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Abstract

In this paper, we provide evidence for a risk-taking channel of monetary policy transmission in the euro area. Our dataset covers the period 2003Q1–2016Q2 and includes, in addition to the standard variables for real GDP growth, inflation, and the main refinancing rate, indicators of bank lending standards and bank lending margins. Based on vector autoregressive models with (i) sign restrictions and (ii) recursive identification, we show that banks react quickly and aggressively to an expansionary monetary policy shock by decreasing their lending standards. The banks' efforts to keep their lending margins stable appear to be successful, as we find a significant decrease over the medium-run in only one specification. Further analysis reveals that there are no significant asymmetries in the reaction of lending rates and deposit rates. Finally, country-specific estimations show that particularly banks in Ireland and Spain decreased their lending standards after an expansionary monetary policy shock.

JEL Codes: E44; E51; E52; E58; G28.

Keywords: European Central Bank; Macroprudential Policy; Monetary Policy Transmission; Risk-Taking Channel; Vector Autoregression.

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1 Introduction

With the onset of the Global Financial Crisis in 2007–2008, researchers and policymakers became increasingly interested in analyzing and understanding interdependencies between the real economy and financial markets. Since "excessive" risk-taking behavior by commercial banks is considered to be one of the factors that led to the outbreak of the Global Financial Crisis, analyzing the effects of monetary policy on banks' risk-taking behavior is of special interest.

The idea that a changing interest rate environment influences banks' perception of risk can be traced back to Hancock (1985) and Aharony et al. (1986), who find that lower short-term interest rates are related to a decrease in the profitability of commercial banks. Asea and Blomberg (1998) point out that the credit market is subject to regular cycles. During bust episodes, competition for liquidity (Acharya et al. 2012) and customers (Beck et al. 2006) increases, thereby narrowing banks' margins and increasing the temptation of more risk-taking.

Borio and Zhu (2012) are the first to use the term "risk-taking channel" and to explain its different facets. The first effect operates on the basis of valuations, incomes, and cash flows. Low policy rates and a high money supply tend to raise the prices of real and financial collateral, thereby reducing the banks' risk perception and increasing leverage (Adrian and Shin 2014), even if lending standards are held constant. Similarly, income and wealth increase, resulting in a higher risk tolerance of borrowers (Pratt 1964; Arrow 1970).

The second effect arises from the impact of monetary policy actions on the banks' profitability. Nominal rate-of-return targets are relatively sticky. Negative deviations would trigger stock price declines and cause serious pressure. Lowering short-term rates drives banks to search for higher yields in order to maintain the trust of their investors (Rajan 2006; Buch et al. 2014). Indirectly, a lower interest environment increases competition in the banking sector, which, in turn, also reduces the banks' ability to generate profits (Maudos and de Guevara 2004). A corresponding flattening of

the yield curve, for instance, by supplementary asset purchasing programs, further compresses banks' margins (Meaning and Zhu 2011; Alessandri and Nelson 2015).[1]

Recent empirical papers provide evidence for the existence of a risk-taking channel in the United States. Lower interest rates result in decreased lending standards (Abbate and Thaler 2015; Angeloni and Faia 2013; Delis and Kouretas 2011; Maddaloni and Peydró 2011), higher leverage (de Groot 2014; Adrian and Shin 2014), and increased asset risks (Angeloni et al. 2015). In addition, Dell'Ariccia et al. (2014) provide a theoretical foundation for a link between the degree of risk-taking and a bank's capital structure. Indeed, small and modestly capitalized banks are empirically found to take more risk (Altunbas et al. 2010; 2014; Buch et al. 2014; Dell'Ariccia et al. 2016; Ioannidou et al. 2015; Jiménez et al. 2014), a finding that can be explained by a relatively higher degree of competitive pressure and an inferior ability to adjust the capital structure.

There is also a growing literature showing evidence for a risk-taking channel in the euro area. Low interest rates are associated with an increase in banks' risk (Altunbas et al. 2010; Jiménez et al. 2014), lower lending standards (Maddaloni and Peydró 2011), and a decrease in the banks' interest rate margin (Claessens et al. 2017). Giannone et al. (2012) find that an expansion of intermediation of interbank transactions across the European Central Bank's (ECB) balance sheet exerts a small but significant effect on loans.

Our key contribution is to combine measures of the banks' propensity to take risks and the banks' profitability in a unified framework to obtain a clearer picture of the risk-taking channel of monetary policy in the euro area. For that purpose, we augment a standard vector autoregressive (VAR) monetary policy transmission model for the euro area and the period 2003Q1–2016Q2, with indicators of bank lending standards and bank lending margins. This makes our paper the first to consider the impact of monetary policy on both banking sector variables simultaneously.

[1] Quantitative easing in Japan can be seen as an example of this effect (Goyal and McKinnon 2003).

Based on (i) sign restrictions and (ii) recursive identification, we show that banks react quickly and aggressively to an expansionary monetary policy shock by decreasing their lending standards. The banks' efforts to keep their lending margins stable appear to be successful, as we find a significant decrease over the medium-run in only one specification. Consequently, our paper provides evidence for a risk-taking channel of monetary policy transmission in the euro area. Further analysis reveals that there are no significant asymmetries in the reaction of lending rates and deposit rates. Finally, country-specific estimations show that particularly banks in Ireland and Spain decreased their lending standards after an expansionary monetary policy shock.

The remainder of this paper is structured as follows. Section 2 introduces the data set and the empirical methodology. Section 3 presents the empirical results. Section 4 concludes with some policy implications.

2 Data and Econometric Methodology

2.1 Data

Our data set covers quarterly data for the euro area (changing composition) and the period 2003Q1−2016Q2, and consists of five variables.[2] First, we include the standard indicator for the monetary policy stance, that is, the main refinancing rate (MRR).[3] Second, we use the inflation rate based on the harmonized index of consumer prices excluding energy and food. Using a core inflation measure precludes exogenous price movements stemming from these two sources, allowing us to establish a parsimonious model without an exogenous oil price indicator. Third, we utilize the growth rate of real GDP as the measure of real economic activity.

In addition to these three standard variables, our fourth and fifth variables are two indicators for the banking sector. For our fourth variable, we use the banks' lending margin, defined by the ECB as the difference between interest rates on new business

[2]The start date coincides with the introduction of the quarterly bank lending survey by the ECB.

[3]As part of our robustness tests, we replace the MRR by (i) the EONIA and (ii) the shadow rate (Wu and Xia 2016).

loans and a weighted average interest rate on new deposits from households and non-financial corporations. This variable reflects the banking sector's ability to generate profit in its core field of credit lending. Declining margins could trigger the aforementioned search for yield and are expected to be a key element in the risk-taking channel. The overall euro area lending margin is calculated as the weighted average of country-specific interest rate margins with the countries' contribution to the ECB's capital as a weighting scheme.[4] Our fifth variable is a measure of lending standards that is taken from the ECB's bank lending survey of around 140 banks from all euro area countries. This indicator is calculated as the net percentage of banks reporting a tightening in credit standards (as opposed to an easing) in comparison to the previous quarter. The rationale behind using this variable is to measure the change of non-financial obstacles in credit lending, such as loan-to-value restrictions, collateral, or securities.

Figure 1 plots the two banking sector variables over time.[5] Lending standards tend to decrease between 2003 and 2005 and remain more or less stable thereafter until the onset of the liquidity crisis in money markets (2007Q3). The indicator peaks at the time of the Lehman collapse (2008Q3), and returns towards neutral lending standards thereafter with the euro area sovereign debt crisis in 2011 being the only exception. Lending margins tend to decrease over time until the Lehman collapse. After 2009 they remain more or less constant with a strong peak in 2014Q1 being the only exception.

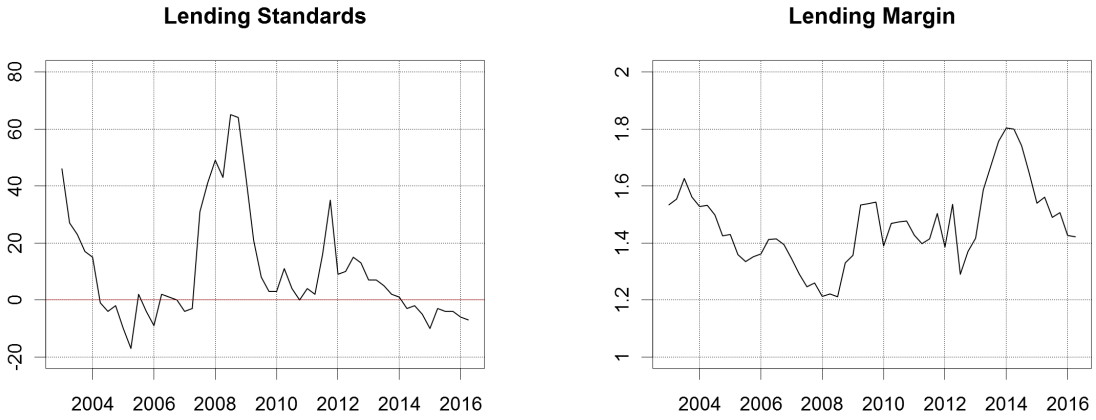
Figure 2 shows scatter plots between both banking sector variables and the MRR. In line with previous research, we find a positive relationship between lending standards and the MRR, that is, lower interest rate levels are associated with lower banking standards and vice versa (see left panel). The relationship between the lending margin and the MRR, in contrast, is negative, implying an increase in margins for lower short-term interest rates and vice versa (see right panel). However, it remains to be

[4]The weighting scheme can be found in Table A1 in the Appendix.

[5]The corresponding plots for the three standard monetary policy transmission variables and the alternative indicators of the monetary policy stance can be found in Figure A1 in the Appendix. Separate plots of the lending rates and the deposit rates can be found in Figure A2 in the Appendix.

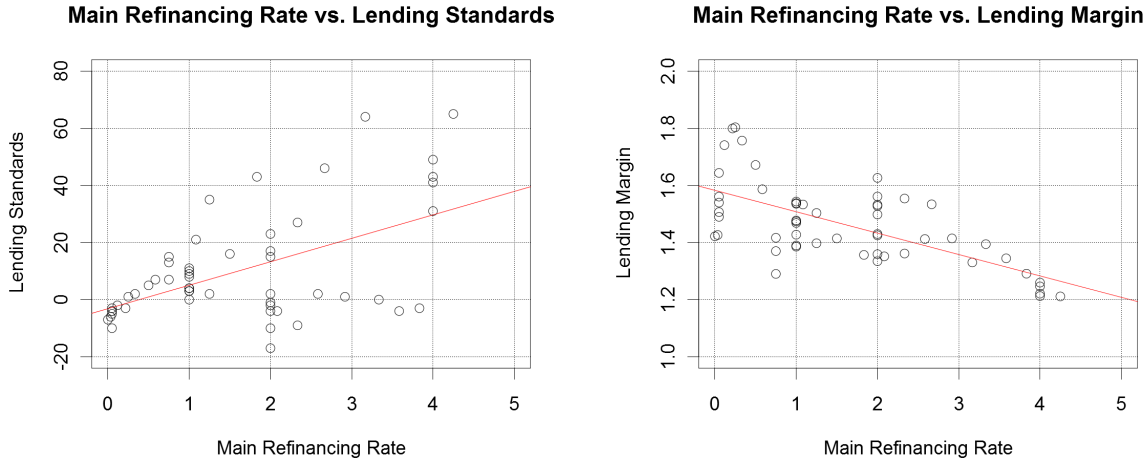
seen if the bivariate contemporaneous relationships hold in a multivariate VAR model that also incorporates dynamics in the connections across variables.

Figure 1: Lending Standards and Lending Margin in the Euro Area



Notes: Lending standards: Net percentage of banks reporting a tightening in credit standards (as opposed to an easing) in comparison to the previous quarter in the euro area bank lending survey. Lending margin: Difference between interest rates on new business loans and a weighted average interest rate on new deposits from households and non-financial corporations. *Source*: ECB.

Figure 2: Scatter Plots for Banking Sector Variables and Main Refinancing Rate



Notes: Figure shows scatter plots between the main refinancing rate and (i) lending standards (left panel, $\rho = 0.54$) and (ii) the lending margin (right panel, $\rho = -0.67$).

2.2 Econometric Methodology

Our empirical strategy builds on two different identification schemes. Both methods are based on a linear VAR model. In general, a VAR(p) model with n endogenous

variables can be written in reduced form as follows:

$$y_t = v + \sum_{i=1}^{p} A_i y_{t-i} + u_t \tag{1}$$

y_t is the 5×1 vector of endogenous variables including lending standards, the lending margin, real GDP growth, core inflation, and the MRR. v is the 5×1 vector of intercepts, u_t is the 5×1 vector of non-structural error terms, and the A_i are 5×5 parameter matrices.

Both the Bayesian information criterion and the Hannan Quinn information criterion favor a lag length of 1 for our five-variable VAR model. However, preliminary estimations show that a VAR(1) model does not sufficiently capture the dynamics in the system. In contrast, the use of two lags eliminates serial correlation in the error terms according to an asymptotic Portmanteau test. Consequently, we employ a VAR(2) model in the following.

To identify the effects of monetary policy shocks on the other variables in the system, we have to transform the reduced form VAR in Eq.(1) into a structural VAR. In a first step, we apply a Bayesian estimation method with sign restrictions.[6] We use a pure sign restriction approach and identify only a single impulse vector. We assume that an expansionary monetary policy shock leads to (i) a decrease in the MRR, (ii) an increase in core inflation, and (iii) an increase in real GDP growth. Table 1 summarizes the restrictions, which are assumed to hold on impact and for four quarters thereafter (Mountford and Uhlig 2009).

Table 1: Sign Restrictions for Bayesian Estimation

Lending Standards	none
Lending Margin	none
Real GDP Growth	+
Core Inflation	+
Main Refinancing Rate	−

Notes: Table summarizes sign restrictions for an expansionary monetary policy shock in the Bayesian estimations. Restrictions are assumed to hold on impact and for four quarters thereafter.

[6] A detailed setup of the model is given in Uhlig (2005).

Uhlig (2005) points out that the major advantage of sign restrictions, that is, allowing for a contemporaneous reaction of all variables in the VAR to an expansionary monetary policy shock, comes at some cost. In his view, sign restrictions can be seen as more restrictive than a recursive scheme. As a consequence, we impose three different recursive schemes as our second identification strategy, thereby (i) allowing for an instantaneous reaction of the credit variables to monetary policy shocks in some of the schemes and (ii) restricting this reaction to zero in others.

First, following Buch et al. (2014), we order the credit variables first. They argue that credit contracts do not respond immediately to monetary policy interventions or shocks to output and inflation since renegotiations of lending rates or lending standards typically take time. In the extreme case, new lending rates and lending standards can only be applied to new contracts, implying an even longer outside lag. We order the lending standards before the lending margin, which is in line with the "search-for-yield" idea, as changing lending margins will set incentives for changes in lending standards. The ordering of the remaining variables follows the standard setup of a monetary policy transmission VAR as real GDP growth is ordered third, core inflation is ordered fourth, and the MRR is ordered last. This reflects the well-known outside lag of monetary policy in its impact on prices and output and the possibility of the central bank to react instantaneously to macroeconomic shocks, that is, to preclude any inside lags in monetary policy.

Second, in line with Bekaert et al. (2013) and Bruno and Shin (2015), who find an immediate adjustment of credit supply after monetary policy shocks, we order both credit variables last, while leaving the remaining order unchanged. Third, we also split the credit variables and order real GDP growth and core inflation first since loan officer typically observe the current status of the economy when they answer the ECB's bank lending survey. Since the ECB might consider the results of the survey in its decisions lending standards are ordered third. In line with this argumentation, the MRR is ordered fourth and the lending margin is ordered last since an inflation "targeting"

central bank should not attach much importance to the banks' profitability in its decisions. Table 2 summarizes the different Cholesky orderings.

Table 2: Different Cholesky Orderings

Ordering 1	**Ordering 2**	**Ordering 3**
Lending Standards	Real GDP Growth	Real GDP Growth
Lending Margin	Core Inflation	Core Inflation
Real GDP Growth	Main Refinancing Rate	Lending Standards
Core Inflation	Lending Standards	Main Refinancing Rate
Main Refinancing Rate	Lending Margin	Lending Margin

Notes: Table summarizes the different Cholesky orderings used for recursive identification of the structural errors in the VAR model.

3 Empirical Results

3.1 Baseline Results

Sign Restrictions using the MRR

Figure 3 shows the baseline results of our sign-restricted model with the MRR as indicator of the monetary policy stance. The responses of both credit variables are consistent with the findings of other VAR papers for the United States (Abbate and Thaler 2015; Afanasyeva and Güntner 2014). Lending standards quickly fall after an expansionary monetary policy shock of 100 basis points. The reaction is significant for a period of one to six quarters after the shock with a peak effect of more than −30 pp after three quarters. Lending margins tend to decrease for five quarters after an expansionary monetary policy shock. However, this reaction is insignificant, indicating that banks are able to shield their lending margins from decreasing short-term interest rates and, hence, their profitability in conventional credit business. Finally, real GDP growth and core inflation both increase after an expansionary monetary policy shock.

Recursive Identification using the MRR

Next, we employ the three different recursive schemes described in Section 2.2 to identify the reaction of lending standards and the lending margin after an expansionary

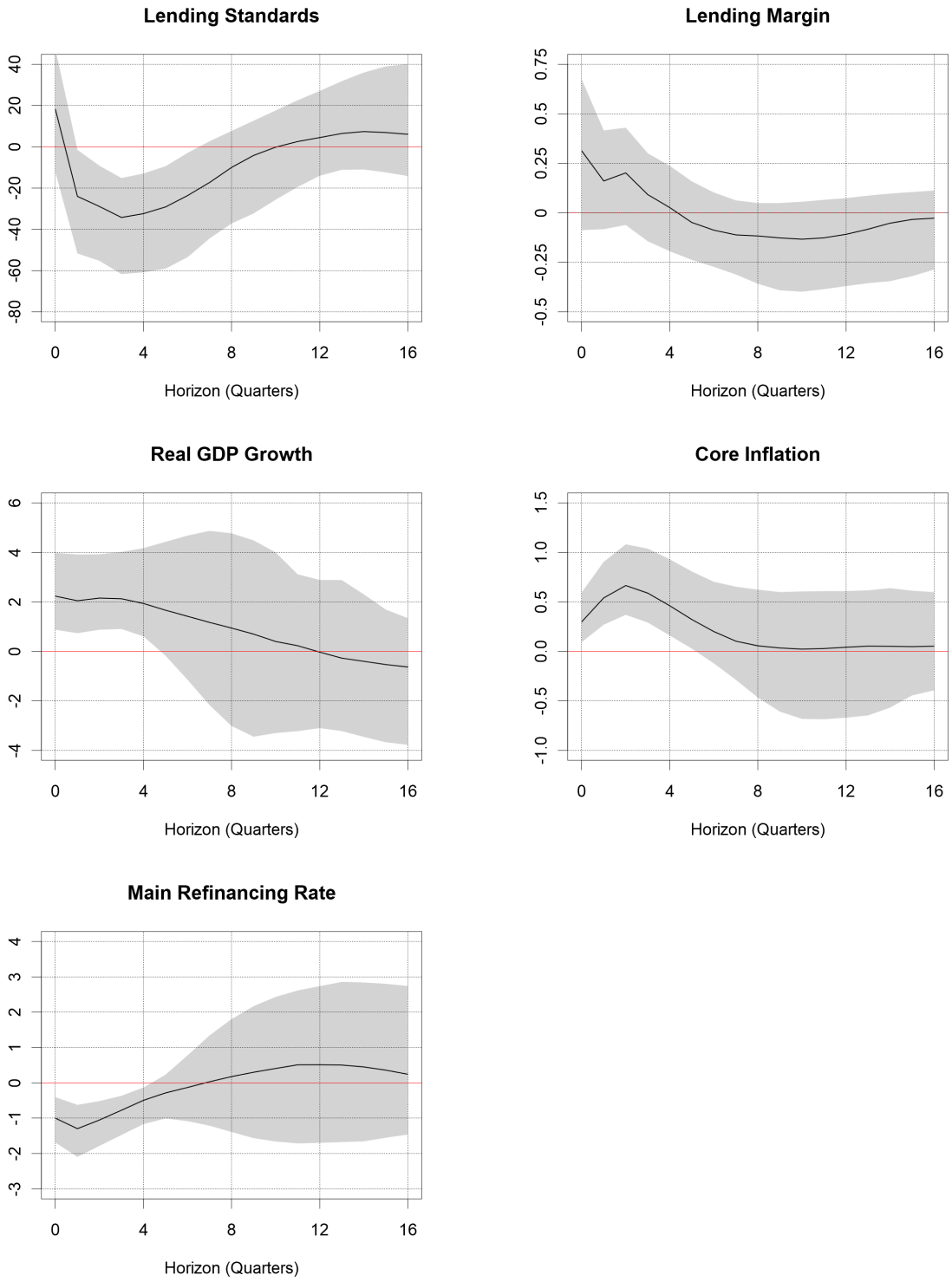
monetary policy shock of 100 basis points. Figure 4 presents the corresponding impulse responses. Our key results remain robust. The impulse responses for lending standards show an immediate downward adjustment (if possible) that lasts up to five quarters with a peak effect of more than −25 pp after two quarters. Lending margins tend to decrease after an expansionary monetary policy shock as well. However, this reaction is insignificant, confirming the notion that banks are able to shield their lending margins.

Sign Restrictions using Alternative Monetary Policy Indicators

To explore the robustness of our findings, we replace the MRR by (i) the Euro Overnight Index Average (EONIA) and (ii) the shadow rate (Wu and Xia 2016). In particular, the latter indicator of the monetary policy stance should be helpful at the zero-lower bound of interest rates as it quantifies all unconventional monetary policy measures in a single interest rate and can take negative values. Figure 5 shows the results.

The results concerning the reduction of the lending standards hold qualitatively. However, these are quantitatively less pronounced compared to the estimations using the MRR. Both, the significance (EONIA: one to four quarters after the shock; shadow rate: one to three quarters after the shock) and the peak effects (EONIA: −22 pp; shadow rate: −12 pp) are less pronounced. Similarly to the previous results, we find no evidence of a compression of the lending margin when employing the EONIA as indicator of monetary policy. However, in case of the shadow rate, we observe a significant reduction of the lending margin five to eight quarters after the shock.

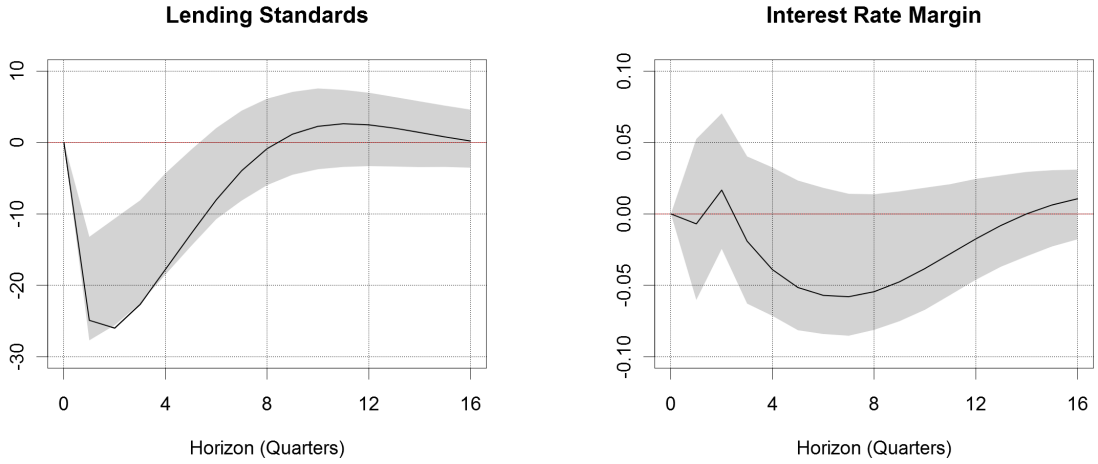
Figure 3: Impulse Responses Based on Sign Restrictions (Main Refinancing Rate)



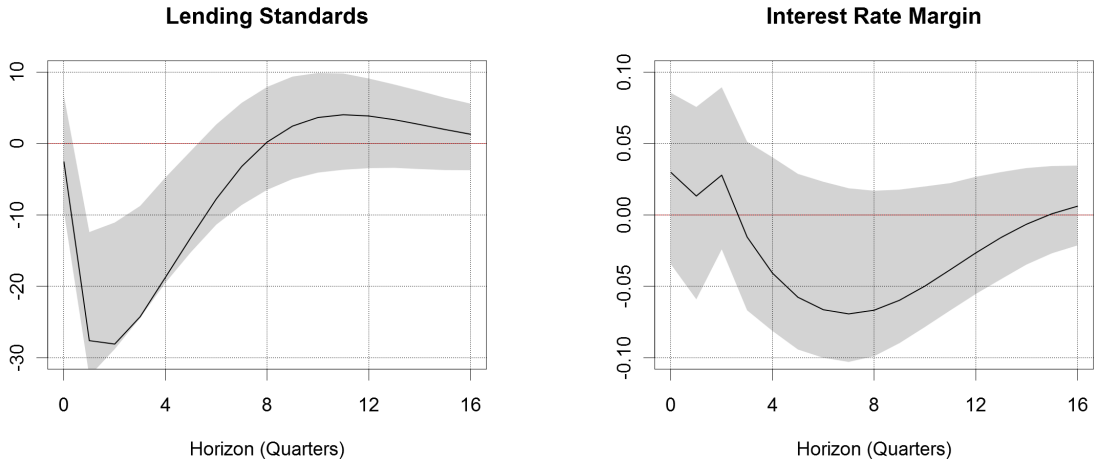
Notes: Solid lines represent median impulse responses (in percentage points) to an expansionary monetary policy shock of 100 basis points based on the sign restrictions in Table 1. Grey-shaded areas indicate the 16% and 84% quantiles of the posterior distribution based on 5,000 accepted MCMC draws.

Figure 4: Impulse Responses Based on Recursive Identification

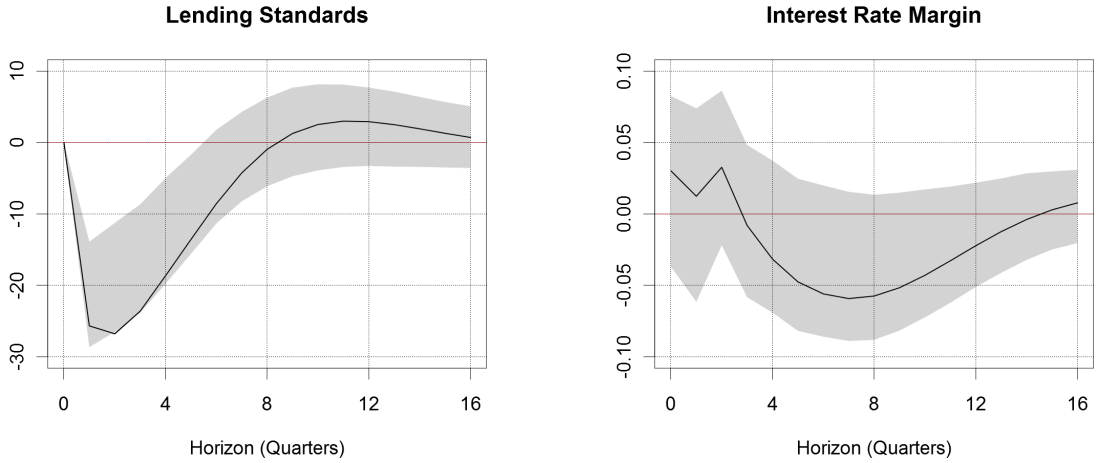
Ordering 1: Lending Standards, Lending Margin, Real GDP Growth, Core Inflation, MRR



Ordering 2: Real GDP Growth, Core Inflation, MRR, Lending Standards, Lending Margin



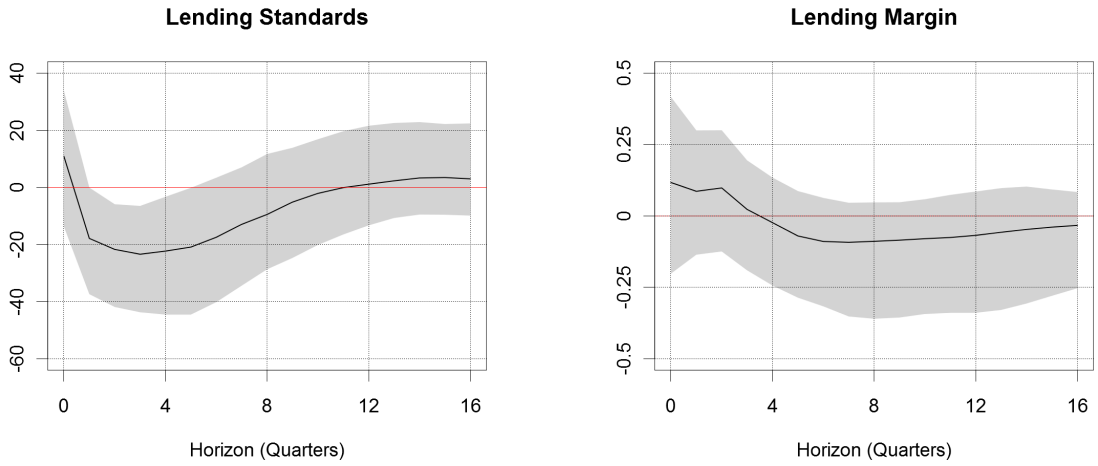
Ordering 3: Real GDP Growth, Core Inflation, Lending Standards, MRR, Lending Margin



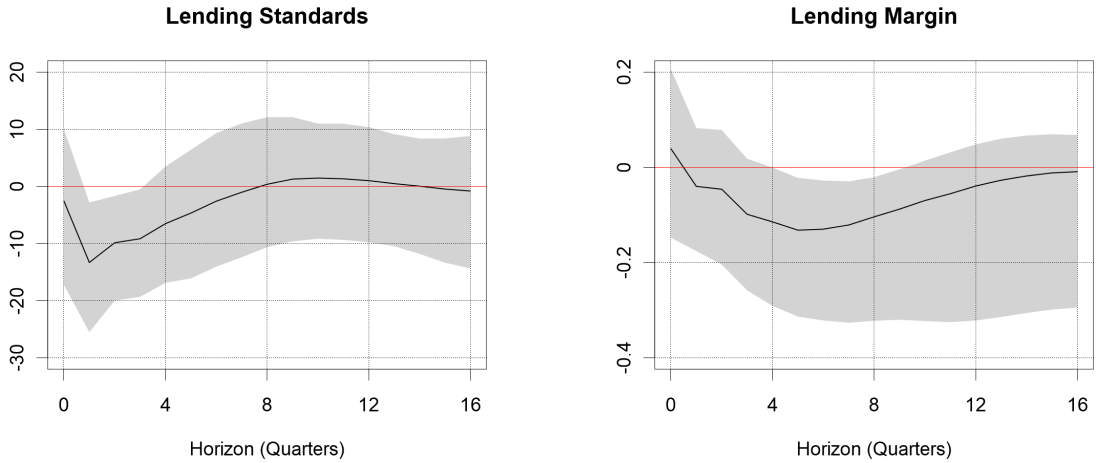
Notes: Solid lines represent mean impulse responses (in percentage points) to an expansionary monetary policy shock of 100 basis points based on recursive identification. Grey-shaded areas indicate 68% confidence bands derived by bootstrapping and 5,000 replications. Full set of impulse responses is available on request.

Figure 5: Impulse Responses for Alternative Monetary Policy Indicators

Euro Overnight Index Average



Shadow Rate (Wu and Xia 2016)



Notes: Solid lines represent selected median impulse responses (in percentage points) to an expansionary monetary policy shock of 100 basis points based on the sign restrictions in Table 1. Grey-shaded areas indicate the 16% and 84% quantiles of the posterior distribution based on 5,000 accepted MCMC draws. Full set of impulse responses is available on request.

3.2 Extensions

Lending Rate versus Deposit Rates

All but one of the previously shown impulse response functions indicate an efficient pass-through of monetary policy shocks to lending rates and deposit rates in the sense that the interest rate margin, that is, the difference between these two series, remains relatively stable. To explore this in more detail we modify our baseline model so that

it contains both, deposit rates and lending rates in addition to credit standards, real GDP growth, core inflation, and the MRR. Figure 6 shows the corresponding impulse responses.

We observe a significant decrease in the deposit rates on impact and during the first three quarters after an expansionary monetary policy shock. The reaction of the lending rates, however, is insignificant over the complete horizon. The initially stronger negative reaction of the deposit rates is line with the previous figures as we observe a tendency towards a positive reaction of the lending margin over the first four quarters. However, when comparing the posterior distributions we can easily see that the responses of the lending rates and the deposit rates are not statistically different.

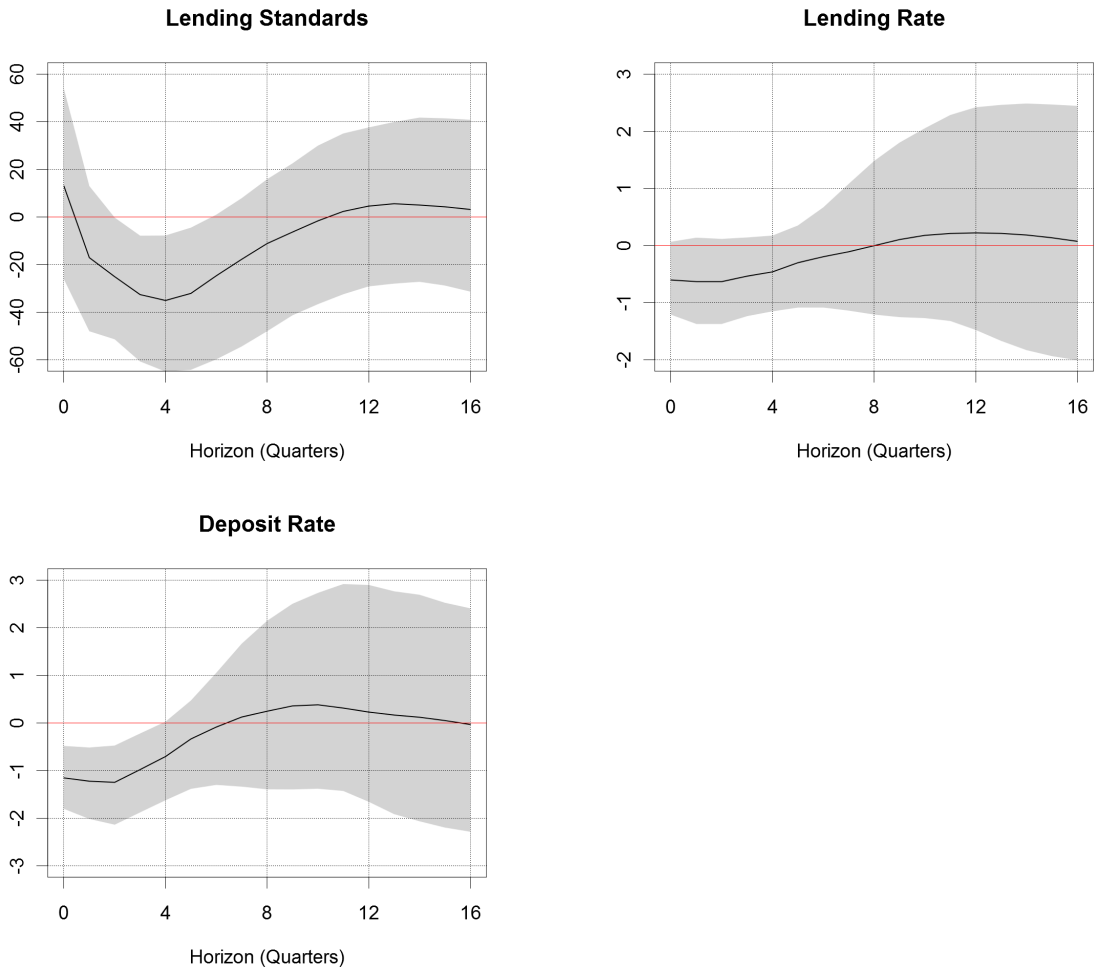
Different Groups of Euro Area Countries

Inspired by previous work on asymmetries in the monetary policy transmission across countries (see, for instance, Ciccarelli et al. 2013), we also analyze differences in the reaction of countries that were/are more severely affected by the financial crisis (Greece, Ireland, Italy, Portugal, and Spain) compared to the two largest euro area economies (France and Germany). For that purpose, we replace the two euro area-wide credit variables in the VAR model with their country-specific counterparts, while leaving the standard monetary policy transmission variables at the euro area level.[7]

Figure 7 shows the impulse responses for all seven countries. Most striking are the results for Ireland and Spain, two countries that experienced a huge banking crisis during our sample period. In particular, lending standards decrease for eight (Spain) and nine (Ireland) quarters after an expansionary monetary policy shock with peak effects of −30 pp (Spain) and −50 pp (Ireland), repectively. In addition, we also find a weakly significant reduction of lending standards in Portugal and France, whereas the opposite can be observed for Germany. Finally, we can also notice some weakly signficant increases of the lendings margins in case of Italy, France, and Germany.

[7]The evolution of lending standards and lending margins for all seven countries can be found in Figure A3 in the Appendix.

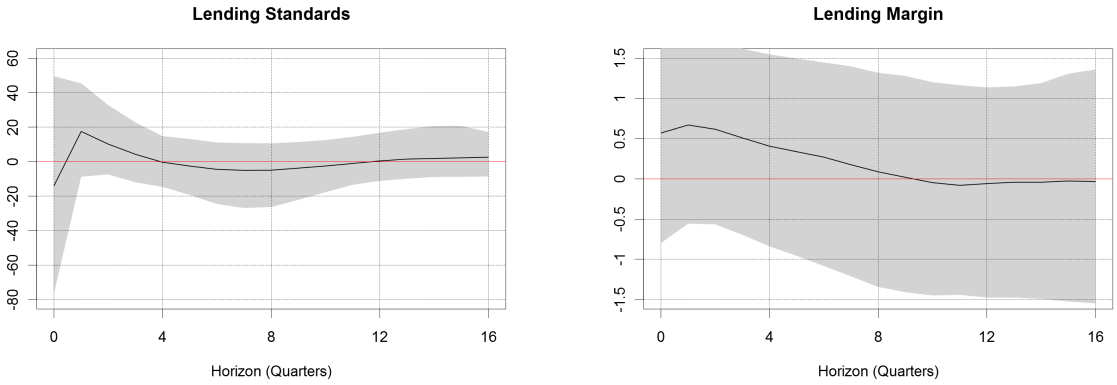
Figure 6: Impulse Responses for Lending Rates and Deposit Rates



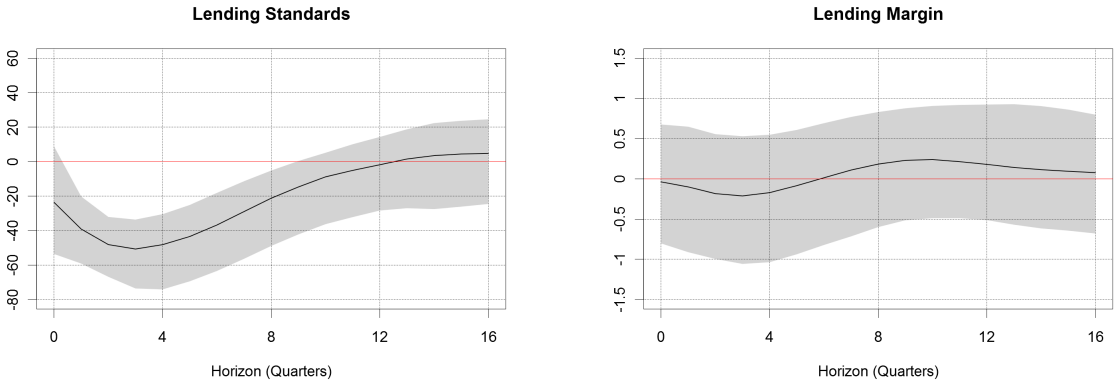
Notes: Solid lines represent selected median impulse responses (in percentage points) to an expansionary monetary policy shock of 100 basis points based on the sign restrictions in Table 1. Grey-shaded areas indicate the 16% and 84% quantiles of the posterior distribution based on 5,000 accepted MCMC draws. Full set of impulse responses is available on request.

Figure 7: Impulse Responses for Different Countries

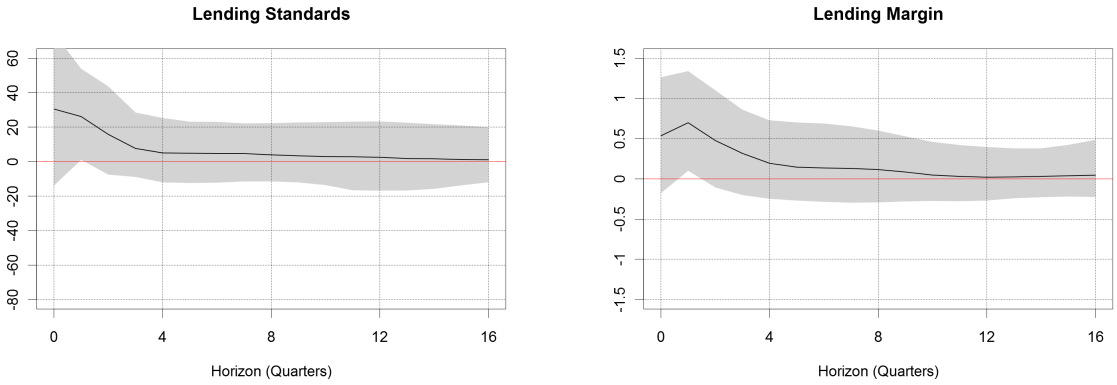
Greece



Ireland



Italy



Portugal

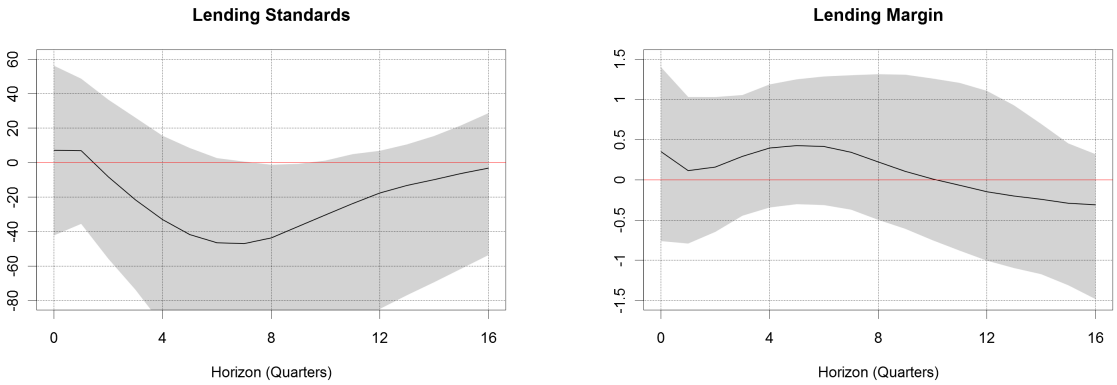
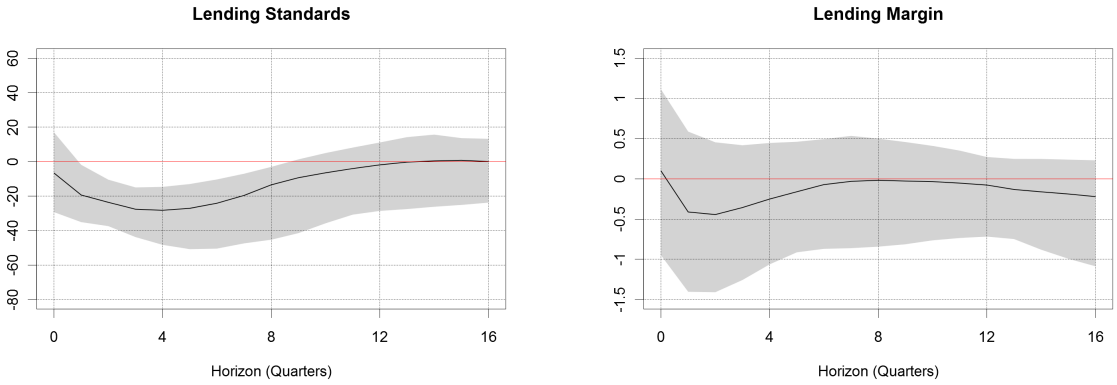
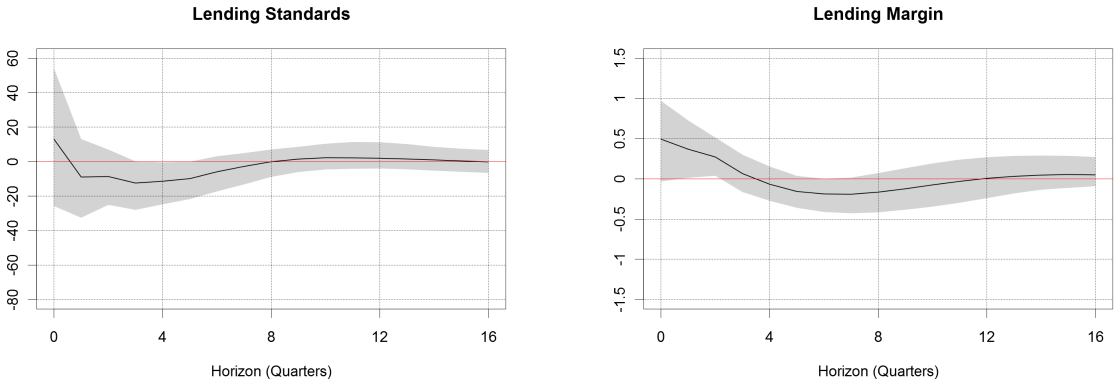


Figure 7: Impulse Responses for Different Countries (Continued)

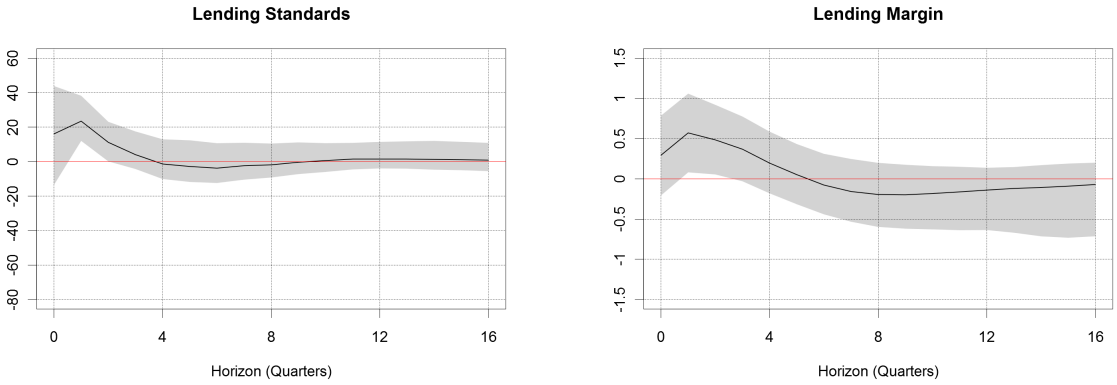
Spain



France



Germany



Notes: Solid lines represent selected median impulse responses (in percentage points) to an expansionary monetary policy shock of 100 basis points based on the sign restrictions in Table 1. Grey-shaded areas indicate the 16% and 84% quantiles of the posterior distribution based on 5,000 accepted MCMC draws. Full set of impulse responses is available on request.

4 Conclusions

In this paper, we augment a standard monetary policy transmission model for the period 2003Q1–2016Q2 with measures of lending standards and lending margins to investigate the risk-taking channel of monetary policy in the euro area. Based on VAR models with (i) sign restrictions and (ii) recursive identification, we show that commercial banks react quickly and aggressively to an expansionary monetary policy shock by decreasing their lending standards for up to six quarters. The banks' efforts to keep their lending margins stable appear to be successful, as we find a significant decrease over the medium-run in only one specification. Consequently, our paper provides evidence for a risk-taking channel of monetary policy transmission in the euro area.

Our findings are in line with previous results for the United States (and the euro area). However, we are not able to consistently verify the theoretical idea of a credit margin compression due to expansionary monetary policy in the euro area. Further analysis reveals that there are no significant asymmetries in the reaction of lending rates and deposit rates. Finally, country-specific estimations show that particularly banks in Ireland and Spain, two countries that experienced a huge banking crisis during our sample period, decreased their lending standards after an expansionary monetary policy shock.

Our paper has several policy implications. First, central bankers should keep the risk-taking channel in mind when setting monetary policy. The case of Japan has shown that prolonged periods of low interest rates may lead to the build-up of risk in the credit system. Second, we provide some implications for macroprudential policy. Proposals to counteract the banks' risk-taking behavior, for instance, restrictions on lending standards can have some costs in times of low interest rates. If banks cannot shield their interest rate margins by taking more risk, profits will fall, which could increase instability in the financial system rather than decreasing it.

Our analysis focuses on the risk-taking channel in the euro area as a whole and on several of its member countries. It might be the case that there are differences in the impact of monetary policy on small versus large banks, in particular with respect to

the lending margin. Allowing for these asymmetries would be an interesting task of future research.

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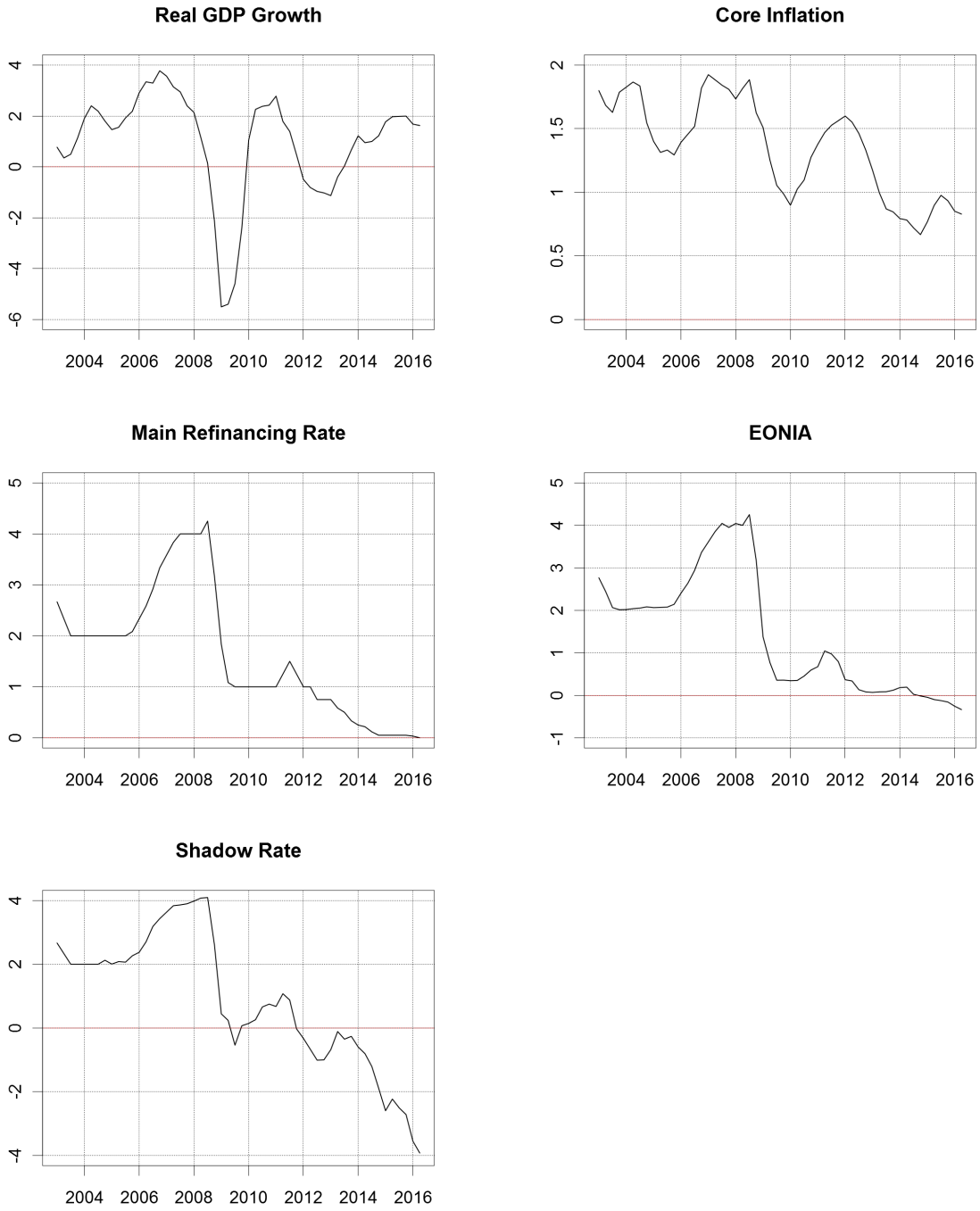
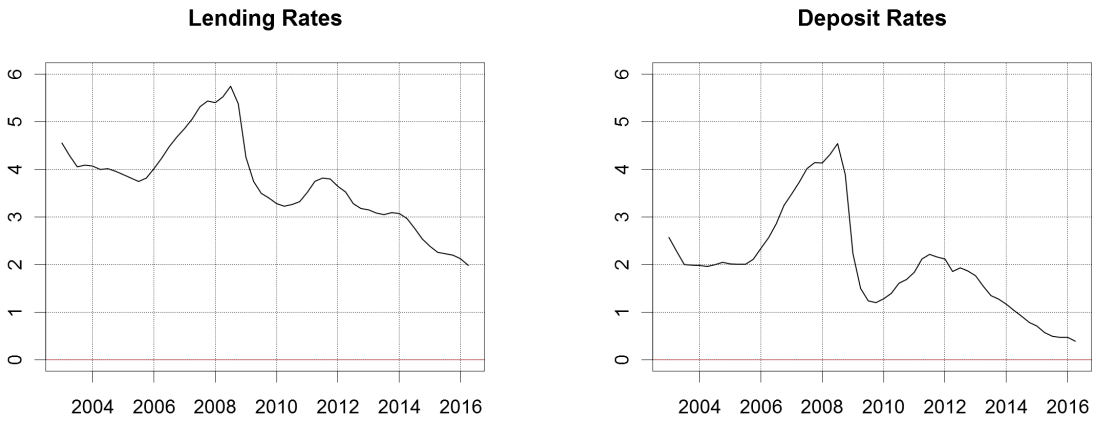
Appendix

Figure A1: Macroeconomic Variables for the Euro Area



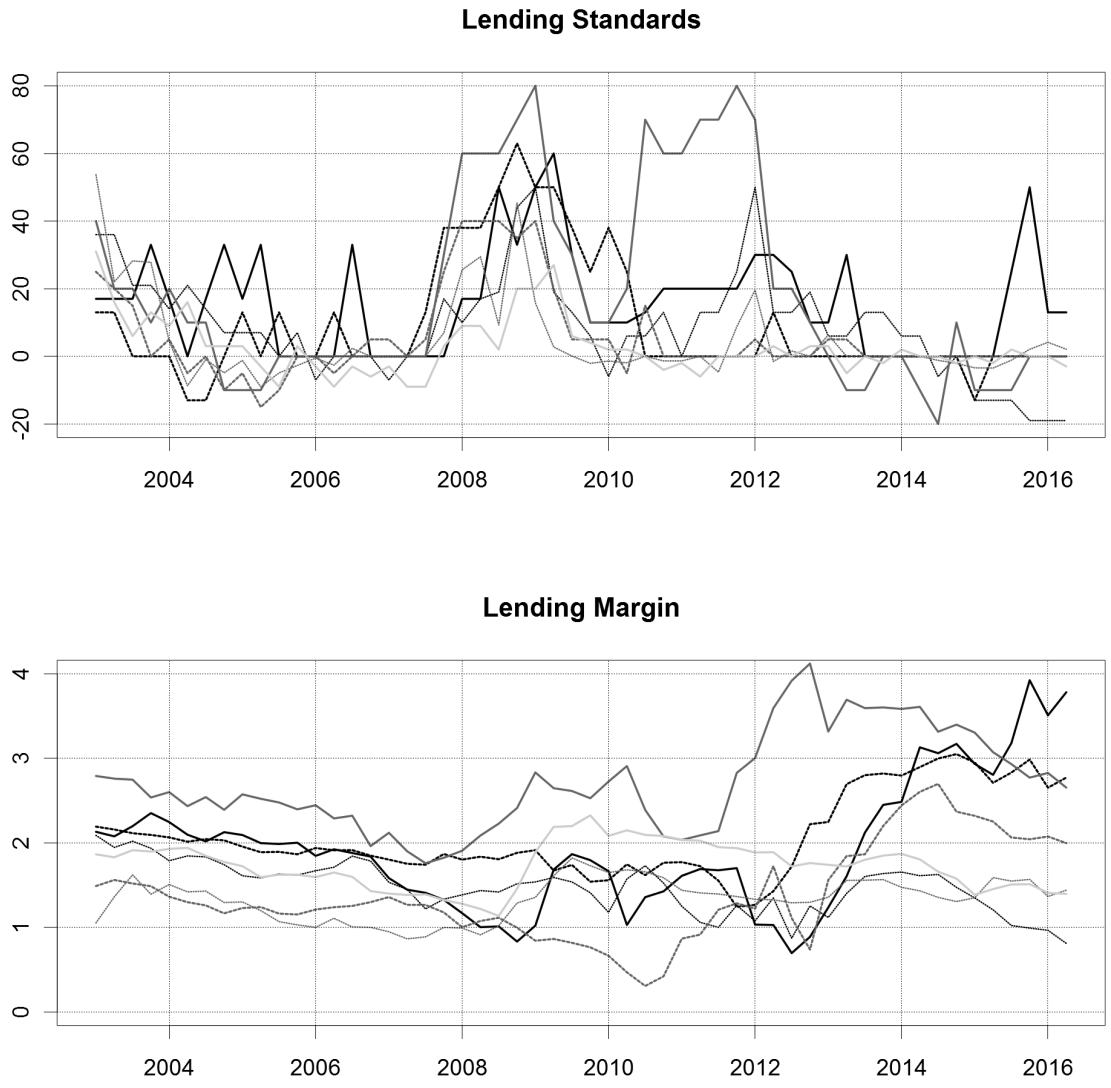
Source: ECB and Wu and Xia (2016) (shadow rate).

Figure A2: Lending Rates and Deposit Rates for the Euro Area



Source: ECB.

Figure A3: Lending Standards and Lending Margin for Different Countries



Notes: Solid black lines: Greece; dashed black lines: Ireland; dotted black lines: Italy; solid dark-grey line: Portugal; dashed dark-grey line: Spain; dotted dark-grey line: France; solid light-grey line: Germany.

Table A1: Weighting Scheme of Lending Margins

	03Q1–06Q4	07Q1–07Q4	08Q1–08Q4	09Q1–10Q4	11Q1–13Q4	14Q1–14Q4	15Q1–16Q2
Austria	2.88	2.87	2.86	2.82	2.82	2.81	2.79
Belgium	3.63	3.62	3.61	3.56	3.56	3.54	3.52
Cyprus	0.00	0.00	0.22	0.22	0.22	0.22	0.21
Estonia	0.00	0.00	0.00	0.00	0.28	0.28	0.27
Finland	1.84	1.83	1.83	1.81	1.80	1.80	1.78
France	20.80	20.70	20.63	20.40	20.34	20.26	20.14
Germany	26.40	26.27	26.19	25.89	25.82	25.72	25.57
Greece	2.98	2.97	2.96	2.93	2.92	2.91	2.89
Ireland	1.70	1.69	1.69	1.67	1.67	1.66	1.65
Italy	18.06	17.97	17.91	17.71	17.66	17.59	17.49
Latvia	0.00	0.00	0.00	0.00	0.00	0.40	0.40
Lithuania	0.00	0.00	0.00	0.00	0.00	0.00	0.59
Luxembourg	0.30	0.30	0.30	0.29	0.29	0.29	0.29
Malta	0.00	0.00	0.09	0.09	0.09	0.09	0.09
The Netherlands	5.87	5.84	5.82	5.76	5.74	5.72	5.69
Portugal	2.56	2.54	2.54	2.51	2.50	2.49	2.48
Slovakia	0.00	0.00	0.00	1.11	1.11	1.10	1.10
Slovenia	0.00	0.50	0.50	0.50	0.50	0.49	0.49
Spain	12.97	12.90	12.86	12.72	12.68	12.63	12.56

Notes: Weights are based on the member countries' contribution to the ECB's capital.