of financial stress, weakly-capitalized banks may be *less* able to expand credit supply in response to expansionary measures due, for example, to an intensified pressure from the markets or from regulators.[3] In addition, conventional and unconventional measures may have opposite implications on banks' future capital position and thus monetary policy transmission (van den Heuvel, 2002): while a reduction in the short-term interest rate is typically associated with a *steepening* of the yield curve and an increase in the banks' net interest income (*bank capital channel*), some unconventional measures entail a *flattening* of the yield-curve, which erodes future profitability (which can be labeled *reverse bank capital channel*).[4] Finally, the predictions related to the holdings of sovereign bonds are uncertain: while in "normal times", large sovereign portfolios are typically associated with a highly liquid balance-sheet and thus with a weak transmission via the BLC (Kashyap and Stein, 2000), during the euro-area sovereign debt crisis, a high exposure may have hampered conventional monetary policy transmission. On the other hand, as a consequence of those monetary policy measure implying increases in the market value of bonds, banks with a higher sovereign exposure realized large capital gains, possibly helping them to accommodate the monetary policy stimulus.

In this paper we rely on a relatively unexplored dataset with monthly bank-level information on interest rates applied to new loans for a representative sample of (up to 200) euro-area intermediaries. The panel data start in July 2007, the first date for which the dataset became available. Our analysis focuses on new loans to firms. The euro area is a particularly well-suited example to study the bank lending channel of unconventional monetary policy. First, the ECB undertook a very wide range of non-standard measures, many of which explicitly targeted credit supply. In particular, the ECB eased the terms of liquidity tender

[2] The transmission channels of unconventional monetary policy measures during a financial crisis have been extensively described in a number of papers (see, *inter alia*, Borio and Disyatat, 2010; Cecioni *et al*., 2011; Pattipeilohy *et al*., 2013; Cova and Ferrero, 2015). Several studies explored their effectiveness on main macroeconomic variables for a number of countries and documented a beneficial aggregate effect on both output and inflation (see Chung *et al*., 2012; Lenza *et al*., 2010; Joyce *et al*., 2011; Gambacorta *et al*., 2014). Despite this large amount of literature, the transmission via the banking system has remained still relatively unexplored.

[3] Similarly, in normal times banks more reliant on market financing have usually been found to be better insulated from changes in monetary policy (Romer and Romer, 1990). During the crisis, however, access to wholesale markets experienced significant fluctuations while retail funding provided a stable source of financing for banks (Gambacorta and Marques-Ibanez, 2011). Thus, a high dependence on wholesale funding may have been associated with stronger constraints to expand lending supply.

[4] The possible detrimental implications of unconventional monetary policy measures via bank profitability have been discussed by Brunnermeier and Koby (2016).

operations, extended the range of eligible collateral, provided liquidity at medium-term horizons (e.g. 6-months, 12-months, 1- and 3-years refinancing operations), intervened in selected financial markets to restore ordinary market conditions (SMP, OMT, CBPP). More recently targeted long-LTROs and a large-scale asset purchase program were implemented to provide additional economic stimulus at the zero-lower bound and contrast downward pressures to inflation. Second, the role of banks in the financing of the private sector is predominant in the euro area.

Two modeling aspects are crucial in our study: (i) the identification of loan demand and supply; (ii) the choice of the appropriate indicators of the monetary policy stance. As regards identification, in our baseline regressions we control for credit demand and borrowers' riskiness by saturating the model with country*year:month fixed-effects, and then compare the reaction to monetary policy changes of banks that differ only in terms of specific balance sheet characteristics. In the context of the euro area crisis, a cross-country dataset allows us to control for the fragmentation along national borders and isolate the effects related to individual banks' characteristics form those specific to the country of residence. Crucially, effectively controlling for country-level macroeconomic conditions is also useful to tackle issues related to the possible endogeneity of monetary policy to lending rates.[5]

As for the monetary policy indicators, we use the rate on the Eurosystem's Main Refinancing Operations (MRO) as our measure of conventional monetary policy. For unconventional policy, we use the spread between the "shadow rate" measure developed by Krippner (2013a, 2013b) and the MRO rate. The shadow rate provides a measure of the monetary stance at the ZLB by parsimoniously summarizing the information about the monetary stance that is embedded in the term structure of interest rates (Pericoli and Taboga, 2015). Movements of the shadow rate tend to be broadly correlated with the events related to the adoption of non-standard monetary policy measures (Krippner, 2013a) and potentially capture the effects related to both the announcement and the implementation of non-standard measures.[6]

In our baseline regressions we interact our measures of conventional and unconventional policy with bank balance sheet indicators such as capitalization, funding structure, asset quality, size of the sovereign portfolio. Our discussion is organized around three main theories, which can be tested based on the estimated signs of the interactions. First, the impact of changes in monetary policy on lending supply is proportional to the degree of information asymmetry between banks and their investors (Kashyap and Stein, 1995; Stein, 1998). This mechanism predicts that monetary policy transmission is *stronger* for banks with weaker balance sheets, which in the context of our regressions are proxied with a smaller amount of regulatory capital, less liquid assets, smaller degree of retail deposit funding, higher NPL ratio. Second, the transmission of monetary policy via lending supply may be hampered by the presence of capital or funding constraints, which could reflect either regulatory requirements or market pressure (Bernanke and Lown, 1991; Van den Heuvel, 2002). This mechanism, contrary to the asymmetric information case, predicts that monetary policy transmission is *stronger* for *more capitalized* banks and, possibly for banks with stronger funding structure. Third, the bank capital channel (BCC) amplifies the transmission of conventional policy, which has a positive impact on net interest margin (NIM), while it attenuates that of unconventional policy, which flattens the yield curve. As the magnitude of these effects should be stronger – other things being equal – for banks heavily relying on traditional intermediation activity, the transmission of conventional (unconventional) policy should be *stronger* for banks for which NIM makes up a *higher* (lower) share of revenues. In addition, the BCC should reinforce the impact of capital constraints on the transmission of

[5] In the comparison with studies based on loan-level datasets with national credit register (e.g. Jimenez *et al*., 2012; Gambacorta and Mistrulli, 2014) our approach is less powerful in identifying shifts in loan supply. For example, we cannot control for shifts in demand across banks within a given country in a given month. On the positive side, using a cross-country dataset does not pose issues regarding the external validity of the results. Moreover, the use of firm-time fixed effects, which is how credit demand is controlled for in studies based on loan-level datasets, inevitably select the analysis only to firms borrowing from multiple lenders.

[6] Several studies identify the *announcement* effects of unconventional measures applying event-study methodologies to high-frequency financial market data. For a survey of the estimated effects of recent large-scale asset purchases on 10-year yields, see Williams (2011). Cecioni *et al*. (2011) provide a survey of the evidence on the effectiveness of the various unconventional monetary policy measures adopted by the Federal Reserve and the Eurosystem. Other studies, instead, use the central bank balance sheet to identify unconventional monetary policy shocks in a VAR framework (see Gambacorta *et al*., 2014; Boeckx et al., 2014; Bulligan and Emiliozzi, 2016). This approach, by construction, only captures the effects of the *implementation* of unconventional monetary policy.

monetary policy, because the easing of future capital constraints is likely to be more effective for currently constrained banks.

Our main findings are the following. First, although it is not the focus of the paper, we evaluate the overall transmission of conventional and unconventional measures to the cost of loans by estimating a standard pass-through regression and find that both types of measures contributed significantly to the observed reduction of interest rates on new loans to firms low. A simple counterfactual analysis suggests that at the end of December 2015 the (negative) contribution of unconventional operations was around 40 basis points.

In relation to our main questions, for conventional operations, we find that the transmission is weaker for highly capitalized banks and for banks with a more solid funding structure (higher retail funding ratio). These results are in line with the standard predictions of the BLC literature, in which the role of asymmetric information is crucial in explaining the sensitivity of bank lending supply to changes in monetary policy. For unconventional monetary policy, we find instead that the monetary policy accommodation is transmitted more by banks with stronger capital and funding positions, pointing towards a relevant role for regulatory and economic constraints. When we also include the interactions between the monetary policy measures and the ratio of net interest income to total assets (NII), we also find a relevant role for the (reverse) bank capital channel in the transmission of unconventional measures. At the same time, the positive coefficient for the interaction between capital and the monetary policy indicators remain significant. Finally, large sovereign holdings are associated to a weaker transmission of MRO changes, but a stronger transmission of unconventional measures. This suggests that while the transmission mechanism of conventional policy was impaired by the tensions in the sovereign debt market,[7] unconventional operations benefited more-exposed banks via their effect on profitability – by addressing mispricing in the sovereign debt markets and more in general affecting valuations of long-term assets (Cova and Ferrero, 2015).

We perform a number of robustness checks. First, we replace the MRO with the Euro Overnight Index Average (Eonia) and also estimate a regression including the Eonia-MRO spread as an additional variable. Including the spread between the Eonia and the MRO may be important in order to capture the effects of the unconventional measures aimed at providing access to ample liquidity but not directly affecting the yield curve (for example, the introduction of fixed rate full allotment or longer-term refinancing operations). Indeed, this indicator is correlated with measures of excess liquidity in the euro area captures in the period 2011-13, during which excess liquidity surged in connection with the 3-year LTROs. Second, we include the interactions between bank-specific variables and two additional macroeconomic controls (unemployment and an indicator of financial market stress), in order to better control for the sources of variation in monetary policy that were correlated to developments in the euro area financial market and national business cycles (Jimenez *et al*., 2012). Third, we substitute the Shadow rate – MRO spread as a measure of unconventional monetary policy with a measure of the slope of the yield curve, calculated as the difference between the 10-year IRS and the MRO rate (see Baumeister and Benati, 2013). This experiment rules out possible concerns related to the possibility that the point estimates of the shadow-rate are model-dependent (Pericoli and Taboga, 2015). Finally, we include two other indicators that may capture additional effects of unconventional policy that could have not be captured by the Shadow rate: a measure of excess liquidity as calculated from the Eurosystem's balance sheet, which has been used in a number of studies based on macro data (Gambacorta *et al*., 2014; Boeckx *et al*., 2014; Bulligan and Emiliozzi, 2016); and a dummy variable to capture the effect of the OMT announcement (see Altavilla *et al*., 2014). Our results are robust to all of these checks.

The rest of the paper is organized as follows. Section 2 discusses a number of related papers. Section 3 describes the data and provides descriptive statistics. Section 4 presents the methodological framework and the empirical strategy. Section 5 shows the main estimation results. Section 6 offers a battery of robustness checks. Section 7 concludes.

[7] It is important to note that the result for conventional policy may also reflect the fact sovereign holdings are a crucial component of the liquidity ratio. Therefore, at least for the first part of our sample until the beginning of the sovereign debt crisis and, for more creditworthy sovereign borrowers possibly even *during* the crisis, this result may capture the standard argument that the BLC is stronger for less liquid banks (Kashyap and Stein, 1995).

2. Related literature

In this section, we discuss in some details some recent contributions that use the same dataset to assess the heterogeneity in the transmission of monetary policy in the euro area. Holton and Rodriguez d'Acrì (2015) estimate an error-correction model for the pass-through of the Eonia rate, separately considering different types of loans (e.g. large vs small loans). Their regressions include interaction terms between the policy rate and bank characteristics so as to capture the transmission via the bank lending channel. Differently to that paper, our methodology, which includes country-time fixed effects, is more effective in controlling for country-specific unobservable factors that may affect loan demand and borrowers' riskiness. One additional important difference is that their paper only considers the role of conventional policy, while we extend the analysis to unconventional measures. Their results are broadly in line to what we find for conventional policy; in particular, similarly to what we find, higher regulatory capital is associated with a weaker transmission via the BLC. In addition, they find that pass-through was weaker for banks relying much on ECB refinancing, with high sovereign exposure and with high risk (as measured by CDS spreads).

Altavilla *et al*. (2016a) analyze the pass-through of both conventional and unconventional monetary policy. For conventional policy, they adopt a two-step approach: first they estimate a bank-by-bank VAR for bank lending rates (which also includes borrowing rates, country-level macroeconomic variables and the Eonia) and compute a bank-specific pass-through based on the responses to a monetary policy shock. Then, they sort the distribution of the estimated pass-through by bank characteristics. For unconventional monetary policy, they retrieve a series of shocks based on an event-study methodology and estimate the contribution of these shocks to the dynamics of lending rates between May 2014 and December 2015. While for sovereign exposure their results are in line with both our results and Holton and Rodriguez d'Acrì's (2015), they find a *positive* relation between the level of regulatory capital and conventional monetary policy pass-through and a *negative* relation for unconventional policy. A crucial difference with our paper is that their methodology is not able to isolate a credit-supply channel; taking into account the feedback between banking variables and macroeconomic variables, that methodology rather captures the pass-through through all the possible channels including, in particular, the effects of monetary policy on loan demand. Moreover, while the use of an event-study-based measure of unconventional monetary policy has the advantage of effectively isolating unexpected changes in the monetary policy stance, it risks capturing just transitory effects of the measures on lending rates.

Boeckx et al. (2016) focus on the transmission of ECB's credit easing policies, i.e., the subset of measures aimed at providing ample liquidity to banks and boosting loan supply (thus excluding communication policies and asset purchase programs). They apply Jordà's (2005) local projection 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. (2014). They find that these policies had a greater impact on small banks, banks with less liquid balance sheets and banks more dependent on wholesale funding. The role of capital is ambiguous and interacts with the other bank characteristics. Overall, the response of more capitalized banks to the credit easing policies was more pronounced, largely reflecting the impact of higher capital on the effects related to size, funding stricture and balance-sheet liquidity.

The dataset used here is also employed in two other papers that address different issues. Holton and McCann (2016) examine the drives of the premium paid by SMEs with respect to large firms. They consider interaction terms between macroeconomic variables and bank-specific characteristics in pass-through equations for the spread between the cost of new loans to firms up to 1 million and that of new loans over 1 million. They find that the bank lending channel is more effective during economic downturns and that capital adequacy helps lower the premium in downturns. Altavilla *et al*. (2016b) investigate the causes and effects of banks' sovereign exposure during the crisis. The find that weaker banks reacted to sovereign stress by increasing their domestic sovereign holdings more than other banks as a result of moral suasion and yield-seeking. Moreover, the extent of bank sovereign exposure significantly amplified the transmission of sovereign risk to lending conditions.

3. Data and descriptive evidence

Our dataset combines different sources of data.

Individual bank interest rates (our dependent variable) and some bank characteristics are taken from the ECB I-BSI/I-MIR datasets. This data cover the period 2007-2015 and include monthly information for an increasing number of MFIs in the euro area, from around 160 in 2007 to around 200 in 2015. As this information is based on the statistical definitions for monetary policy purposes, banks are classified according to a residency principle and data are un-consolidated. The individual loan rate is the weighted average rate applied by each bank to the new loans (i.e. the loans issued in a given month, excluding overdrafts) to non-financial corporations. Based on balance-sheet items we construct the following MFI-level indicators: the deposit ratio, defined as the ratio between firm and household M3 deposits over total main liabilities, which we use as a measure of the importance of retail funding; sovereign exposure, defined as the ratio of domestic sovereign bonds to total main assets.

Individual bank data are matched with consolidated balance-sheet information from the public provider Bankscope. We match each individual MFI to its corresponding parent group, whose residency is based on the ultimate parent country. Balance-sheet information is typically collected on a yearly basis. We transform balance-sheet information into monthly data assigning previous-year data up until June of each year, and current-year data from July through December. From Bankscope we collect the following group-level indicators: the Tier 1 ratio, which is a measure of regulatory capital; the liquidity ratio, defined as the ratio of cash and short-term securities to total assets; the NPL ratio, defined as the share of non-performing loans over total loans, which is a measures of banks' asset quality; and the net interest income, which is expressed as a ratio to total assets, which proxies for the importance of traditional intermediation activity in banks' business. Table 1 provides summary statistics for a number of bank-specific variables.

Figure 1 plots developments in the rate on new loans to firms for the aggregate sample as well as by bank home country (stressed *vs* non-stressed countries).[8] Dispersion increases significantly since the intensification of the sovereign debt crisis, in the summer of 2011 and, in particular, interest rates diverge significantly based on the country of bank residency. Figure 2 plots developments in the median loan rate by quartiles of bank-specific characteristics. In particular, it compares the median rate for banks below the 33th percentile of given characteristic and banks above the 66th percentile. After the start of the sovereign debt crisis dispersion increases also by characteristics of banks, in particular when banks are split based on the level of NPLs and sovereign exposure.

As monetary indicators we use two variables. For conventional monetary policy we use the official MRO rate. The MRO is, in our view, a better measure of the stance of conventional monetary policy than the overnight market interest rate (e.g. the Eonia), because the latter is also influenced by developments in excess liquidity, which are likely to also capture the effect of unconventional operations.[9] For unconventional monetary policy in the baseline regressions we use the difference between the shadow rate as developed by Krippner (2013a, 2013b) and the MRO rate. The so-called "shadow rate models" belong to a recently-developed class of term structure models which have been proposed to study market interest rates near the zero-lower bound (ZLB). Once the ZLB is reached, the central bank can alter the monetary stance by influencing long-term interest rates through forward guidance as well as through direct or indirect market interventions. The shadow rate provides a measure of the monetary stance at the ZLB by parsimoniously summarizing the information about the monetary stance that is embedded in the term structure of interest rates (Pericoli and Taboga, 2015). Therefore movements of the shadow rate tend to be broadly correlated with the events related to the adoption of non-standard monetary policy measures (Krippner, 2013a). Using the difference between the shadow rate and the MRO in our regressions, together with the MRO, allows us to disentangle the effect on lending rates of the two types of measures. In our robustness checks we will use alternative monetary policy indicators (see Section 6).[10]

[8] Here our definition of stressed countries includes Spain, Italy, Ireland, Portugal and Slovenia, whereas non-stressed countries are all other countries in the euro area.

[9] Nonetheless, as specified below, we will perform robustness checks including the Eonia and the spread between the Eonia and the MRO.

[10] In particular, as already mentioned, we will replace the MRO rate with the Eonia and estimate the baseline regression adding the difference between the Eonia and the MRO rate; we will replace the shadow rate-MRO spread with slope of

Figure 3 shows the developments of the two monetary policy measures, the MRO and the difference between the shadow rate and the MRO, and includes bars highlighting events relevant for non-standard monetary policy. We observe that before the crisis the shadow rate and the official short-term rate roughly coincided; the spread between the two subsequently widened, as the MRO approached the ZLB and the ECB undertook a growing number of unconventional operations. Figure 4, panels a and b, compare the shadow-MRO spread to two alternative measures of unconventional operations that will be used in the robustness checks: the slope of the yield curve and (the inverse of) a measure of excess liquidity derived from the ECB balance sheet. The charts confirm that the shadow rate tracks quite closely the movements in the term structure; it is also correlated with excess liquidity, though the correlation is milder reflecting the fact that excess liquidity does not capture announcement effects and is affected only once the measures are implemented; moreover, excess liquidity does not capture the effect of policies that do not affect the amount of liquidity, like forward guidance or the OMT.[11]

Finally, we collect two country-level and one euro-area level macro variables that we use as controls in some of the regressions: the domestic 10-year sovereign spread (measured as the difference between the 10-year domestic Government bond yield and the 10-year IRS rate); the domestic unemployment ratio; the Composite Indicator of Systemic Stress (CISS) proposed by Holló et al. (2012), which captures financial stress and systemic risk in various financial markets (money markets, bond markets, equity markets, foreign exchange markets and CDS market).[12]

The final sample is obtained by dropping banks from Greece and Cyprus. Moreover, consolidated information from Bankscope is only available for a subset of banking groups. Finally, we drop five observations that are clearly outliers in terms of CET1 ratio (with values above 34%). Therefore, our final sample (in the baseline regression) comprises 127 banks from 14 euro area countries for 101 months (for a total number of 8,600 observations).

4. Empirical strategy and expected signs

The baseline regression for the bank-lending channel (BLC) is the following dynamic pass-through equation:

$$r_{it}^{C} = \omega_i + \alpha\, r_{it-1}^{C} + \beta\, X_{it-1} + \rho\, MP_{t-1} \cdot X_{it-1} + \theta_t^{C} + \varepsilon_{ijt} \qquad (1)$$

where r_{it}^{C} is a the weighted-average rate on new loans to firms charged by bank *i* in country C in month *t*; ω_i is a set of bank fixed-effects; X_{it-1} is a vector of five (lagged) bank-specific variables: the Tier1 ratio, the liquidity ratio, the deposit ratio, sovereign exposure, the NPL ratio; $MP_{t-1} \cdot X_{it-1}$ is a vector of interactions between the two monetary policy measures and the bank specific indicators; θ_t^{C} identifies a set of country-specific time dummies (country*year:month fixed effects). The specification also includes the lagged value of the dependent variable. The sample period of the estimation runs from July 2007 to December 2015. We calculate standard errors with a double clustering, at year*bank and year:month level, to reflect the fact that balance indicators may vary at a yearly frequency while macroeconomic indicators, such as monetary policy measures, vary month by month.[13] Although we use a dynamic panel model, we do not need to rely on IV estimators *à la* Arellano-Bover (1995), which would be instead necessary if we had a short time series. We nonetheless checked the robustness of the estimated coefficients using this alternative methodology and found that all results remain virtually unchanged (not shown).

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the euro area yield curve, measured as the difference between the 10-year IRS and the MRO; we will include a dummy variable for the period July-September 2012, to control for the effects of the OMT.

[11] In Figure 4, panel c, we also show the developments in the Eonia-MRO spread, which will be used in one of the robustness exercises (Section 6.4). Indeed, one may argue that the Eonia-MRO spread may – to some extent – capture the effects of the unconventional measures aimed at providing access to ample liquidity but not directly affecting the yield curve (for example, the introduction of fixed rate full allotment or longer-term refinancing operations).

[12] The CISS indicator is very highly correlated with sovereign spread of the more stressed countries during the sovereign debt crisis while it also captures tensions in the interbank markets during the global crisis period.

[13] Without imposing clustered standard errors, the coefficients that resulted to be not statistically significant would remain so. For the other coefficients the statistical significance would be reinforced.

The inclusion of country*year:month fixed effects allows us to control for all observable and unobservable country-level factors affecting banks' interest rate setting in a given month. In particular, this set of fixed effects allows us to control for demand conditions and borrowers' riskiness in the country where the bank operates (and thus we define the nationality of banks at the level of the individual institution rather than at the parent company). Including time*country fixed effects also significantly attenuates concerns of possible reverse causality between loan supply and monetary policy, because the channel through which lending rates potentially affect monetary policy decisions is via their effect on macroeconomic conditions.

Of course, this specification has some limitations. In particular, unlike papers using Credit Register data we cannot control for changes in the pool of borrowers faced by each single bank, which would be feasible only relying on bank-firm information. Up to now, however, the use of this granular information has been limited to studies based on individual countries. In contrast, our identification strategy allows us to analyze the euro-area as a whole.

Once we control for demand and riskiness, the estimated coefficients on the interactions between monetary policy measures and a bank characteristics (i.e., the coefficients in the vector ρ) capture the effect of monetary policy via changes in the *supply* of credit. Table 2 reports the expected signs of the interactions, where a positive – negative – sign indicates a stronger – weaker – pass through. The discussion revolves around three main mechanisms that have been typically identified in the BLC literature.

First, the impact of changes in monetary policy on lending supply is proportional to the degree of information asymmetry between banks and their investors), which is typically higher for weaker banks (Kashyap and Stein, 1995; Stein, 1998). This implies that we expect a *negative* sign for the interactions between each monetary policy indicator and Tier1 ratio, liquidity ratio, deposit ratio and a *positive* sign for the NPL ratio.[14] The sign of sovereign exposure is in principle ambiguous: in the period before the start of the sovereign debt crisis (i.e., until 2010), large holdings of sovereign bonds are likely to have been associated with a highly liquid balance-sheet (implying a *negative* sign for the interaction); during sovereign debt crisis, however, a high share of sovereign bonds was considered a sign of fragility and is likely to have hampered bank's ability to transmit monetary policy impulses (i.e. we expect a *positive* sign); finally, after ECB President Draghi's "Whatever it takes" speech of July 2012 banks with a high sovereign exposure realized higher capital gains on their sovereign portfolios, which possibly entailed a stronger response of lending supply to monetary easing (i.e., *positive* sign).

Second, the transmission of monetary policy via lending supply may be hampered by the presence of regulatory and economic constraints, such as capital requirements and/or funding pressure (Bernanke and Lown, 1991; Van den Heuvel, 2002). This mechanism, contrary to the asymmetric information case, predicts a *positive* sign for the interactions between monetary policy measures, on the one hand, and Tier1 ratio and the deposit ratio, on the other.

Third, one has to consider the dynamic impact of monetary policy on banks' capital position via its impact on the net interest income (the *bank capital channel*, BCC; van den Heuvel, 2002). Easing via conventional policy (i.e., a reduction in the overnight interest rate) is typically associated with an increase in the slope of the yield curve and an increase in the net interest income, which amplifies the transmission of the monetary measures. Since capital requirements affect bank behavior more when bank equity is low, the amplification is stronger for banks that start out with already low capital than for well-capitalized banks. Thus, this mechanism predicts a *negative* sign for the interaction between Tier1 capital and conventional monetary policy. For unconventional monetary measures we have an opposite prediction (i.e., a *positive* sign) because the impact of an easing on the net interest income is likely to be negative, as unconventional measures – especially when undertaken at the zero-lower bound – entail a *flattening* of the yield-curve.

These considerations suggest that it is difficult to disentangle the relevance of each channel, especially as regards the role of capital. However, two considerations can help us in testing this hypothesis. First, other things equal, the effects through this mechanism are likely to be stronger for those banks heavily relying on traditional intermediation activity. One measure of the importance of traditional intermediation activity is the ratio of net interest income to total assets (NII), which measures the contribution of net interest income to the

[14] A negative relation between the deposit ratio and the transmission of monetary policy may also reflect the higher sluggishness of deposit rates as compared to the cost of wholesale funding (e.g., Kok Sorensen and Werner, 2006), which implies an attenuated transmission of changes to the short-term policy rate to banks' average cost of funding.

formation of ROA.[15] This mechanism thus predicts that the interaction between NII and conventional and unconventional measures have, respectively, a *positive* and *negative* sign and, (ii) that the triple interaction between monetary policy measures*bank capital*NII have the same sign of the double interaction between monetary measures*bank capital (which is *ex ante* ambiguous, as discussed above). Moreover, once controlling for the bank capital channel, one may expect that the results regarding the "double" interactions of monetary policy measures with Tier1 ratio become sharper.

5. Results

5.1. Preliminary: simple pass-through equation

Before estimating our main BLC regressions, in order to have an assessment of the overall transmission of conventional and unconventional monetary policy, we run a standard panel regression of bank interest rate pass-through:

$$r_{it}^{C} = \omega_i + \alpha\, r_{it-1}^{C} + \delta\, MP_{it-1} + \varphi Z_{jt-1} + \beta\, X_{it-1} + \varepsilon_{ijt} \qquad (2)$$

Compared to regression (1) here we do not saturate the model with country*year:month fixed effects and we do not include the interaction terms. Instead, we include the (lagged) level of our two monetary policy indicators (the vector MP_{it-1}). In order to control for borrowers' riskiness at the country level we include also the domestic 10-year sovereign spread and the domestic unemployment ratio (in the vector (Z_{jt-1}).[16] Like (1), this regression also includes bank fixed-effects (ω_i) and bank-specific time-varying characteristics (X_{it-1}). Standard errors are clustered at the year*bank level.

Results are reported in Table 3. In column (a) we include only the MRO as a monetary policy indicator; in column (b) we add the shadow-MRO spread. Both the MRO rate and the unconventional monetary policy measure have a positive and significant effect on lending rates. According to the estimated coefficients, the effect of a 100bps decline in the MRO rate corresponds to a reduction in the average rate of new loans to firms of 40bps on impact and 90 in the long-run.[17] The estimated effect for the Shadow-MRO spread is equal to around 4 and 7 bps, on impact and in the long-run, respectively.

As regards the macroeconomic controls, we find that an increase in the unemployment rate is associated to a higher cost of credit, which may capture the effect of the business cycle on both loan demand and borrowers' riskiness. Also the domestic sovereign spread is positively associated to the cost of credit, which captures the (multi-faceted) sovereign-bank nexus (BIS, 2011; Angelini et al., 2014).[18] Finally, turning to bank-specific characteristics, the only significant variable is the NPL ratio, which is positively associated with lending rates. This may reflect both more accommodative lending policies by banks with sounder balance sheets and higher average riskiness of that bank's loan portfolio.

A point often debated is whether the transmission of monetary policy has been heterogeneous across countries during the sovereign debt crisis. In this regard, the available evidence suggests little difference

[15] One may argue that changes in this variable mostly reflect business cycle conditions, meaning that there might be low heterogeneity in the cross-section. In order to include a structural indicator of banks' business model, we also replicate our regression using the long-run average of the loan-to-asset ratio. Results are robust and available upon request.

[16] We checked the robustness of the results by including county*quarter fixed effects: the estimated coefficients for monetary policy measures are virtually unaffected. In these exercises, we implicitly assume that borrowers' riskiness is not influenced by monetary policy which is a strong assumption. While this implies that we probably underestimate the overall pass-through, it should be pointed out that this is not a of particular concern for us, as the core of our analysis is represented by the regressions where we focus on the bank-lending channel only.

[17] Belke et al. (2013) analyzed the pass-through from money market rates to various lending rates for up to 12 European countries between 2003 and 2011 and found that, in the majority of cases, the pass-through is incomplete, and the dynamics of loan adjustment are different for reductions and hikes in money market rates. A key finding is that the pass-through is more homogenous and more nearly complete for loans to non-financial corporations than to households.

[18] In particular, we find that a 100bps increase in the spread is associated with an average pass-through of about 10bps after one month and 20bps in the long-run. As for the latter, the magnitude of the effect is similar to the results found in previous studies based on aggregate data for the cost of new loans to enterprises (Albertazzi et al., 2014; Zoli, 2013; Neri, 2013) as well as bank-level information for the case of Italy (Del Giovane *et al*, 2013).

between lending rates charged by banks from stressed and non-stressed countries, provided that one controls for business cycle conditions and developments in financial markets (Hristov et al., 2014; von Borstel et al., 2015; Altavilla et al., 2016a). In order to investigate this issue, in column € we include interaction terms between the monetary policy variables and a "stressed countries" dummy (as well as interactions with other macroeconomic variables as relevant controls).[19] The estimated coefficients suggest a weaker effect of changes in the MRO rate for stressed countries, thus pointing to some role of fragmentation in impairing the transmission of conventional monetary policy. No significant difference is instead recorded for the transmission of unconventional monetary policy, meaning that the beneficial effects of the various measure have been widespread among euro-area countries. We do find that business cycle conditions (as captured by the unemployment rate) and developments in the sovereign spread did have an effect on loan rates charged by banks in stressed countries but the effect was negligible in the core countries.

Based on column(c), we can calculate the contribution of monetary policy– as well as macroeconomic conditions – to the rate on new loans to firms at each point in time. The results of this exercise are reported in Figure 4, for stressed and non-stressed countries. For monetary policy, the graph shows that the contribution of conventional measures (i.e., the MRO rate) to loan rates became practically insignificant in the peripheral countries since the second half of 2009; in core countries, the contribution remained relevant until the summer of 2012. The negative contribution of the Shadow rate-MRO spread increased after the summer of 2011 and became prominent in the second half of 2014, when the TLTROs and then the APP were announced.[20] We estimate that at the end of our sample interest rate on loans would have been around 40 bps higher on average, had not unconventional monetary measures been implemented. [21]

5.2. Main results: the bank lending channel and the bank capital channel

Table 4 presents the main results. Column (a) reports the estimates of the baseline regression (1). For conventional policy, we find negative and significant coefficients for the Tier1 capital ratio and for the deposit ratio. These results are in line with the "asymmetric information" hypotheses, suggesting that the transmission of conventional policy is stronger for weaker banks. For unconventional policy, instead, we find a positive coefficients for the interaction with bank capital; for the interaction with the deposit ratio we also find a positive sign which is not, however, significant at conventional levels. These results suggest that during the period in which the ECB deployed its unconventional operations, economic and regulatory constraints prevailed, and monetary policy transmission was stronger for better-capitalized banks.

As mentioned, however, the opposite signs of the interactions between Tier1 ratio, on the one hand, and conventional and unconventional measures, on the other, may in principle be also consistent with the existence of a (reverse) bank-capital channel, and reflect the opposite impact of the two sets of measures on banks' net interest income. In order to control for this channel, in column (b) we include the interactions between the ratio of net interest income to total asset (NII) and our two monetary policy measures (we also include the non-interacted NII). We find that the estimated coefficients for the interactions between monetary policy variables and the Tier1 ratio remain virtually unchanged. For the interactions with the NII, we find a negative and significant sign for the shadow rate-MRO spread. In column (c) we further include the triple interactions monetary policy measures*Tier1 ratio*net interest income (and also the remaining double interaction between the Tier1 and the NII). Also in this case we find a significant coefficient for unconventional policy: the negative sign suggests – as expected – that the dampening effect of low bank capital on the monetary policy pass-through is relevant in particular for banks with a business model relying on the traditional intermediation activity. At the same time, the magnitude of the estimated coefficients for the (double) interactions of the Tier1 ratio with both conventional and unconventional policy indicators

[19] The dummy takes value 1 for banks from Italy, Spain, Portugal, Ireland and Slovenia and for months from April 2010 onwards. We also ran separate regressions for banks belonging to "stressed countries" and "core countries"; results are qualitatively similar, although the small size of the two subsamples affects their statistical significance.

[20] On November 5, 2014 ECB's President Draghi announced that ECB Staff had started preparatory work for the APP, which was engineered market expectations of an imminent announcement of the actual programme (that indeed happened in January 2015).

[21] The two subplots in Figure 4 differ also in the contribution of unemployment and the sovereign spread, which is negligible in the core countries and significantly positive in the stressed countries. In particular, we find that the reduction in the domestic sovereign spread between the summer of 2012 (i.e., after Draghi's "Whatever it takes" speech) and the end of 2015 contributed by around 100bps to the reduction of loan rates in stressed countries.

doubles. Given the estimated coefficients, the intensity of the transmission of unconventional measures is positively related to bank capital for any possible value of the NII, suggesting that (static) pressure on bank capital position overall prevailed over the negative effect via profitability.

We now discuss the role of sovereign exposure. In all specifications, we find that the interaction between this variable and the MRO rate has a very strong negative sign, implying that transmission for banks holding higher shares of sovereign bonds has been weaker. This result is in line with the idea that the transmission of standard measures was hampered by the tensions in the sovereign debt market.[22] Also the coefficient for the interaction with the unconventional policy indicator is strongly significant but positive: this suggests that non-standard measures, by addressing mispricing in the sovereign debt markets and – more in general – positively affecting valuations of long-term assets, were more beneficial for banks with a large sovereign exposure via their effects on profitability (see Cova and Ferrero, 2015). In turn, larger profits translated into a better capital position and allowed these banks to ease lending conditions by more.[23]

Our results are economically significant. In order to assess their quantitative relevance, like in Kashyap and Stein (2000) and Jimenez et al. (2014) we can calculate (based on the regression in column b) the difference in the long-run pass-through between a bank in the 10th percentile of a given bank characteristic and a bank in the 90th percentile.[24] Following a 100 bps reduction in the MRO rate, loan rates charged by banks with low capital, low retail funding and low sovereign exposure fall by 17, 15 and 11 basis points more, respectively, than for banks with high levels of each characteristics. For unconventional policy, the corresponding values for Tier 1 and sovereign exposure are, respectively, 17 and 14 basis points.

The regressions also include non-interacted bank characteristics. The coefficients for the NPL and the Tier1 ratio are consistent with the notion that – other things equal – stronger banks have higher credit supply (and charge lower loan rates). The positive coefficient for the deposit ratio is somewhat counter-intuitive, given that retail funding is typically considered a cheap source of funding; however, it may capture the fact that during the period of stress included in our sample competition for retail deposits became harsher, as wholesale funding sources dried up for many banks. Indeed, when interpreting the coefficients on these variables one has to consider that, due to presence of bank fixed effects, they capture the within-bank time series variation and not the cross sectional one.

6. Additional analyses and robustness checks

In this section we describe a number of additional analyses and robustness checks.

6.1. Regressions for stressed and non-stressed countries

In Table 5, columns (b) and (c) we replicate our regression by splitting the sample between banks from stressed and non-stressed countries (column a in the Table reports the baseline regression, as a memo item). The objective is to investigate whether the average effects estimated in the baseline regression hide substantial heterogeneity between core and peripheral countries. The coefficients show that all the results for the unconventional policy measures hold for both core and peripheral countries. Interestingly, for banks in the core countries the estimated positive effect for sovereign exposure is almost double and the NPL ratio has a negative and significant coefficient, suggesting that this factor hampered the transmission of non-standard measures. As regards conventional policy, the signs are consistent across the two groups of countries though the coefficients are significant only for the core group, in line with the result of Table 2 suggesting that overall transmission of conventional policy was significantly weaker in these countries.

[22] Evidence about the role of banks' sovereign exposure in the transmission of macroeconomic shocks via the bank lending channel is not clear-cut. Bofondi et al. (2013), using data from the Italian Credit Register find that banks' holdings of Italian sovereign bonds were unrelated to the tightening in lending supply conditions in the most acute phase of the sovereign debt crisis. On the contrary, Bottero et al. (2015) show that the Greek bailout in the spring of 2010 led to a tightening in credit supply to firms. Popov and Van Horen (2015) show that, in 2011, European banks resident in countries not exposed to the crisis but with a higher exposure to the debt of Greece, Ireland, Portugal, Spain and Italy, decreased the volume of syndicated loans at the country–borrower level more than less exposed banks.

[23] A similar result is found by Ono et al. (2016), which is based on a firm-bank loan-level panel dataset for Japan spanning the period 2002–2014. In particular, they find that banks that enjoyed larger capital gains on their bond holdings following an unanticipated reduction in long-term interest rates significantly increased their loan supply.

[24] For the Tier 1 ratio, deposit ratio and sovereign exposure the 10th percentile thresholds correspond to, respectively, 7.2, 0.5 and 0.0 per cent; the 90th percentile threshold to 15.6, 67.6 and 11.2 per cent.

6.2 Including interactions with other macroeconomic variables

In Table 5, column (c), we test whether our results are robust to the inclusion of the interactions between bank-specific variables and two macroeconomic controls: the domestic unemployment rate and the (euro-area-level) Composite Indicator of Systemic Stress (CISS) proposed by Holló et al. (2012), which captures financial stress and systemic risk in various financial markets in the euro area (money markets, bond markets, equity markets, foreign exchange markets and CDS market).[25] These variables allow us to control– when we estimate the interactions with bank-balance-sheet variables – for the sources of variation in monetary policy that were correlated to developments in the euro area financial market and national business cycles (Jimenez et al., 2012). We find that the results for our main interactions of interest are virtually unchanged. Among the (unreported) coefficients for the interactions with the macroeconomic variables only the interaction between unemployment and the NPL ratio is significant, suggesting that worse macroeconomic conditions had a more restrictive effect on the supply of credit by banks with poorer asset quality.

6.3 Excluding foreign branches and subsidiaries

An important concern is that we are using individual bank-level information for the deposit ratio. In this regard, it may be important to control for subsidiaries and branches of foreign banks, whose funding structure and liquidity positions are typically influenced by decisions taken at the group level. We therefore perform the same regression excluding those institutions whose parent bank is from another country. The coefficients, reported in column (e), are basically the same as in the baseline regression. The only difference is that the interaction between the unconventional policy indicator and the deposit rate becomes significant, as the effect of funding structure is now more sharply identified. The positive and significant sign suggests that, for the transmission of non-standard measures, funding constraints are likely to have played a role alongside capital constraints, so that banks with a stronger retail base could more easily expand lending supply.

6.4 Using alternative monetary policy indicators

In Table 6 we report the results of robustness checks to using alternative indicators of conventional and unconventional monetary policy.

In column (b) we check robustness to using the Eonia as an indicator of conventional monetary policy.[26] The magnitude of the estimated coefficients (as well as the signs and statistical significance) are virtually identical to those obtained using the MRO rate. In column (c) we also test whether the inclusion of a separate Eonia-MRO spread has explanatory power in the regression. Indeed, one may argue that the Eonia-MRO spread may – to some extent – capture the effects of the unconventional measures aimed at providing access to ample liquidity but not directly affecting the yield curve (for example, the introduction of fixed rate full allotment or longer-term refinancing operations). Indeed, this indicator is correlated with measures of excess liquidity in the euro area since the second half of 2011, when the 3-year LTROs were launched (fig. 4, panel c). The results, however, suggest that this variable has no explanatory power on the supply of loans while, at the same time, the coefficients for the other variables are basically unchanged.

In column (d) we replace the Shadow rate-MRO spread with a measure of the slope of the yield curve, calculated as the difference between the 10-year IRS and the MRO rate. The results for the interaction between this variable and bank characteristics are very similar to the baseline regressions. For conventional policies, however, the coefficients are no longer significant due to larger estimated standard errors.

Finally, we include two other indicators that may capture additional effects of unconventional pol€. Column (e) includes a measure of excess liquidity as calculated from the Eurosystem's balance sheet, which has been used in a number of studies based on macro data (Gambacorta et al., 2014; Boeckx et al., 2014; Bulligan and Emiliozzi, 2016).[27] In addition, in column (e) we include a dummy variable taking value 1 for the period July-September 2012, in order to control for possible specific effects related to the OMT announcement. In both cases, the results are strongly confirmed, with the only exception of the interaction

[25] With respect to domestic sovereign spreads, the CISS indicator has additional information content for the global crisis period. Results are robust also to the inclusion of interactions with the domestic sovereign spreads.
[26] Column (a) reports, as usual, the baseline regression as a memo item.
[27] Excess liquidity is calculated as deposit facility + current account – reserve requirement – marginal lending.

between the MRO and the Tier1 ratio in column (d) which maintains a similar coefficient but is no longer significant at conventional levels.

7 Conclusions

In this paper we studied the transmission of conventional and unconventional monetary policy in the euro area via shifts in the supply of credit. Using a relatively unexplored dataset of bank-level interest rates for 200-some MFIs for the period 2007-15, we asked the following questions: To what extent have unconventional measures transmitted to the cost of loans to non-financial corporations ? Was a bank-lending channel (BLC) operational during the crisis? If yes, what are the main bank-specific factors affecting the BLC? Is the BLC different from conventional and unconventional monetary policy?

To measure the stance of unconventional monetary policy we use the deviation of the shadow rate proposed by Krippner (2013a) and the fixed rate on ECB's main refinancing operations (MRO rate), which is our measure of conventional monetary policy. In order to identify shifts in the supply of credit, we saturate the model with time*country fixed effects, which allow us to control for country-level loan demand conditions and borrowers' riskiness, and then compare the reaction to monetary policy changes of banks differing in terms of specific balance-sheets characteristics. One caveat is that this identification scheme is less powerful in identifying shifts in loan supply than studies based on loan-level datasets with national credit register (e.g. Jimenez et al., 2012; Gambacorta and Mistrulli, 2014), though it has broader external validity.

Our findings – which are robust to a number of robustness checks – document that the transmission via the banking system differed between conventional and unconventional policy: for standard measures the analysis confirms previous results in the BLC literature, which emphasize the role of asymmetric information (Stein, 1998; Kashyap and Stein, 2000; Jimenez et al., 2012); for unconventional policy, instead, we find that capital and economic constraints are the key dimension that determines the extent to which banks transmit monetary impulses via shifts in lending supply. One important policy implication of this result is that, especially during stressed periods, a close coordination is required between the central bank and the supervisory authority. Excessive regulatory and supervisory pressure on the level of bank capitalization may weaken the effectiveness of non-standard monetary operations, by increasing the (effective or perceived) constraints of banks' ability to expand credit supply.

Moreover, we also find a role for the dynamic impact of non-standard monetary policy on bank's capital position via the net interest income (reverse *bank capital channel*). In particular, this channel attenuates the transmission of monetary impulses, reflecting the fact that these measures tend to flatten the yield curve. In the context of the debate on the potential negative effects of the current stance of monetary policy on bank profitability, this result highlights one potential downside of unconventional monetary policy measures. This notwithstanding, a full evaluation of the impact of recent monetary policy actions must take into account the effects on all the dimensions of bank profitability: increased intermediation volume, reduced firm default risk and loan loss provisions, positive effect on capital gains and other income: for the euro area, available evidence suggests that the overall impact is net positive (Cœuré, 2016).

Finally, we find that the size of banks' exposure vis-à-vis the domestic sovereign was a crucial driver of the effectiveness of both conventional and unconventional policy transmission. In this context, our results indicate that a crucial channel by which ECB's actions were effective in restoring the transmission mechanism in the euro area was via measures (like the OMT) which addressed mispricing in the sovereign debt markets and brought the valuations of long-term assets more in line with their fundamental values.

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Tables and Figures

Table 1. **Descriptive statistics**

Variable	p25	p50	mean	p75	N
Loan rate (1)	2.18	3.01	3.34	4.39	21,426
Tier1 ratio	8.63	10.62	11.12	12.50	11,582
Liquidity ratio	15.74	33.82	46.07	61.44	14,222
Deposit ratio	5.06	30.37	32.44	52.30	23,308
Sovereign exposure	0.10	1.85	4.12	5.83	23,171
NPL ratio	2.70	4.67	6.14	7.24	11,695
Net interest margin	0.71	1.19	1.27	1.73	11,528

(1) Average rate on new loans to firms.

Note: all variables are expressed in per cent.

Table 2. **Expected signs of interactions**

Conventional monetary policy			
MRO rate*	BLC: asymmteric information	BLC: capital constraints	Bank capital channel
Tier1 Ratio	-	+	
Liquidity ratio	-	+	
Deposit ratio	-		
NPL ratio	+		
Sov. Exposure ratio	+/-		
Net interest income			+
Net interest income * Tier1 Ratio			same sign as Tier1 Ratio
Unconventional monetary policy			
Shadow-MRO spread*	BLC: asymmteric information	BLC: capital constraints	Bank capital channel
Tier1 Ratio	-	+	
Liquidity ratio	-	+	
Deposit ratio	-		
NPL ratio	+		
Sov. Exposure ratio	+/-		
Net interest income			-
Net interest income * Tier1 Ratio			opposite sign as Tier1 Ratio

Table 3. **Overall pass-through**

Dependent variable: average rate on new loans to non -financial firms			
	Only conventional MP	Conventional and unconventional MP	Additional effects for stressed countries
	(a)	(b)	(c)
Dependent variable (t-1)	0.528 ***	0.528 ***	0.518 ***
Macroeconomic variables (t-1)			
MRO	0.418 ***	0.407 ***	0.393 ***
SHADOW-MRO		0.035 **	0.049 ***
Sovereign spread	0.092 ***	0.086 ***	-0.016
Unemployment rate	0.024 ***	0.026 ***	-0.001
Additional effect for stressed countries during sovereign crisis			
MRO * Stressed countries			-0.249 ***
SHADOW-MRO * Stressed countries			0.034
Sovereign spread * Stressed countries			0.123 ***
Unemployment rate * Stressed countries			0.023 ***
Stressed countries			-0.006
Bank characteristics (t-1)			
Tier1Ratio	-0.002	0.002	-0.002
Liquidity ratio	-0.003	-0.003	-0.002
Deposit ratio	0.187	0.265	0.189
NPL ratio	0.013 ***	0.014 ***	0.011 ***
Sovereign exposure	-0.049	0.066	-0.157
Long-run pass-trough of policy measures:			
MRO	0.89	0.86	
SHADOW-MRO		0.07	
Bank fixed effects	Yes	Yes	Yes
Country-time fixed effects	No	No	No
Clustering	Year*Bank	Year*Bank	Year*Bank
Observations	8800	8800	8800

Table 4. **Main results: bank lending channel and bank capital channel**

Dependent variable: average rate on loans to non -financial firms			
	Baseline: bank lending channel	Bank lending channel & bank capital channel	
	(a)	(b)	(c)
Dependent variable (t-1)	0,465 ***	0,460 ***	0,459 ***
Macroeconomic variables (t)			
MRO * Tier1 ratio	-0,011 **	-0,010 **	-0,023 **
MRO * Liquidity ratio	0,000	0,000	0,000
MRO * Deposit ratio	-0,128 ***	-0,130 ***	-0,139 ***
MRO * Sovereign exposure	-0,548 **	-0,561 **	-0,527 **
MRO * NPL ratio	0,000	0,000	-0,001
SHADOW-MRO * Tier1 ratio	0,011 ***	0,012 ***	0,025 ***
SHADOW-MRO * Liquidity ratio	0,000	-0,001	-0,001
SHADOW-MRO * Deposit ratio	0,062	0,076 *	0,091 **
SHADOW-MRO * Sovereign exposure	0,673 ***	0,636 ***	0,606 ***
SHADOW-MRO * NPL ratio	0,000	0,000	0,001
Bank capital channel			
MRO * Net interest income		-0,008	-0,089
SHADOW-MRO * Net interest income		-0,046 **	0,068
Net interest income		-0,139 *	0,160
MRO * Net interest income * Tier1 ratio			0,008
SHADOW-MRO * Net interest income * Tier1 ratio			-0,010 **
Net interest income * Tier1 ratio			-0,028 *
Bank characteristics (t-1)			
Tier1 ratio	0,012	0,015	0,052 **
Liquidity ratio	0,000	0,000	0,000
Deposit ratio	0,982 ***	1,084 ***	1,116 ***
Sovereign exposure	1,254 **	1,112 *	0,989
NPL ratio	0,014 *	0,013	0,016 *
Bank fixed effects	Yes	Yes	Yes
Country-time fixed effects	Country * Year:month	Country * Year:month	Country * Year:month
Clustering (two-way)	Year*Bank, Year:month	Year*Bank, Year:month	Year*Bank, Year:month
Observations	8600	8570	8570

Table 5. **Additional regressions**

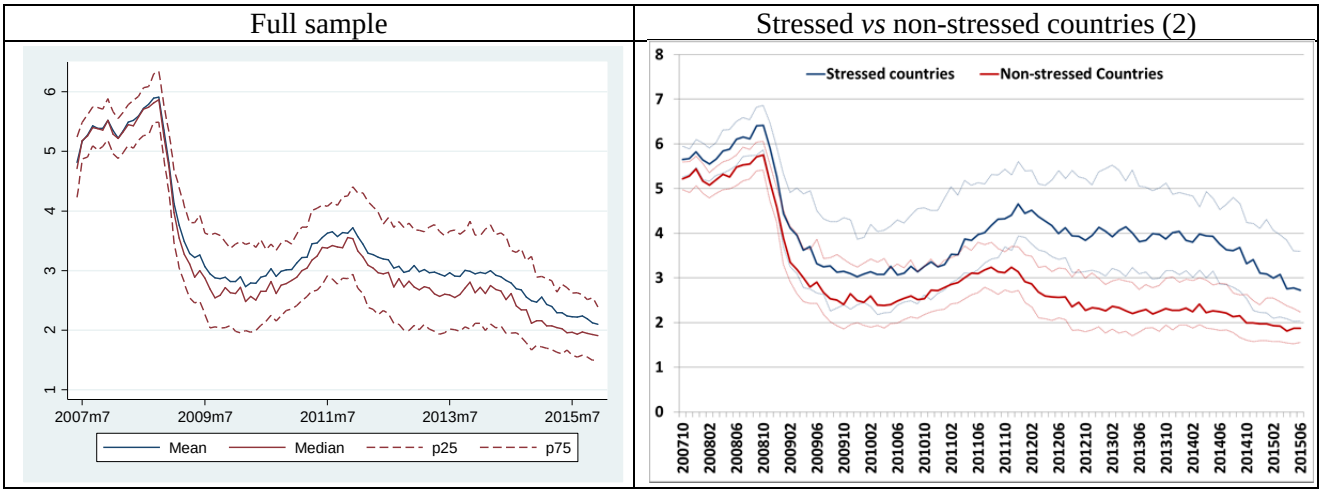
Dependent variable: average rate on loans to non -financial firms					
	Baseline regression (memo)	By contry group		Controlling for interactions with other macro variables	Excluding branches and subsidiaries of foreign banks
		Not stressed countries	Stressed countries		
	(a)	(b)	(c)	(d)	(e)
Dependent variable (t-1)	0.465 ***	0.459 ***	0.445 ***	0.461 ***	0.551 ***
Macroeconomic variables (t)					
MRO * Tier1 ratio	-0.011 **	-0.014 **	-0.007	-0.010	-0.010 **
MRO * Liquidity ratio	0.000	0.000	0.000	0.000	0.000
MRO * Deposit ratio	-0.128 ***	-0.104 *	-0.097	-0.127 **	-0.112 ***
MRO * Sovereign exposure	-0.548 **	-1.069 **	-0.322	-0.719 **	-0.482 **
MRO * NPL ratio	0.000	0.006	-0.005	0.002	-0.004
SHADOW-MRO * Tier1 ratio	0.011 ***	0.012 *	0.013 **	0.010 ***	0.009 ***
SHADOW-MRO * Liquidity ratio	0.000	0.000	0.000	0.000	0.000
SHADOW-MRO * Deposit ratio	0.062	0.025	0.084	0.063	0.074 *
SHADOW-MRO * Sovereign exposure	0.673 ***	0.918 ***	0.591 **	0.598 **	0.595 **
SHADOW-MRO * NPL ratio	0.000	-0.007 **	0.004	0.000	0.003
Bank characteristics (t-1)					
Tier1 ratio	0.012	0.002	0.021	-0.005	0.014
Liquidity ratio	0.000	0.001	0.000	0.000	0.000
Deposit ratio	0.982 ***	0.441	1.457 ***	1.163 ***	1.015 ***
Sovereign exposure	1.254 **	1.090	1.631 **	0.574	1.250 **
NPL ratio	0.014 *	-0.017	0.032 ***	-0.003	0.025 ***
Additional macroeconomic controls					
Bank characteristics*Unemployment				Yes	
Bank characteristics*CISS indicator				Yes	
Bank fixed effects	Yes	Yes	Yes	Yes	Yes
Country-time fixed effects	Country * Year:month	Country * Year:month	Country * Year:month	Country * Year:month	Country * Year:month
Clustering (two-way)	Year*Bank, Year:month	Year*Bank, Year:month	Year*Bank, Year:month	Year*Bank, Year:month	Year*Bank, Year:month
Observations	8600	4927	3673	8600	6958

Table 6. **Alternative monetary policy indicators**

Dependent variable: average rate on loans to non -financial firms						
	Baseline	**Using the EONIA rate and the shadow-EONIA spread**	**Including the EONIA-MRO spread**	**Using the slope of the yield curve**	**Including excess liquidity**	**Including dummy for OMT**
	(a)	(b)	(c)	(d)	(e)	(f)
Conventional monetary policy						
MP Measure *	MRO *	EONIA *	MRO *	MRO *	MRO *	MRO *
Tier1 ratio	**-0.011 ****	**-0.009 ***	**-0.010** *	0.000	-0.008	**-0.011 ****
Deposit ratio	**-0.128 *****	**-0.116 *****	**-0.098 ****	-0.068	**-0.087 ***	**-0.128 *****
Sovereign exposure	**-0.548 ****	**-0.439 ****	**-0.461 ***	0.107	**-0.430 ***	**-0.545 ****
Unconventional monetary policy						
MP Measure *	SHADOW-MRO *	SHADOW-EONIA *	SHADOW-MRO *	10YIRS - MRO	SHADOW-MRO *	SHADOW-MRO *
Tier1 ratio	**0.011 *****	**0.009 *****	**0.010 *****	**0.015 ****	**0.011 *****	**0.011 *****
Deposit ratio	0.062	0.051	0.035	0.118	0.066	0.063
Sovereign exposure	**0.673 *****	**0.564 *****	**0.585 *****	**0.996 *****	**0.677 *****	**0.673 *****
MP Measure *			EONIA-MRO *			
Tier1 ratio			-0.013			
Deposit ratio			-0.252			
Sovereign exposure			-0.881			
Including other MP measures						
Excess liquidity * Bank characteristics	NO	NO	NO	NO	YES	NO
OMT dummy * Bank characteristics	NO	NO	NO	NO	NO	YES
Interactions of MP with NPL and Liq ratio	Y, Not Sign.	Y, Not Sign.	Y, Not Sign.	Y, Not Sign.	Y, Not Sign.	Y, Not Sign.
Bank characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country-time fixed effects	Country*YY:M	Country*YY:M	Country*YY:M	Country*YY:M	Country*YY:M	Country*YY:M
Clustering (two-way)	Year*Bank, Year:mm	Year*Bank, Year:mm	Year*Bank, Year:mm	Year*Bank, Year:mm	Year*Bank, Year:mm	Year*Bank, Year:mm
N° of observations	8600	8600	8600	8600	8600	8600

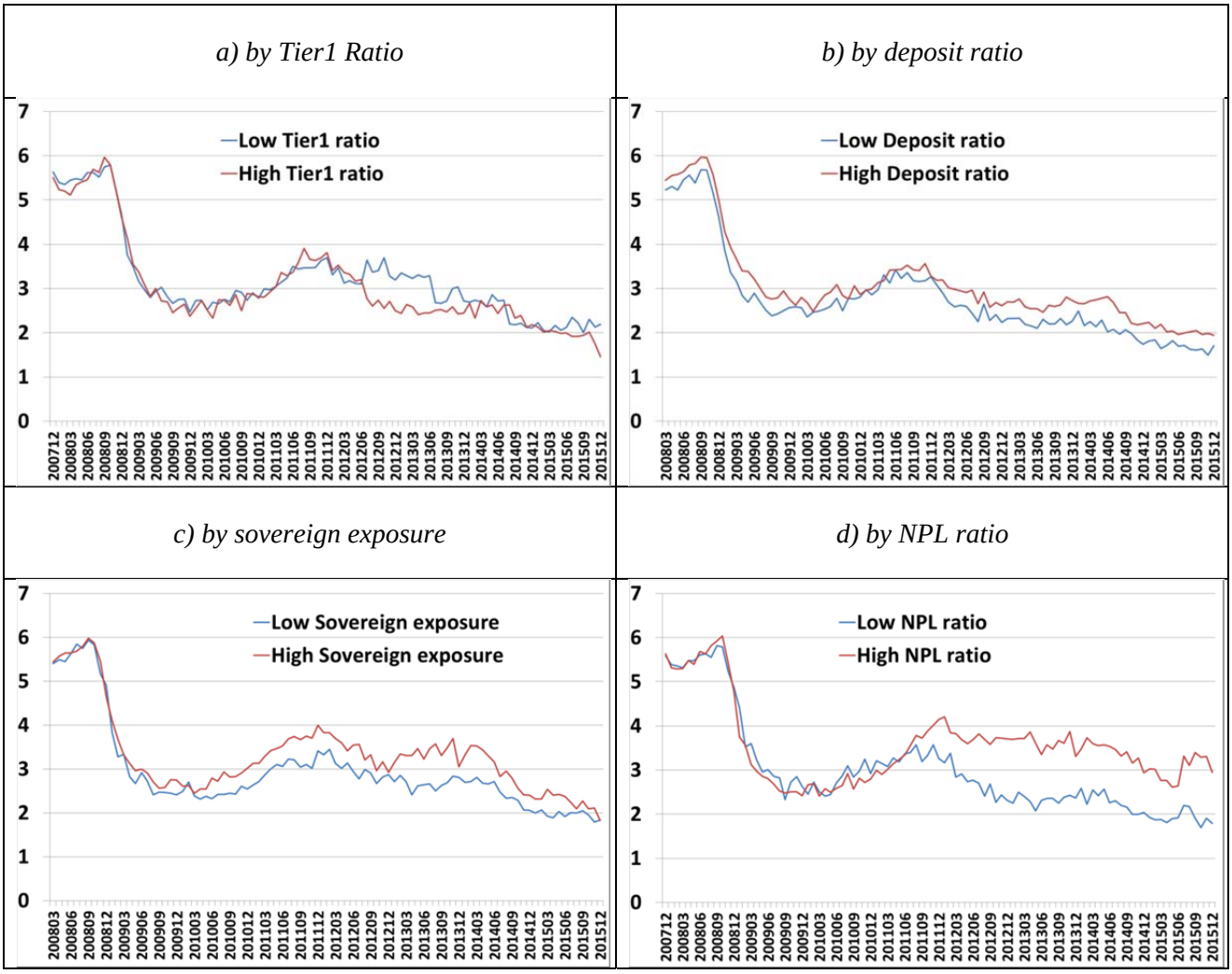
Figure 1. **Rates on new loans to firms (1)**

(monthly data; percentage points)



(1) Excluding overdrafts. (2) Stressed countries are Spain, Italy, Ireland, Portugal and Slovenia. Non-stressed countries is all the other countries in the euro area. Solid lines: median for each group; shaded lines: 25th and 75th percentiles for each group.

Figure 2. **Rates on new loans to firms, by bank characteristic** (1)
(monthly data; percentage points; cross-section average for each percentile)



(1) Excluding overdrafts. The figures report median values for each bank category. Banks with "Low" and "High" values of a specific characteristic are defined as those below the 33th percentile and above the 66th percentile of the distribution (calculated as of the previous year) of that characteristic, respectively.

Figure 3. **Measures and timing of monetary policy in the euro area**

(monthly data; percentage points)

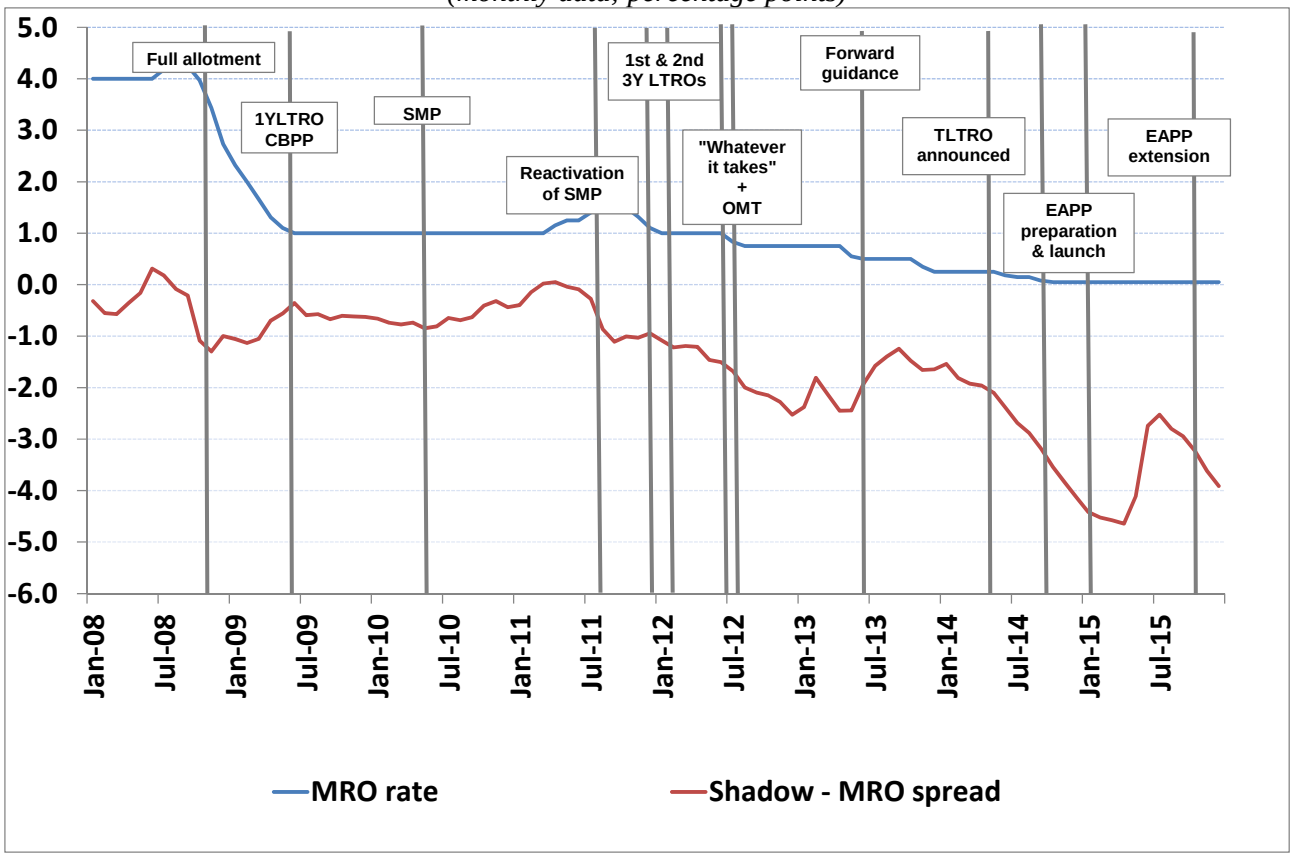
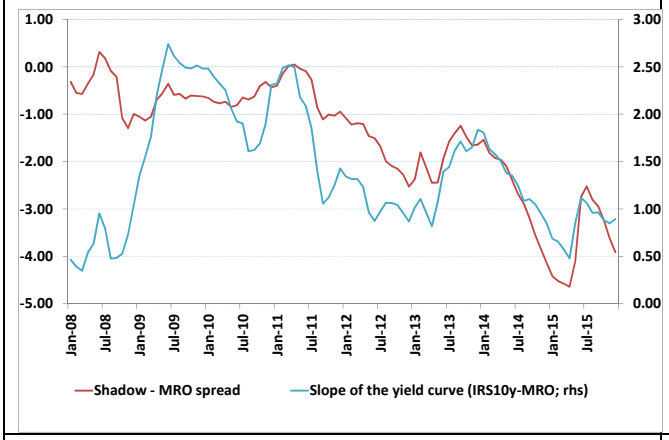


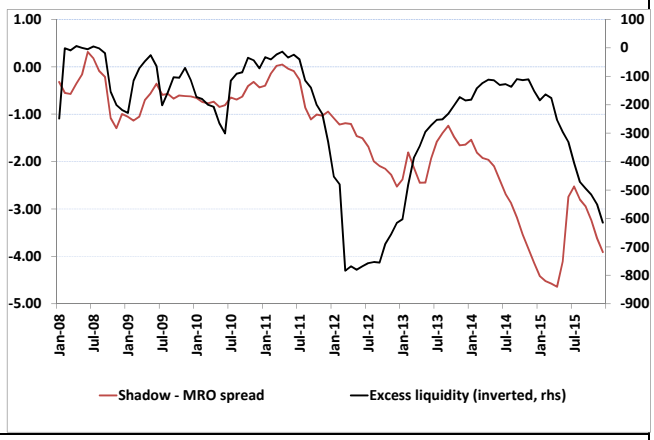
Figure 4. **Alternative measures of unconventional monetary policy in the euro area**

(monthly data; percentage points)

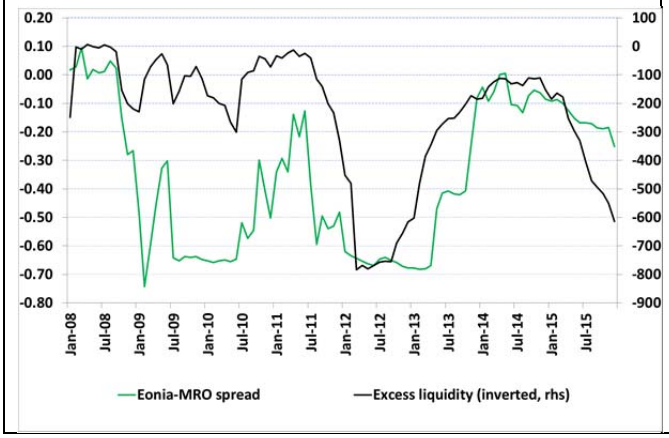
a) Shadow rate-MRO spread and the slope of the yield curve (1)



b) Shadow rate-MRO spread and excess liquidity (2)



c) Eonia-MRO spread and excess liquidity (2)



(1) The slope of the yield curve is the difference between the 10-year euro IRS and the MRO rate. (2) Excess liquidity is deposit facility + current account – reserve requirement – marginal lending.

Figure 5**. Effects of UMP on lending rates in the euro area: a counterfactual exercise**

(monthly data; percentage points)