The bank lending channel of conventional and unconventional monetary policy: evidence from a panel of euro-area banks [1]

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Abstract

Using a new monthly dataset on bank-level lending rates, we assess the transmission of monetary policy on the cost of credit in the euro area. We find that the stimulus provided by both conventional and unconventional monetary policy measures led to a reduction in lending rates. We show that a bank lending channel was at work for both conventional and unconventional operations. For conventional policy, consistently with previous studies highlighting the role of asymmetric information problems, we find that the transmission is weaker for relatively sounder banks. On the contrary, in response to unconventional measures, less capitalized banks expanded loan supply less. We document that this behaviour is likely to reflect perceived constraints on their capital positions, as the results are robust – and are indeed reinforced – once we control for the possible negative impact of unconventional measures on the net interest margin (bank capital channel). In addition, we find that a large sovereign exposure muted the response of lending rates to conventional policy, but amplified the transmission of unconventional measures.

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1. Introduction and main findings

In the aftermath of the collapse of Lehman Brother in September 2008, central banks in all main developed countries vigorously reacted by quickly cutting official rates and adopting a wide range of unconventional measures. In the euro area the ECB undertook a number of such measures. Specifically, it introduced: a fixed-rate full allotment regime (FRFA), whereby banks could obtain all liquidity needed, upon availability of adequate collateral; long-term liquidity provisions (e.g. 6-months, 12-months, 3-years refinancing operations, VLTROs); measures aimed at enlarging collateral availability (e.g. additional credit claims); outright purchases of financial securities (sovereign bonds, covered bonds, ABS). Furthermore, in order to provide additional stimulus once policy rates approach their effective lower bound, large-scale asset purchase programs (APP) was also implemented.

While there is a vast body of literature describing the transmission of unconventional monetary policy measures during a financial crisis (see Borio and Disyatat, 2010; Cecioni et al. 2012; Pattipeilohy et al., 2013; Cova and Ferrero, 2015, *inter alia*), the debate on their effectiveness is still open. Recent studies using VAR or DSGE models documented a beneficial aggregate effect in several euro-area countries.[2]

The traditional mechanism through which monetary policy impacts on the real economy is the so-called interest-rate channel, which is the ability of monetary policy to directly alter the level of both short and long-term market interest rates and therefore to stimulate investments and consumption. However, a large body of theoretical literature has emphasized the role of the bank lending channel (BLC), that is, the idea that monetary policy acts also by influencing the supply of credit to the economy (Bernanke and Blinder 1988; Kashyap and Stein, 1995). The underlying mechanism typically relies on the presence of asymmetric information in the markets for banks' liabilities, which tend to be more severe for smaller, less liquid and less capitalized banks (Stein, 1988; Kashyap and Stein, 2000; Jimenez et al., 2012). The central prediction of these theories is that the transmission of changes in the monetary policy rate is stronger for smaller and/or weaker banks, whose loan supply is more sensitive to changes in monetary policy.[3]

Despite this large amount of literature, the transmission channel of unconventional monetary policy rates via the banking system is still relatively unexplored. In this paper we would like to fill this gap by addressing the following questions. To what extent have unconventional measures transmitted to the cost of loans in the euro area? Was a 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?

These issues are important for a number of reasons. First, many of the measures undertaken in the euro area explicitly targeted loan supply, in a context where the transmission channel of conventional policy was considered impaired due to tensions in financial markets, heavy losses on banks' balance sheet, depressed valuations of bank stocks and expectations of weak bank profitability (see Cecioni et al, 2011; Cova and Ferrero, 2014). A dysfunctional loan supply may inhibit the transmission of monetary policy stimulus, particularly so in an economy where the role of SMEs and banks is predominant, as in the euro area.

The second reason is that unconventional monetary policy measures have been implemented during a financial crisis. Under such circumstances, some of the standard predictions of the BLC literature may be reversed. In our view, the most relevant issue is the negative relationship between bank capitalization and monetary policy changes, typically found in the empirical literature (see Jimenez et al., 2012). In times of financial stress or deep recessions, banks are more likely to feel pressure from markets or regulators on their capitalization in order to compensate the capital erosion due to losses on securities and loan portfolios. A tighter regulation may render capital constraints severely binding and weakly-capitalized banks may not be able to accommodate an expansion of credit demand. This leads to an opposite prediction of the BLC as weakly capitalized banks could transmit less forcefully the monetary policy stimulus. As a result, depending on what is the predominant factor, the pass through of the monetary policy measures may be expected to be positively or negatively correlated with banks capitalization.

[2] See Lenza et al. (2010), Casiraghi et al. (2015), Darracq-Paries and De Santis (2013), Baumeister and Benati (2013), Boeckx et al. (2014), Weale and Wieladek (2014), Burlon et al. (2015), von Borstel et al. (2015), Ferrando et al. (2015).

[3] In principle, heterogeneity in pricing (both in terms of average loan rates and in terms of adjustments to monetary policy shocks) is limited by competitive pressures; it is nonetheless reasonable to suppose that competition will never be so extreme to fully thwart cross-sectional differences in loan pricing. Imperfect spatial competition and asymmetric information, also related to tight bank-firm relationships, always leave some room for monopolistic power.

A related point is that a positive relation between pass-through intensity of monetary policy and the capital ratio could be related to the so-called bank capital channel (BCC), in the spirit of van den Heuvel (2007). Due to the maturity transformation and the duration gap typical of banks' business activity, unconventional measures aiming at flattening the slope of the yield-curve may be expected to erode future profitability via the net interest income and, in turn, capital accumulation. In anticipation of future pressures on bank capital, banks may be reluctant to transmit the monetary accommodation, in particular those with a lower capital ratio (i.e. banks for which capital is a binding constraint). The BCC may be particularly relevant in our analysis because some of the unconventional measures adopted by the Eurosystem (i.e. the large-scale asset purchase program or forward guidance) had the objective to reduce long-term yields.[4] Unlike the interpretation based on (statically) binding capital constraints of the BLC paradigm, the BCC involves monetary policy measures in exacerbating pressure on banks' capital position in a dynamic fashion. We will try to assess which of the two hypothesis is more relevant, if any, by further distinguishing banks based on their business models and considering interactions of monetary policy measures with the net interest income. The idea is that banks whose profitability is more negatively affected by the reduction of long-term yields are those deriving their income primarily from the traditional intermediation activity which involves a transformation of maturity and benefits from a steepening of the term structure.[5]

The third reason is that, during a financial crisis, new bank-specific factors might have affected the monetary transmission mechanism in the euro area. Interestingly, Gambacorta and Marques-Ibanez (2010) found an important role played by banks' business models and market funding patterns that during the global crisis of 2007-2010 both in Europe and in the US. We do not only corroborate these findings for both conventional and unconventional measures but also extend the range of bank-specific variables to include two variables that have often been associated with the functioning of the BLC during the financial crisis, namely the NPL ratio and the amount of sovereign exposure. As regards NPLs, it has been argued that a large volume of impaired loans has been holding back credit supply. A high level of sovereign exposure may have impaired the transmission of conventional monetary policy.[6]

In this paper we investigate these important issues by relying 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.[7] The panel data start in July 2007, the first date for which the dataset became

[4] In principle, the BCC may be at work for any unconventional monetary policy measure, including the exceptional liquidity injections aiming at reducing short-term market rates. While the positive relation between bank profitability and the slope of the yield curve is rather uncontroversial, for short-term rates the relation is ambiguous. On the one side, the decline in short-term rates leads to a decline in the net interest margin via the reduction of the cost of new loans and rates on outstanding floating-rate loans. On the other side, an expansion of monetary policy stimulates lending volumes via demand and, in turn, the net interest margin.

[5] Implicit in this theory there is the assumption that bank profits are inversely related to the level of interest rates. This because variation in interest rates typically brings about changes of the opposite sign in the slope of the term structure which in turn, due to the presence of a positive duration gap between assets and liabilities, determines, at least in the long run once all new contract are re-priced, an increase in bank net interest income. While this is a reasonable characterization of the relationship between profits and interest rates, there could be special situations where such relationship breaks down. This is the case when overnight deposits, typically held for transaction purposes and as such do not provides interests to their holders or do so at rates that have little relation with market rates, are a prevalent source of funding or do not pay interests at all, as in some jurisdictions, due to legal or business practices.

[6] This issue is particularly interesting because there is no clear-cut evidence about the role of banks' sovereign exposure in amplifying the transmission of macroeconomic shocks via the bank lending channel. In this regard, the available empirical evidence for Italy is paradigmatic. Bofondi et al. (2013) used data from the Italian Credit Register and found 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, meaning that the riskiness of domestic intermediaries was mostly determined by that of the Italian government. On the contrary, Bottero et al. (2015) showed that the Greek bailout in the spring of 2010 had a negative impact on the riskiness of government securities held in the banks' portfolio, which in turn led to a tightening in credit supply to firms. As for the euro area, Popov and Van Horen (2013) showed 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.

[7] Our paper also relates to other studies using the same dataset. In this regard, Holton and Rodriguez d'Acrì (2015) find that bank characteristics matters for developments in lending rates. Holton and McCann (2015) examined the drives of the premium paid by SMEs with respect to large firms. They find that the bank lending channel is more effective during economic downturns and that capital adequacy helps lower the premium in downturns.

available. This is not a limitation for our analysis as before that date the ECB never announced or implemented unconventional policy tools to influence macroeconomic and financial market conditions.

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 the identification of loan supply effects, the granularity of our dataset allows us to isolate, more effectively than in macro-economic studies, supply effects linked to banks' balance sheet conditions from credit demand and borrowers' riskiness. In particular, we saturate our regressions by including country*month fixed-effects and compare the reaction to monetary policy changes of banks that differ only in terms of specific balance sheet characteristics. Specifically, in the regressions we interact measures of conventional and unconventional policy with bank balance sheet indicators such as capitalization, funding structure, asset quality, size of the sovereign portfolio. Effectively controlling for country-level macroeconomic conditions is also useful to tackle issues related to the possible endogeneity of monetary policy to lending rates.

In the comparison with studies based on loan-level dataset (e.g. Jimenez et al., 2012) our approach is less powerful in identifying shifts in loan supply. However, unlike those analyses, it is based on an international dataset rather than on a national credit register. Using a national dataset poses an issue regarding the external validity of the results obtained. Disposing of cross-country dataset is crucial also because during the period we examine we have witnessed in the euro area a fragmentation of financial and credit markets along national borders with flight to safety phenomena that have created stark cross-country differences in the way the transmission mechanism has operated. Our dataset then allows to effectively disentangle the effects stemming from individual banks' conditions from those due to financial markets fragmentation.

As for the choice of conventional and unconventional monetary policy indicators, we mainly use two variables in our regressions. The rate on the Eurosystem's Main Refinancing Operations (MRO) is 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. This indicator captures the stimulus provided on top of that implied by the level of policy rates. The shadow rate is considered a measure of the stance of monetary policy that takes into account the existence of the zero lower bound. It is estimated using affine models of the term structure and, therefore, changes in this rate beyond the MRO should capture all unconventional measures affecting the entire term structure of interest rates.

As robustness checks, we also consider alternative measures for unconventional monetary policy. 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. The reason is that the spread between the shadow rate and the MRO could be more effective in capturing unconventional measures lowering long-term interest rates (such as, for example, forward guidance and the Asset Purchase Programme), while the spread between the Eonia and the MRO 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 captures in the period 2011-13, during which excess liquidity surged in connection with the 3-year LTROs.[8] 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. Finally, we include two other indicators that may capture additional effects of unconventional policy: 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., 2015; Bulligan and Emiliozzi, 2016); and a dummy variable to capture the effect of the OMT announcement. Our results are robust to all of these checks.

[8] The two unconventional monetary policy indicators cannot be more closely associated to specific measures announced or adopted by the Eurosystem as these are too many and may have exerted an impact on both short-term (via excess liquidity) and long-term market rates.

Our main findings are the following. First, both conventional and unconventional measures contributed significantly to keeping interest rates on new loans to firms low, thus providing empirical evidence of the interest rate channel. In particular, a simple counterfactual analysis suggests that at the end of December 2015 the (negative) contribution of unconventional operations was around 40 basis points.

Second, we find that a bank lending channel was operational for both conventional and unconventional operations. For conventional operations, we find that the transmission is weaker for highly capitalized banks and for banks with a larger deposit-to-liability ratio. For bank capital, this is a typical result of the BLC literature (Kashyap and Stein, 2000; Jimenez et al., 2014). The result for the deposit ratio, while at odds with the pre-crisis consensus on the bank lending channel (Romer and Romer, 1990; Gambacorta and Marques-Ibanez, 2011) is consistent with the notion that during the financial crisis a heavier reliance on wholesale markets implied a more pronounced transmission of financial market conditions on lending markets (Gambacorta and Marques-Ibanez, 2011).

As regards unconventional operations, we instead find that the intensity of the pass-through is positively related to the Tier1 capital ratio. This would suggest that weakly capitalized banks transmit to a lesser extent the monetary policy accommodation. Interestingly, this result still holds and is even reinforced when controlling for the bank capital channel, as captured by interactions between the monetary policy measures and the net interest income.

Third, we find that the ratio between banks' sovereign exposure and their total assets is an important driver of the transmission of monetary policy. In particular, the reduction in the shadow-MRO spread transmitted more strongly on the cost of loans extended by banks more exposed to domestic sovereign risk, while at the same time the transmission of conventional policy was weaker for these banks. This is consistent with the notion that these unconventional measures, by positively affecting valuations of long-term assets, affected translated into a better capital position (Cova and Ferrero, 2014).

The closest contribution to ours is the concomitant paper by Altavilla, Canova and Ciccarelli (2015), where the same dataset is used to assess the heterogeneity in the transmission of conventional and unconventional monetary policy in a panel Bayesian-VAR framework. The authors also find a considerable heterogeneity of the pass-through of standard measures depending on banks' balance sheet characteristics (capital ratios and exposures to domestic sovereign debt), while the location of a banks is not relevant. Non-standard measures seem to have been effective in reducing lending rates especially banks with high level of non-performing loans and high exposure to sovereign debt. Compared to our paper, their approach allows to take into account feedback effects from macroeconomic conditions to the banking sector. On the other hand, it does not allow to fully exploit the within-country bank cross-section to effectively control for credit demand and risk. We also differ in terms of how we measure the stance of monetary policy. Their approach identifies monetary policy shocks based on event-study methodology. While this has the advantage of effectively isolating unexpected shocks to monetary policy, at the same time it risks capturing only a small components of the measures or just transitory effects.

The rest of the paper is organized as follows. Section 2 describes the data and presents the methodological framework. Section 3 shows the main estimation results while Section 5 offers a battery of robustness checks.

2. Data and methodology

Our dataset combines three different sources of data.

First, we use individual bank interest rates and some bank characteristics from the ECB I-BSI/I-MIR datasets. This data cover the period 2007-2015 and include 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 based on a residency principle and data are un-consolidated. For loan rates we collect the following series: average rate on new loans to firms, excluding overdrafts; rate on new loans to firms with amount below 1 million euro; rate on new loans to firms with amount larger than 1 million euro; average rate on outstanding firms' current account deposits; rate on new variable-rate loans to households for house purchase; rate on new fixed-term loans to households for house purchase.[9] Balance-sheet items include total asset and liabilities, capital and reserves, external assets and liabilities, deposit liabilities, debt liabilities, government bonds held, interbank assets and liabilities.

Individual bank data are matched with balance-sheet information from the public provider Bankscope. In this case, information is consolidated. 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.

Table 1 provides summary statistics for a number of bank-specific variables. The Tier 1 ratio, liquidity ratio and NPL ratio are group-level variables from Bankscope. The latter two variables are defined, respectively, as the ratio between cash and short-term securities over total assets and as the share of non-performing loans over total loans. The other variables are MFI-level indicators taken from I-BSI and are defined as follows: the deposit ratio is the ratio between firm and household M3 deposits over total Main liabilities; sovereign exposure is the ratio of domestic sovereign bonds over total assets.

Finally, we include several macroeconomic variables. First, we use a number of monetary policy indicators. The official MRO rate is our main measure of conventional monetary policy. As measures of unconventional monetary policy stance, 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 new class of term structure models, which have been proposed to study market interest rates near the ZLB.[10] They are appealing for two reasons. First, Gaussian affine term structure models do not constrain interest rates to be positive. Therefore, when rates are close to zero, these models tend to assign high probability to future scenarios in which short-term rates go much below zero, which, however cannot materialize in practice, due to the possible arbitrage between loans and physical cash. As a result, these models determine a downward bias in the estimates of expected future rates and an upward bias in those of term premia. The second reason is that traditional models are often unable to reproduce one of the main stylized facts that are observed when interest rates are near the ZLB, namely, that once the short term rate reaches the bound it tends to remain there for long periods of time. As suggested by Kim and Singleton (2012), shadow rate models can provide a satisfactory solution to this problem and they also outperform the other models in fitting realized risk premia. In addition, we use the difference between the Eonia and the MRO rate to capture the effect of excess liquidity.

Figure 1 shows developments in the various monetary policy measures. The indicators summarize the effects of the various unconventional measures on market rates which imply an accommodative monetary policy stance in a ZLB environment. For example, before the crisis, the shadow rate and the official short-term rate roughly coincided; the spread between the two however, widens as the MRO approaches the ZLB and the ECB undertakes a growing number of unconventional operations.

[9] Variable and fixed-rate loans are defined as initial period of rate fixation up to 1 year and beyond 1 year, respectively.

[10] Pericoli and Taboga (2015) provide an in-depth discussion of pros and cons of the shadow rate measures. They argued that. negative values of the shadow rate can be interpreted as a measure of distance from the most likely date for the lift-off rather than the interest rate that would be optimally set by the central bank in the absence of the ZLB. In this regard, the shadow rate is more of a statistical device to parsimoniously describe the stance of monetary policy at the ZLB in line. Krippner (2013a) also interpreted the shadow rate as a measure of the monetary stance, after observing that its movements tend to be broadly consistent with the timing of unconventional monetary policy events.

Figures 2 and 3 plot developments in the rate on new loans to firms for the aggregate sample as well as by clusters of countries and bank-specific characteristics. From all figures, we observe that there is significant heterogeneity across banks. Dispersion, in particular, increases significantly since the intensification of the sovereign debt crisis, in the summer of 2011.

The empirical analysis is based on the following dynamic pass-through equation:

$$lr_{ijt} = \omega_i + \alpha\, lr_{ijt-1} + \beta\, X_{it-1} + \gamma\, Z_{jt} + \delta\, MP_t + \rho\, MP_t \cdot X_{it-1} + \eta_j + \theta_t^C + \varepsilon_{ijt} \quad (1)$$

where lr_{ijt} is a specific loan rate charged by bank *i* in country J at month *t*, while X_{it} is a vector of bank-specific variables, Z_{jt} is a vector of country-specific variables and MP are indicators of the monetary policy stance (i.e. variables capturing both conventional and unconventional measures). The specification also include the lagged value of the dependent variable, bank fixed effects η_j and time*country fixed effects θ_t^C (with different specifications, as described in the following section). We are particularly interested in the estimation of vector ρ which captures the interaction between the monetary policy indicators and the bank-specific variables and provides a formal test of the BLC and BCC hypotheses. The sample period of the estimation runs from July 2007 to December 2015. Notwithstanding we use a dynamic panel model, we do not need to rely on Arellano-Bond estimation technique, as the time series dimension is large and the implicit "Nickell bias" negligible.

As regards possible reverse causality, it should be noted that any possible impact of lending rates on monetary policy would only take place because of some consequences on the macroeconomy. These are taken into account by the fixed effect sic conditions, which is likely to take some times. This argument is reinforced by the fact that regressors are included with a lag. Finally, we will show that all main results carry over when considering only subsamples of countries. Given the low correlation of cyclical conditions across different countries in the euro area, this reinforces the validity of the identification strategy adopted.

3. Empirical analysis

3.1. Interest rate channel

As a first set of regressions, we estimate standard pass-through equations, aiming at capturing the interest rate channel of transmission of monetary policy on loan rate to firms. Results are reported in Table 2. In all specifications we include several control variables. In particular, we consider two macroeconomic variables, namely the domestic 10-year sovereign spread (measured as the difference between the 10-year domestic Government bond yield and the 10-year IRS rate) and the domestic unemployment ratio. These indicators help to isolate monetary policy changes from financial shocks as well as loan demand conditions and borrowers' riskiness. The regressions also include bank fixed-effects and the following bank-specific time-varying characteristics: bank Tier1 ratio, the liquidity ratio, the deposit ratio, the NPL ratio and sovereign exposure. The bank-level variables identify the main channels of transmission via balance sheet conditions.[11]

In column (a) we begin our analysis by including only our measure of conventional monetary policy. Then, in column (b) we add a measure of unconventional monetary policy (the Shadow– MRO spread). The main results are the following. As expected, both the MRO rate and the unconventional monetary policy measure have a positive and significant effect on lending rates, thus suggesting that the interest rate channel is at work. 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 .[12] The estimated effect for the Shadow-MRO spread is equal to around 4 and 7 bps, on impact and in the long-run, respectively.

[11] Unlike what we do in the following sections, we cannot introduce country*month fixed effects in our credit supply equation to control for unobserved heterogeneity in macroeconomic conditions. We checked the robustness of the results by including county*quarter fixed effects, which represents a similar but less powerful controls. The estimated coefficients for monetary policy measures are virtually unaffected.

[12] As for the non-linearity in the pass-through of monetary policy to lending rates, Belke et al. (2013) analyzed the interest rate pass-through from money market rates to various loan 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.

As regards the macroeconomic controls, as expected 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 is likely to capture the impact running from sovereign tensions to banks' balance-sheet conditions via the (multi-faceted) sovereign-bank nexus[13]. 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, Nobili and Signoretti, 2012).[14]

Turning to bank-specific characteristics, we find that a higher NPL ratio is associated to higher lending rates. This result may reflect both more accommodative lending policies by banks with sounder balance sheets, and higher average riskiness of that bank's loan portfolio – if one interprets the NPL ratio as a proxy of the ex-post riskiness of a bank's average new loans. Tier1 ratio is significant in regression (a) while not in regression (b). One may argue that the weak role we find for the Tier1 ratio might reflect the fact that this variable carries the same information as the NPL ratio. Bank capital and credit quality may have the same information content since the impairment stemming from the increase in non-performing loans during the crisis inevitably eroded bank profitability, which in turn put pressures on bank capital. However, in our panel the correlation between the NPL ratio and the Tier1 ratio is negative but very low (-0.05). Moreover, we find the same result if we drop the NPL ratio from the regression. Finally, neither the deposit ratio nor bank sovereign exposure are statistically significant. As for the deposit ratio, this result may reflect the empirical correlation between banks' funding structure and macroeconomic conditions. As shown in the following sections, when we introduce country*month fixed effects this variable turns out to be highly significant with a positive sign.

A point often debated is whether the transmission of monetary policy has been different among countries during the sovereign debt crisis, leading to fragmentation among member states. In this regard, the available evidence suggests little difference between stressed and no-stressed countries (Hristov et al., 2014; von Borstel et al., 2015). In order to investigate this issue, in column (c) 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).[15] The "Stressed countries" dummy takes value 1 for banks whose the ultimate parent is from Italy, Spain, Portugal, Ireland and Slovenia. Since fragmentation became a relevant issue only since the start of the sovereign debt crisis while it was not a concern during the global crisis period, the dummy activates only from April 2010 onwards. The estimated coefficients suggest a weaker effect of changes in the MRO rate for stressed countries, thus confirming that fragmentation impaired 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 the various monetary policy measures – 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

[13] Tensions in the sovereign debt market may affect banks' balance sheets and lending supply conditions through several channels: banks hold sizeable portfolios of their country's government bonds; government securities are used as collateral in secured interbank transactions; yields on government bonds may be a benchmark for alternative assets; the creditworthiness of the governments affects the value of the explicit or implicit guarantee provided to the banking sector (BIS, 2011; Angelini et al., 2014).

[14] In the case of Italy, Albertazzi et al. (2014) analyzed reduced-form relationships between the BTP-Bund spread and developments in the cost and availability of lending in various market segments, as well as in bank profitability, using macro data for the entire banking system. Their results indicate that the effects were indeed substantial. Del Giovane et al. (2012), Bofondi et al. (2013), Neri and Ropele (2013) and Zoli (2013) also found that the sovereign spread played a significant role in determining bank loan rates in a number of euro-area countries.

[15] 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.

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.[16] 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.

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.

All in all, the results presented in Table 1 suggest that the various unconventional monetary policy measures undertaken in the last recent years contributed to reducing the cost of credit to firms in the euro area, thus providing empirical support to the interest rate channel. In the following sections we focus on the transmission of monetary policy via the bank lending channel.

3.2. Heterogeneity in the monetary policy transmission: the Bank lending channel

In Table 3 we move on to analyzing the transmission of monetary policy via the bank lending channel (e.g. Kashyap and Stein, 2000; Jimenez *et al*., 2014).

According to the literature on the BLC, monetary policy may transmit via shifts in lending supply via three main mechanisms. 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). As asymmetric information problems are typically more severe for smaller banks, banks with less liquid balance-sheet and smaller amount of regulatory capital, this mechanism predicts that monetary policy transmission is *stronger* for *weaker* banks. Second, the transmission of monetary policy via lending supply may be hampered by the presence of capital requirement, which could reflect either regulatory constraints or market pressure (Bernanke and Lown, 1991; Van den Heuvel, 2007). This mechanism, contrary to the asymmetric information case, predicts that monetary policy transmission is *stronger* for *more capitalized* banks. Third, the transmission via bank lending is amplified or attenuated depending on the impact of monetary policy decisions on bank profits and thus on the future level of capital (the *bank capital channel*, BCC; van den Heuvel, 2002). The implications of this mechanism for the transmission of monetary policy differ between conventional and unconventional measures and may depend on the relative importance of traditional intermediation activity as opposed to other income. Indeed, conventional policy (i..e, reduction in the short-term rate in normal times) increases the slope of the yield curve and boosts net interest margin, while unconventional operations tend to flatten the yield curve, with an opposite effect; moreover, unconventional measures are likely to increase other income via their effect on asset price valuations, while this effect is likely to be muted for conventional measures. This implies that the BCC amplifies the transmission of conventional monetary policy but attenuates it for unconventional measures. In addition, other things equal, the effects on the net interest margin are amplified for banks heavily relying on traditional intermediation activity (for which NIM makes up a higher share of revenues). Finally, the BCC should reinforce the impact of capital constraints on the transmission of monetary policy, because the easing of future capital constraints is likely to be more effective for currently constrained banks.

As typical in this literature, we interact our measures of conventional and unconventional policy, on the one hand, and the five bank-specific variables included in the previous regression: the Tier1 capital, the liquidity ratio, the deposit ratio, the NPL ratio and sovereign exposure. The liquidity ratio, the Tier1 ratio and (the inverse of) the NPL ratio can all be interpreted as measures of bank strength. As mentioned above, an alternative interpretation for the Tier1 ratio is as a measure of distance from regulatory constraints. As for the deposit ratio, retail funding provided a stable source of financing for banks during the crisis, therefore one interpretation is also as a measure of balance-sheet strength.[17] An alternative, more "mechanical"

[16] 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).

[17] It is important to note that, according to the pre-crisis consensus, the transmission via the BLC should be stronger for banks with a larger deposit base, while a large reliance on market financing (such as securitization) would insulate

explanation, relies on the fact that, since deposit rates tend to be more sluggish than those on wholesale funding sources (e.g., Kok Sorensen and Werner, 2006), a high deposit share attenuates the transmission of changes to the short-term policy rate to banks' average cost of funding. Finally, the interpretation of the amount of sovereign exposure during our sample is not univocal: in the period up to the beginning of the sovereign crisis, a high share of sovereign bonds is associated to a highly liquid balance-sheet; during the high increase in sovereign spreads in 2010-12, a high share of sovereign bonds might have implied a hampering of monetary policy transmission; after the "whatever it takes" speech of July 2012 and the ensuing fall in spreads, banks with high sovereign exposure made a lot of profits.

Given the structure of our dataset, the best way whereby we can control for loan demand is to saturate the model with country*month fixed effects, which 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). 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. Standard errors are clustered at the year*bank level and month, 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. [18]

In column (a) we estimate a regression which includes only conventional monetary policy, proxied by the MRO rate. In column (b) we also include unconventional policy, as proxied by the shadow rate-MRO spread. First, we find that (in both regressions) the interaction between the MRO and the deposit ratio is significant and has a negative sign, indicating that the transmission is weaker for banks with a higher share of deposit funding. Second, as regards the role of the Tier1 ratio, we find that the interactions with both conventional and unconventional policy measures are significant but the signs diverge: the transmission of conventional policy is stronger for weaker banks, while the opposite is true for unconventional policy operations. In both the regressions of column (a) and (b) neither the interactions with the NPL ratio nor those with the liquidity ratio are significant.

To assess the economic relevance of these results, 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 Tier 1 and deposit ratio and a bank in the 90th percentile (i.e., banks with a Tier 1 ratio of 7.2 versus 15.5 percent or a deposit ratio of 1.1 versus 65.7 percent). Following a 100 bps reduction in the MRO rate, loan rates charged by weakly capitalized banks fall by 17bps more than by highly capitalized banks in the long-run. The long-run beneficial effect for banks more dependent from market funding with respect to those more dependent from retail deposits is similar (16bps for tenth versus ninetieth percentile). For unconventional policy, the estimated coefficient implies that – following a 100bps reduction in the shadow rate – highly capitalized banks reduce lending rates by 17bps more than low-capitalized banks.

Turning to the role of sovereign exposure, we find that their amount also exerted a significant effect on the transmission of monetary policy; the signs of the interactions with both conventional and unconventional policy indicators are as expected. For the interaction with the MRO, we find a weaker transmission for banks holding higher shares of sovereign bonds, in line with the idea that sovereign bonds are correlated with the degree of balance sheet liquidity and, at the same time, that during the sovereign debt crisis the standard

intermediaries from changes in monetary policy (Romer and Romer, 1990; Gambacorta and Marques-Ibanez, 2011). However, studies on the BLC conducted after the onset of the financial crisis have shown that larger reliance on wholesale markets implied larger effects of financial market conditions on banks' balance sheets and thus on lending conditions (Gambacorta and Marques-Ibanez, 2011).

[18] 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.

transmission mechanism of monetary policy was hampered by the tensions in the sovereign debt market. The sign for unconventional monetary operations is instead reversed, as banks with higher shares of sovereign exposure are those that transmitted more. This seems consistent with a bank- capital channel story: by addressing mispricing in the sovereign debt markets and – more in general – positively affecting valuations of long-term assets, these measures were more beneficial for banks with a large sovereign exposure via their effects on profitability (see Cova and Ferrero, 2014). In turn, larger profits translated into a better capital position and allowed these banks to ease lending conditions by more. The differential effect (calculated between banks with a sovereign exposure of 11.2 percent of their total assets and banks with 0 percent exposure) of a 100–basis point decline in the MRO rate is equal to 12 bps; the corresponding effect for the shadow rate-MRO spread is 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, the positive relation 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.

In the regression of column (b), 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 liquidity position is typically influenced by funding structure decisions taken at the group level. We therefore perform the same regression excluding those MFIs whose parent bank is from another country. The coefficients, reported in column (c), are robust.

In columns (d) and (e) we replicate our regression splitting the sample between banks from stressed and non-stressed countries. 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. As regards conventional policy, the signs are consistent across the two groups of countries though the coefficients are significant only for the core group, possibly reflecting the overall weaker explanatory power of MRO (as seen in Table 2).

The above results suggest that, first, a bank lending channel was operational both for conventional and unconventional monetary operations. Its functioning, however, differed: during normal times, when monetary policy was mainly undertaken via reductions of the short-term rate, the transmission via the BLC reflected a standard asymmetric information explanation; during the period in which the ECB deployed its unconventional operations, the constraints related to banks' capital requirements instead prevailed, and lending supply expanded more for better-capitalized banks.

However, also an alternative explanation – based on a bank capital channel – is possible. In particular, the opposite signs of the interactions between Tier1 ratio, on the one hand, and conventional and unconventional measures, on the other, may also be consistent with the different impact that these have on bank profits, via net interest margin, and thus on future capital. This is the topic of the next section.

3.3 The Bank capital channel (via net interest margin)

Our findings on the role of bank capital are consistent with an important role for asymmetric information problems for conventional policy and capital constraints for unconventional. However, as mentioned above, these results might also reflect the effect of monetary policy on bank profits via net interest margin, i.e, the so called *bank capital channel*. Indeed, an expansion through conventional policy entails a reduction in the short term rate and increase in the slope of the yield curve, which *raises* the margins on new loans (and thus supports the overall net interest margin); on the opposite, unconventional operations (especially forward guidance, asset purchase programs, longer-term refinancing operations) tend to reduce the yields at longer maturities, with an opposite negative effect on the net interest margin.

Two considerations can help us in testing this hypothesis. First, other things equal, the effects through this mechanism should be stronger for those banks heavily relying on traditional intermediation activity, for which this item makes up a differentially higher share of revenues. Secondly, this mechanism should reinforce the effects estimated for the interactions between unconventional monetary policy measures and bank capital, because the easing of future capital constraints is likely to be more effective for currently constrained banks. More in detail, we can make the following predictions:

(i) MINT * MRO > 0

(ii) MINT * SHADOW <0

(iii) MINT * SHADOW * TIER1<0

where MINT is the ratio of net interest margin to total assets. This is intended as a measure of the importance of traditional intermediation activity, as it measures the contribution of net interest margin to the formation of ROA.[19]

In addition, once controlling for the bank capital channel, our results regarding the "double" interactions of monetary policy measures with Tier1 ratio should become sharper and better capture, respectively, the role of asymmetric information and capital constraints.

Table 4 shows the results of the regressions in which we first include the "double interactions" between MINT and our two monetary policy measures (column b) and then the triple interactions with the Tier1 ratio (column c) – in addition to the remaining double interaction between Tier1 and MINT. The results are in line with our predictions, although the coefficients relating to conventional policy are not significant. For unconventional measures, instead, we find that indeed the negative effect on profits reinforces the (negative) effect of capital constraints on the transmission of unconventional policy, i.e. banks that have low capital and high dependence on MINT transmit even less.

4. Robustness checks

In this section we describe a number of robustness checks.

First, in Table 5 we check robustness to using the Eonia rather than the MRO as an indicator of conventional monetary policy. Column (a) reports the estimation including only conventional policy; column (b) includes also the differential between the Shadow rate and the Eonia. The results confirm those in the baseline regressions of Table 3. 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 captures in the period 2011-13, during which excess liquidity surged in connection with the 3-year LTROs (fig. 5). The results suggest that instead 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.

Second, in Table 6, column (b) we test whether our results are robust to the inclusion of the interactions between bank-specific variables and two macroeconomic controls:[20] unemployment and 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

[19] One may argue that it is not a very good measure as it is cyclical. While it could indeed be cyclical in the time-series, it does not change much in the cross-section, so that it can quite safely represent a structural indicator. Moreover, we also replicate our regression using a long-run average of the loan-to-asset ratio as an alternative indicator. Results (not shown) are robust.

[20] Column (a) reports, as usual, the baseline regression for memo.

markets and CDS market).[21] These variables allow us to control– when we estimate the interactions witrh 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.]

Third, in Table 6, column (c) 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. The results are very similar. One difference is that the interaction between conventional policy and the sovereign exposure is no longer significant.

Finally, we include two other indicators that may capture additional effects of unconventional policy. Column (d) 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., 2015; Bulligan and Emiliozzi, 2016). Since, however, measures of the central bank balance sheet are not able to capture "announcement effects" of the various measures and the effects related to the ECB communication, in column (e) we include a dummy variable taking value 1 for the period July-September 2012,in order to capture the effect of the OMT announcement. In both cases, all our results are unaffected.

5 Alternative loan rates

In this section we replicate our baseline regression using alternative loan rates as dependent variables. The results are presented in Table 6. [to be completed]

[21] It should be noted that the CISS indicator is very highly correlated with sovereign spread of the more stressed countries during the sovereign debt crisis, while it has additional information content for the global crisis period.

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Tables and Figures

Table 1. Descriptive statistics

Variable	p25	p50	mean	p75	N
Loan rate (1)	2.27	3.11	3.40	4.43	10,330
Tier1 ratio	8.63	10.60	10.99	12.50	11,528
Liquidity ratio	16.32	33.34	44.04	59.76	11,522
Deposit ratio	0.08	0.30	0.32	0.50	11,355
Sovereign exposure	0.01	0.03	0.05	0.07	11,292
NPL ratio	2.69	4.67	6.17	7.35	10,213

(1) average rate on new loans to firms

Note: all variables are expressed in per cent.

Table 2. Interest rate channel of conventional and unconventional monetary policy in the euro area

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
Clustering	Year*Bank	Year*Bank	Year*Bank
Observations	8800	8800	8800

Table 3. Bank lending channel of conventional and unconventional monetary policy in the euro area

Dependent variable: average rate on loans to non -financial firms

	Only conventional MP	Conventional and unconventional MP	Excluding branches and subsidiaries of foreign banks	Not stressed countries	Stressed countries
	(a)	(b)	(c)	(d)	(e)
Dependent variable (t-1)	0.471 ***	0.465 ***	0.551 ***	0.459 ***	0.445 ***
Macroeconomic variables (t)					
MRO * Tier1 ratio	-0.003	-0.011 **	-0.010 **	-0.014 **	-0.007
MRO * Liquidity ratio	0.000	0.000	0.000	0.000	0.000
MRO * Deposit ratio	-0.091 **	-0.128 ***	-0.112 ***	-0.104 *	-0.097
MRO * Sovereign exposure	-0.034	-0.548 **	-0.482 **	-1.069 **	-0.322
MRO * NPL ratio	0.001	0.000	-0.004	0.006	-0.005
SHADOW-MRO * Tier1 ratio		0.011 ***	0.009 ***	0.012 *	0.013 **
SHADOW-MRO * Liquidity ratio		0.000	0.000	0.000	0.000
SHADOW-MRO * Deposit ratio		0.062	0.074 *	0.025	0.084
SHADOW-MRO * Sovereign exposure		0.673 ***	0.595 **	0.918 ***	0.591 **
SHADOW-MRO * NPL ratio		0.000	0.003	-0.007 **	0.004
Bank characteristics (t-1)					
Tier1 ratio	-0.017 ***	0.012	0.014	0.002	0.021
Liquidity ratio	0.000	0.000	0.000	0.001	0.000
Deposit ratio	0.853 ***	0.982 ***	1.015 ***	0.441	1.457 ***
Sovereign exposure	-0.506	1.254 **	1.250 **	1.090	1.631 **
NPL ratio	0.013 ***	0.014 *	0.025 ***	-0.017	0.032 ***
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	8600	6958	4927	3673

Table 4. Including the 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 * Liquidity ratio	0.011 ***	0.012 ***	0.025 ***
SHADOW-MRO * Deposit ratio	0.000	-0.001	-0.001
SHADOW-MRO * Sovereign exposure	0.062	0.076 *	0.091 **
SHADOW-MRO * NPL ratio	0.673 ***	0.636 ***	0.606 ***
SHADOW-MRO * NPL ratio	0.000	0.000	0.001
Bank capital channel			
MRO * Net interest margin		-0.008	-0.089
SHADOW-MRO * Net interest margin		-0.046 **	0.068
Net interest margin		-0.139 *	0.160
MRO * Net interest margin * Tier1 ratio			0.008
SHADOW-MRO * Net interest margin * Tier1 ratio			-0.010 **
Net interest margin * 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. Bank lending channel:
using alternative monetary policy indicators

Dependent variable: average rate on loans to non -financial firms

	Using the EONIA rate	Using the EONIA rate and the shadow-EONIA spread	Including the EONIA-MRO rate
	(a)	(b)	(c)
Dependent variable (t-1)	0.469 ***	0.464 ***	0.464 ***
Macroeconomic variables (t)			
EONIA * Tier1 ratio	-0.004	-0.009 *	
EONIA * Liquidity ratio	0.000	0.000	
EONIA * Deposit ratio	-0.095 ***	-0.116 ***	
EONIA * Sovereign exposure	-0.123	-0.439 **	
EONIA * NPL ratio	0.001	0.001	
SHADOW-EONIA * Liquidity ratio		0.009 ***	
SHADOW-EONIA * Deposit ratio		0.000	
SHADOW-EONIA * Sovereign exposure		0.051	
SHADOW-EONIA * NPL ratio		0.564 ***	
SHADOW-EONIA * NPL ratio		0.000	
MRO * Tier1 ratio			-0.010 *
MRO * Liquidity ratio			0.000
MRO * Deposit ratio			-0.098 **
MRO * Sovereign exposure			-0.461 *
MRO * NPL ratio			0.001
SHADOW-MRO * Liquidity ratio			0.010 ***
SHADOW-MRO * Deposit ratio			0.000
SHADOW-MRO * Sovereign exposure			0.035
SHADOW-MRO * NPL ratio			0.585 ***
SHADOW-MRO * NPL ratio			0.000
EONIA-MRO * Liquidity ratio			-0.013
EONIA-MRO * Deposit ratio			0.000
EONIA-MRO * Sovereign exposure			-0.252
EONIA-MRO * NPL ratio			-0.881
EONIA-MRO * NPL ratio			0.001
Bank characteristics (t-1)			
Tier1 ratio	-0.018 ***	0.000	0.004
Liquidity ratio	0.000	0.000	0.000
Deposit ratio	0.833 ***	0.895 ***	0.826 ***
Sovereign exposure	-0.463	0.669	0.763
NPL ratio	0.013 ***	0.014 **	0.014
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	8600	8600

Table 6. Robustness checks

Dependent variable: average rate on loans to non -financial firms					
	Baseline	Controlling for interactions with other macro variables	Using the slope of the yield curve	Including excess liquidity	Including dummy for OMT
	(a)	(b)	(c)	(d)	(e)
Dependent variable (t-1)	0.465 ***	0.461 ***	0.466 ***	0.465 ***	0.465 ***
Macroeconomic variables (t)					
MRO * Tier1 ratio	-0.011 **	-0.010	0.000	-0.008	-0.011 **
MRO * Liquidity ratio	0.000	0.000	0.000	0.000	0.000
MRO * Deposit ratio	-0.128 ***	-0.127 **	-0.068	-0.087 *	-0.128 ***
MRO * Sovereign exposure	-0.548 **	-0.719 **	0.107	-0.430 *	-0.545 **
MRO * NPL ratio	0.000	0.002	0.001	0.001	0.000
SHADOW-MRO * Tier1 ratio	0.011 ***	0.010 ***		0.011 ***	0.011 ***
SHADOW-MRO * Liquidity ratio	0.000	0.000		0.000	0.000
SHADOW-MRO * Deposit ratio	0.062	0.063		0.066	0.063
SHADOW-MRO * Sovereign exposure	0.673 ***	0.598 **		0.677 ***	0.673 ***
SHADOW-MRO * NPL ratio	0.000	0.000		0.000	0.000
Slope of the yield curve * Tier1 ratio			0.015 **		
Slope of the yield curve * Liquidity ratio			0.000		
Slope of the yield curve * Deposit ratio			0.118		
Slope of the yield curve * Sovereign exposure			0.996 ***		
Slope of the yield curve * NPL ratio			-0.002		
Bank characteristics*Unemployment		Yes			
Bank characteristics*CISS indicator		Yes			
Bank characteristics*Excess liquidity				Yes	
OMT dummy*Deposit ratio					0.132 ***
OMT dummy*Other bank characteristics					Yes
Bank-specific controls	Yes	Yes	Yes	Yes	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	8600	8600	8600	8600

Table 7. Bank lending channel in the euro area: using various lending rates

Dependent variable: average rate on loans to non -financial firms					
	Average rate on new loans to firms	Average rate on new loans to firms over 1 million	Average rate on new loans to firms less 1 million	Average rate on credit lines	Average rate on new mortgage loans to households
	(a)	(b)	(c)	(d)	(e)
Dependent variable (t-1)	0.465 ***	0.394 ***	0.573 ***	0.791 ***	0.739 ***
Macroeconomic variables (t)					
MRO * Tier1 ratio	-0.011 **	0.001	-0.010 *	-0.011	-0.007 **
MRO * Liquidity ratio	0.000	0.000	0.000 *	-0.001	0.000
MRO * Deposit ratio	-0.128 ***	-0.016	-0.107 **	0.050	-0.028
MRO * Sovereign exposure	-0.548 **	-1.088 ***	-0.129	-0.155	0.068
MRO * NPL ratio	0.000	0.006	-0.002	-0.006	-0.002
SHADOW-MRO * Tier1 ratio	0.011 ***	0.009 **	0.010 ***	0.005	-0.004
SHADOW-MRO * Liquidity ratio	0.000	-0.001	0.000	0.001 **	0.001 ***
SHADOW-MRO * Deposit ratio	0.062	0.032	0.074 **	0.051	0.043 *
SHADOW-MRO * Sovereign exposure	0.673 ***	0.643 **	0.087	0.042	-0.085
SHADOW-MRO * NPL ratio	0.000	0.002	0.001	-0.001	0.001
Bank characteristics (t-1)					
Tier1 ratio	0.012	0.003	0.015 *	0.009	0.001
Liquidity ratio	0.000	0.000	-0.001 **	0.002	0.000
Deposit ratio	0.982 ***	0.882 ***	0.347 *	0.319	0.037
Sovereign exposure	1.254 **	1.844 ***	-0.373	-1.442 **	-0.729 **
NPL ratio	0.014 *	0.018 *	0.010	-0.012	0.000
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	8134	8486	8393	7819

Figure 1

Measures and timing of monetary policy in the euro area

(monthly data; percentage points)

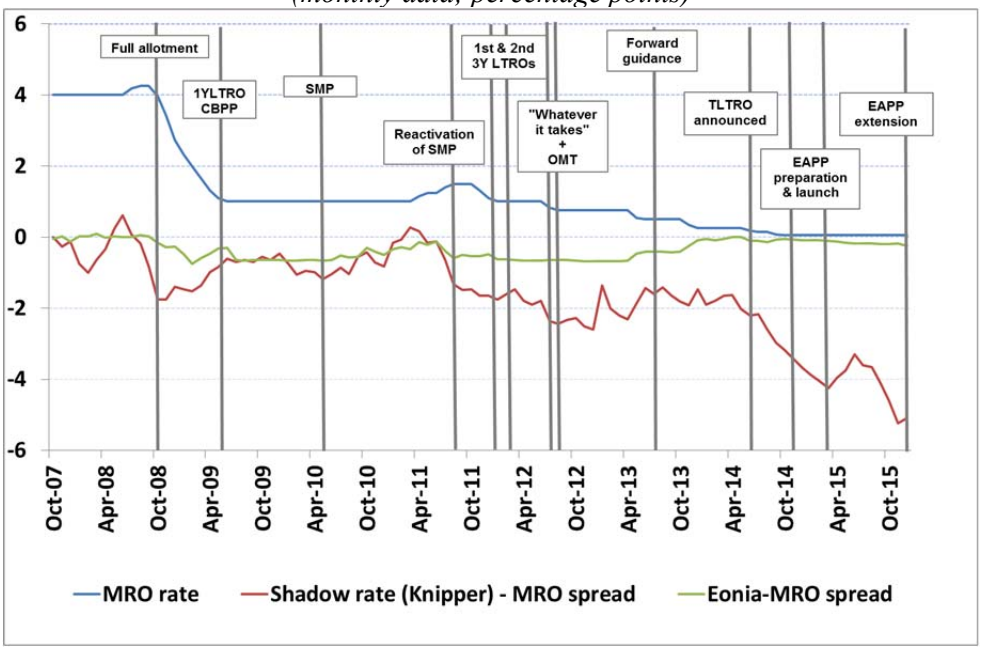
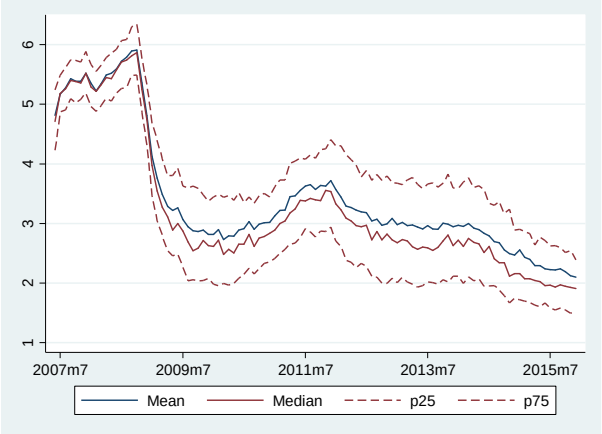


Figure 2

Rates on new loans to firms (1)

(monthly data; percentage points; cross-section average for each percentile)

All sample



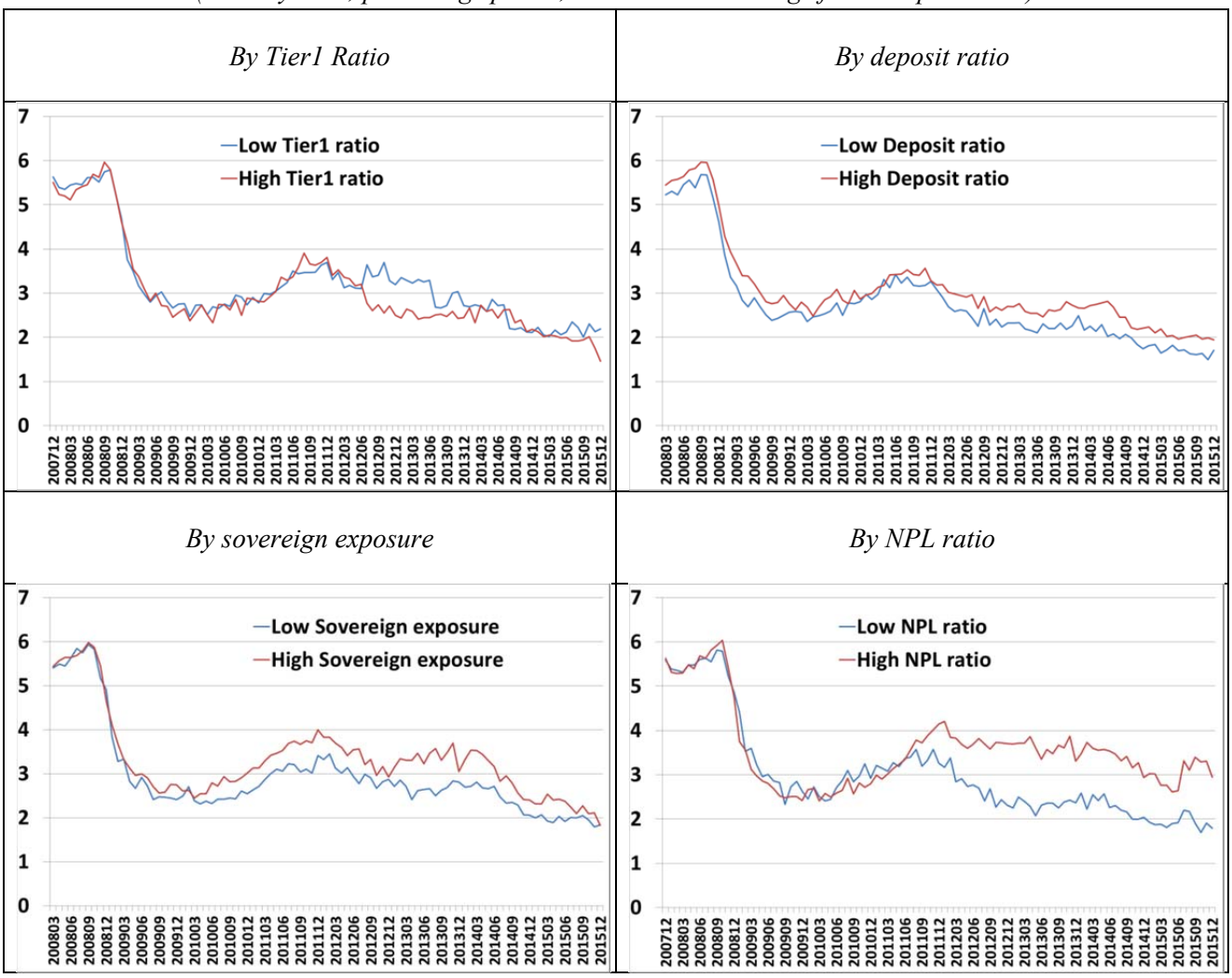
Stressed vs non-stressed countries

(1) Excluding overdrafts.

Figure 3

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 4

Effects of UMP on lending rates in the euro area: a counterfactual exercise

(monthly data; percentage points)

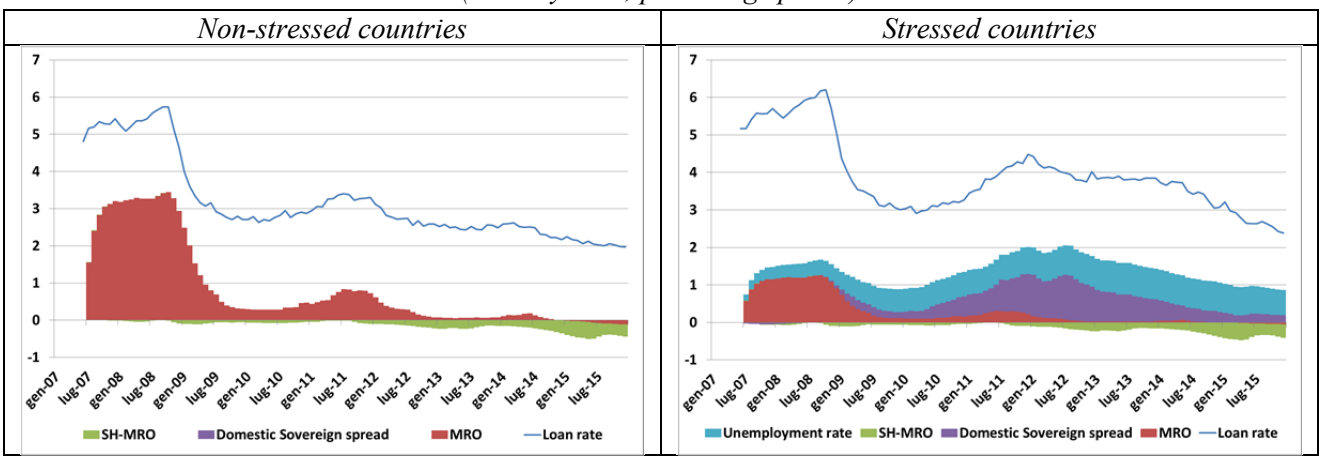


Figure 5

Excess liquidity in the euro area (based on ECB's balance sheet)

(monthly data; billions of euro)

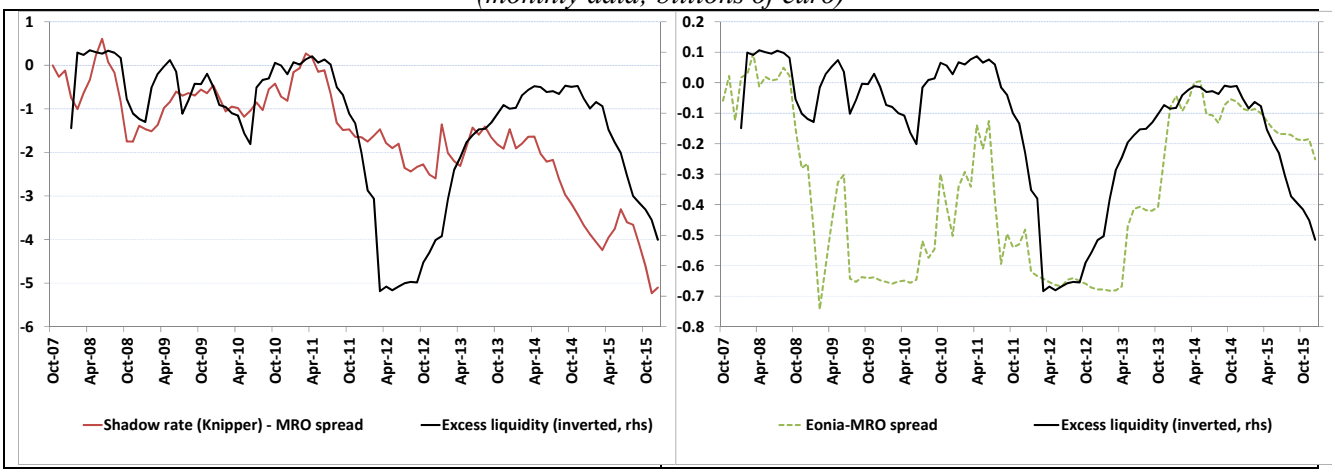


Figure 6

Alternative measures of unconventional monetary policy in the euro area

(monthly data; percentage points)