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The Risk-Taking Channel of Monetary Policy Transmission in the Euro Area

Abstract

In this paper, we provide evidence for a risk-taking channel of monetary policy transmission in the euro area that works through the relaxation of lending standards for borrowers. Our dataset covers the period 2003Q1-2016Q2 and includes, in addition to the standard variables for real GDP growth, inflation, and the monetary policy stance, indicators of bank lending standards and bank lending margins. Based on vector autoregressive models with (i) recursive identification and (ii) sign restrictions, we show that banks react aggressively to an expansionary monetary policy shock by lowering their lending standards. The banks' efforts to keep their lending margin stable, however, are not successful as we detect a significant compression. We document these findings for the euro area as a whole and for its individual member states. In particular, banks in the Netherlands, Portugal, Spain, and Ireland lowered their lending standards after expansionary monetary policy shocks. The compression of the lending margin is most pronounced in the five crisis countries (Greece, Ireland, Italy, Portugal, and Spain).

JEL-Codes: E440, E510, E520, E580, G280.

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 value 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 rate 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 reduced 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. 2014; Buch et al. 2014; Dell'Ariccia et al. 2017; 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 presenting evidence for a risk-taking channel in the euro area. Low interest rates are associated with an increase in the willingness of banks to accept risk (Altunbas et al. 2014; 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 when the European Central Bank (ECB) expands its balance sheet in an effort to intermediate interbank transactions in a frozen private interbank money market, a small but significant effect is exerted on loans.[2]

Our paper aims at obtaining additional evidence for a risk-taking channel of monetary policy in the euro area. Previous literature for the euro area mostly adopts a bank-level perspective and establishes a contemporaneous relationship between monetary policy and banks' risk-taking behavior with the help of panel techniques(Altunbas et al. 2014; Claessens et al. 2017; Jiménez et al. 2014; Maddaloni and Peydró 2011). In contrast, our paper takes a macroeconomic perspective as we are particularly interested in the dynamic impact of monetary policy shocks on banks' risk-taking.

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

[2] The ECB expanded its balance sheet, inter alia, due to its increased engagement in maturity transformation and liquidity transformation.

For that purpose, we augment a standard vector autoregressive (VAR) monetary policy transmission model for the euro area using data for the period 2003Q1−2016Q2, with indicators of bank lending standards and bank lending margins.[3] This makes our paper the first to use a unified framework allowing us to simultaneously consider the impact of monetary policy on both the propensity of banks to take risks and the banks' profitability. Our approach also allows us to test for any outside lag in the reaction of banks to monetary policy shocks. In addition to providing VAR evidence for the euro area as a whole, we also test for differences in the banks' reaction in ten euro area countries. Finally, we are able to establish the effects of conventional monetary policy shocks with the help of the main refinancing rate (MRR) and a mixture of conventional and unconventional monetary policy shocks with the help of the shadow rate (SR; Wu and Xia, 2016).

Based on (i) recursive identification and (ii) sign restrictions, we show that banks react aggressively to an expansionary monetary policy shock by lowering their lending standards. Hence, our paper provides evidence for a risk-taking channel of monetary policy transmission in the euro area that works through the relaxation of lending standards for borrowers. The banks' efforts to keep their lending margin stable, however, are not successful as we detect a significant compression. We document these findings for the euro area as a whole and for its individual member states. In particular, banks in the Netherlands, Portugal, Spain, and Ireland lowered their lending standards after expansionary monetary policy shocks. The compression of the lending margin is most pronounced in the five crisis countries (Greece, Ireland, Italy, Portugal, and Spain).

The remainder of this paper is structured as follows. Section 2 introduces the data set and the empirical methodology. Sections 3 presents the baseline results. Section 4 shows the results for some extensions as we test for an asymmetric reaction of lending rates and deposit rates and for heterogeneous reactions across euro area countries. Section 5 concludes with some policy implications.

[3]Giannone et al. (2012) also employ a VAR model for the euro area. However, their purpose is to establish a counterfactual scenario rather than obtaining impulse responses to monetary policy shocks.

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.[4] First, we utilize the growth rate of real GDP as the measure of real economic activity. 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 make use of two different monetary policy indicators, (i) the MRR and (ii) the SR. The MRR is utilized to test for the influence of conventional monetary policy, whereas the SR allows for an assessment of conventional and unconventional monetary policy. Indeed, with short-term interest rates stuck at the zero lower bound, the SR should be helpful as it quantifies all unconventional monetary policy measures in a single interest rate and can take negative values.[5]

In addition to these three standard variables, our fourth and fifth variables are two indicators for the banking sector. Our fourth variable is a measure of lending standards that is taken from the ECB's bank lending survey of approximately 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. For our fifth variable, we use the banks' lending margin, defined by the ECB as the difference between interest rates on new business 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

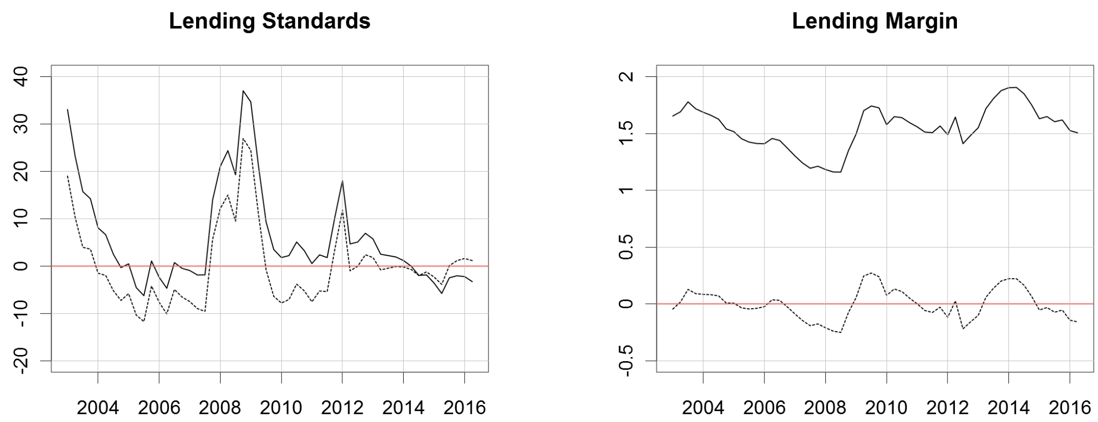
[4]The start date coincides with the introduction of the quarterly bank lending survey by the ECB.

[5]As part of our robustness tests, we also utilized the EONIA as indicator of monetary policy. The results are very similar to those for the MRR and, in an effort to conserve space, not shown but available on request.

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.

Figure 1 plots the two banking sector variables over time. The solid lines show the actual series, the dashed lines show the cyclical component obtained with the help of a Hodrick and Prescott (1997) filter ($\lambda = 1,600$).[6]

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. Solid lines show the actual series, dashed lines the HP-filtered ($\lambda = 1,600$) series. *Source*: ECB.

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 the exception of a strong peak in 2014Q1.

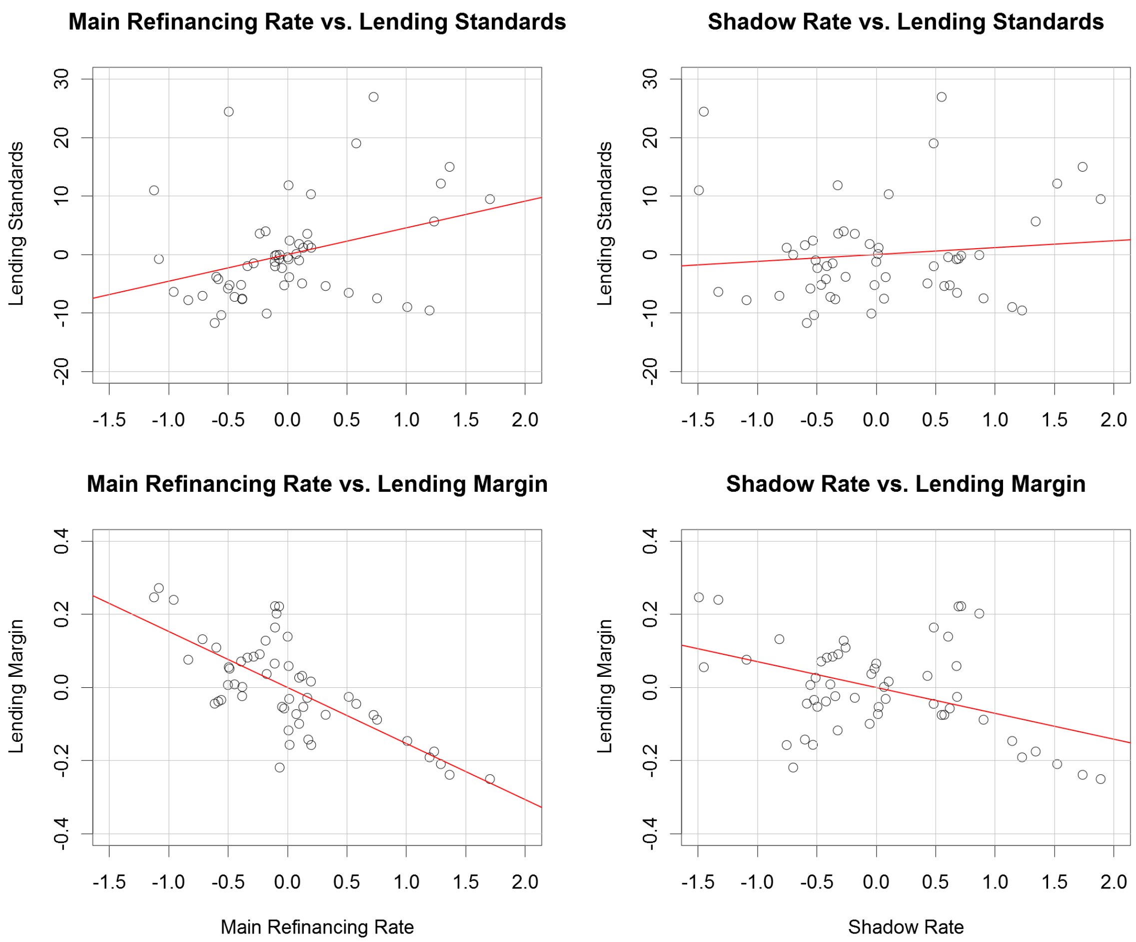
The left panel of Figure 2 shows scatter plots between both banking sector variables and the indicator for conventional monetary policy, the MRR. The right panel repeats

[6]The corresponding plots for the standard monetary policy transmission variables and separate plots of lending rates and deposit rates can be found in Figures A1 and A2 in the Appendix.

this exercise with the combined indicator for conventional and unconventional monetary policy, the SR. All variables are HP-filtered with $\lambda = 1,600$.

Figure 2: Scatter Plots for Banking Sector Variables and Interest Rates

Panel A: Conventional MP | Panel B: (Un-)Conventional MP



Notes: Left panel shows scatter plots between the MRR and (i) lending standards ($\rho = 0.33$) and (ii) the lending margin ($\rho = -0.72$). Right panel shows scatter plots between the SR and (i) lending standards ($\rho = 0.11$) and (ii) the lending margin ($\rho = -0.44$). All series are HP-filtered with $\lambda = 1,600$.

In line with previous research, we find a positive relationship between lending standards and both interest rate indicators. Specifically, lower interest rate levels are associated with lower credit standards and vice versa (see top panel). However, the correlation is less pronounced when employing the SR ($\rho = 0.11$) as compared to the MRR ($\rho = 0.33$). The relationship between the lending margin and both monetary policy indicators, in contrast, is negative, implying an increase in margins for lower short-term interest rates and vice versa (see bottom panel). Again, the correlation is lower for the

SR ($\rho = -0.44$) than for the MRR ($\rho = -0.72$). However, it remains to be seen if these bivariate contemporaneous relationships hold in a multivariate VAR model that also incorporates dynamics in the connections across variables.

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 real GDP growth, core inflation, the monetary policy indicator (MRR or SR), lending standards, and the lending margin. All series are HP-filtered to remove deterministic trends and to ensure stationarity.[7] 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 in the case of both monetary policy indicators. However, in both cases, the residuals of three equations of a VAR(1) model exhibit significant autocorrelation at the 5% level. Hence, a VAR(1) is not able to sufficiently capture the dynamics in the system. In contrast, the use of two lags eliminates serial correlation in the error terms of all equations at the 10% level and yields stable impulse responses.[8]

To identify the effects of monetary policy shocks on the other variables in the system, we have to transform the reduced form VAR into a structural VAR. In a first step,

[7] According to an augmented Dickey and Fuller (1979) test, the null hypothesis of non-stationarity can be rejected for all variables at the 1% level.

[8] Note that the Akaike information criterion, which typically overestimates the appropriate lag length, favors four (three) lags when using the MRR (SR) as monetary policy indicator. Employing four (three) lags in the estimations does not change the results qualitatively. Hence, we stick to the more parsimonious specification with two lags since it allows a sharper identification of the impulse responses.

we impose a recursive identification scheme. We order the three key monetary policy transmission variables in their standard way. Real GDP growth is ordered first, core inflation is ordered second, and the interest rate indicator is ordered third. This reflects the well-known outside lag of the impact of monetary policy on prices and output, and the possibility that the central bank might react instantaneously to macroeconomic shocks, thus, precluding any inside lags in monetary policy. 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. Specifically, we order the lending standards fourth, that is, 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.[9]

In a second step, we apply a Bayesian estimation method with sign restrictions.[10] 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. The restrictions are assumed to hold on impact and for four quarters thereafter (Uhlig 2005). Table 1 summarizes the two different identification schemes.

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 one will see in Section 3, the identification

[9] Note that we also considered two alternative identification schemes. Alternative 1: Lending standards, lending margin, real GDP growth, core inflation, monetary policy indicator. This ordering follows Buch et al. (2014) who 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. Alternative 2: Real GDP growth, core inflation, lending standards, monetary policy indicator, lending margin. The idea here is that bank loan officers 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 before the monetary policy indicator. The lending margin is ordered last since an inflation "targeting" central bank should not attach much importance to the profitability of banks in its decisions. The results (available on request) are qualitatively very similar when applying these alternative identification schemes. The only exception is that Alternative 1 precludes an instantaneous reaction of both credit variables to monetary policy shocks, and Alternative 2 precludes an instantaneous reaction of the lending standards.

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

of the impulse responses is sharper for the recursively-identified VAR compared to the sign-restricted VAR. For the former, we will provide 95% confidence bands, whereas for the latter we "only" present 68% credible sets. As a consequence, we use the recursively identified VAR as a benchmark and utilize the sign-restricted VAR only as a robustness test for the euro area-wide specification.

Table 1: Identification Schemes

Cholesky Decomposition	**Sign Restrictions**
Real GDP Growth	+
Core Inflation	+
Main Refinancing Rate / Shadow Rate	−
Lending Standards	none
Lending Margin	none

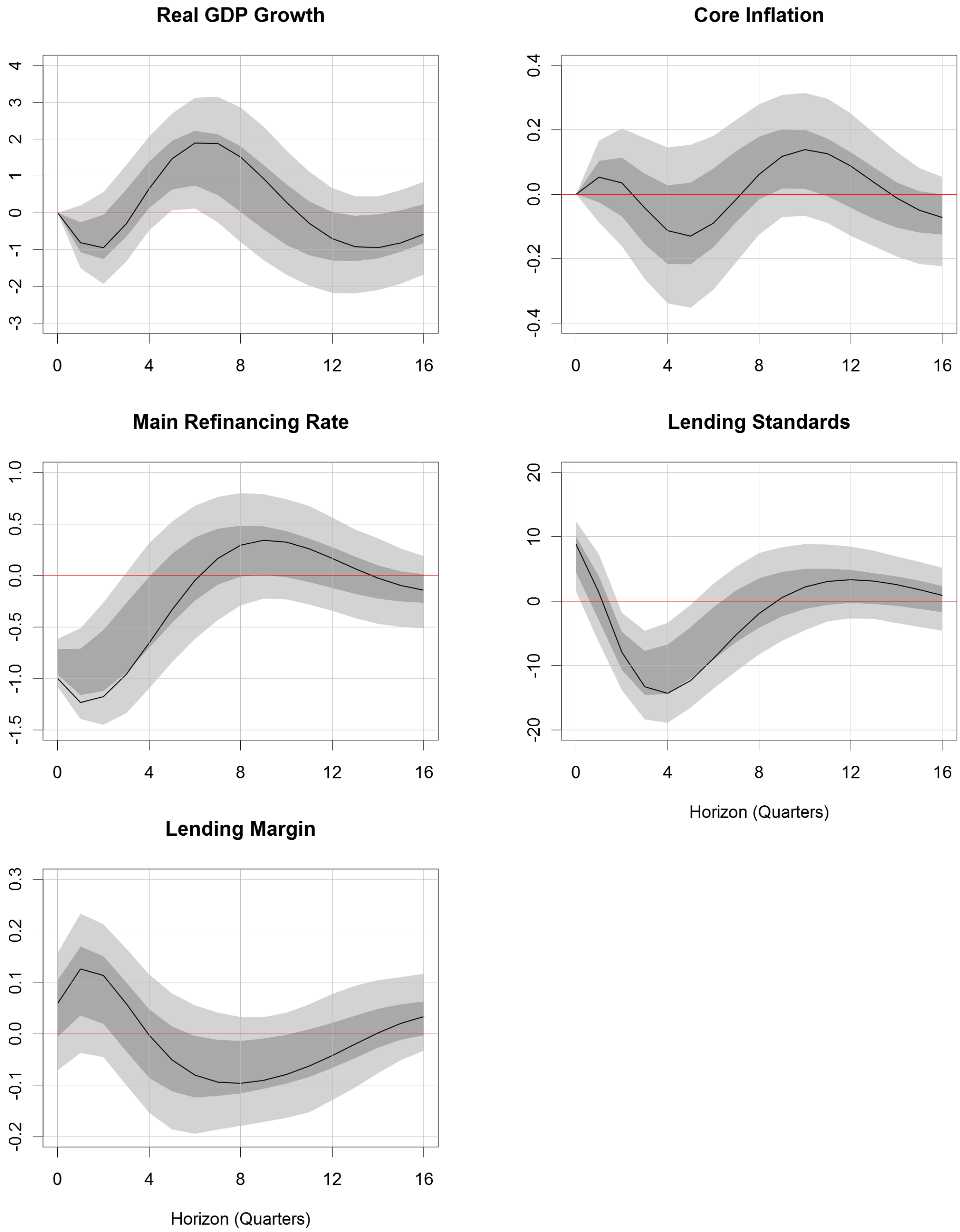
Notes: Left column summarizes the Cholesky ordering used for recursive identification of the structural errors in the VAR model. Right column summarizes sign restrictions for an expansionary monetary policy shock in the Bayesian estimations. Restrictions are assumed to hold on impact and for four quarters thereafter.

3 Baseline Results

Figures 3 and 4 show impulse responses based on recursive identification for a 100 basis points (bps) expansionary shock in the MRR and the SR, respectively. First, it has to be noted that the impulse response functions (IRFs) based for the MRR show stronger peak effects compared to those for the SR. In addition, the level of significance is more pronounced in the case of the MRR.[11] Nevertheless, we find qualitatively similar results when employing the conventional monetary policy indicator, the MRR, and the combined indicator for conventional and unconventional monetary policy, the SR.

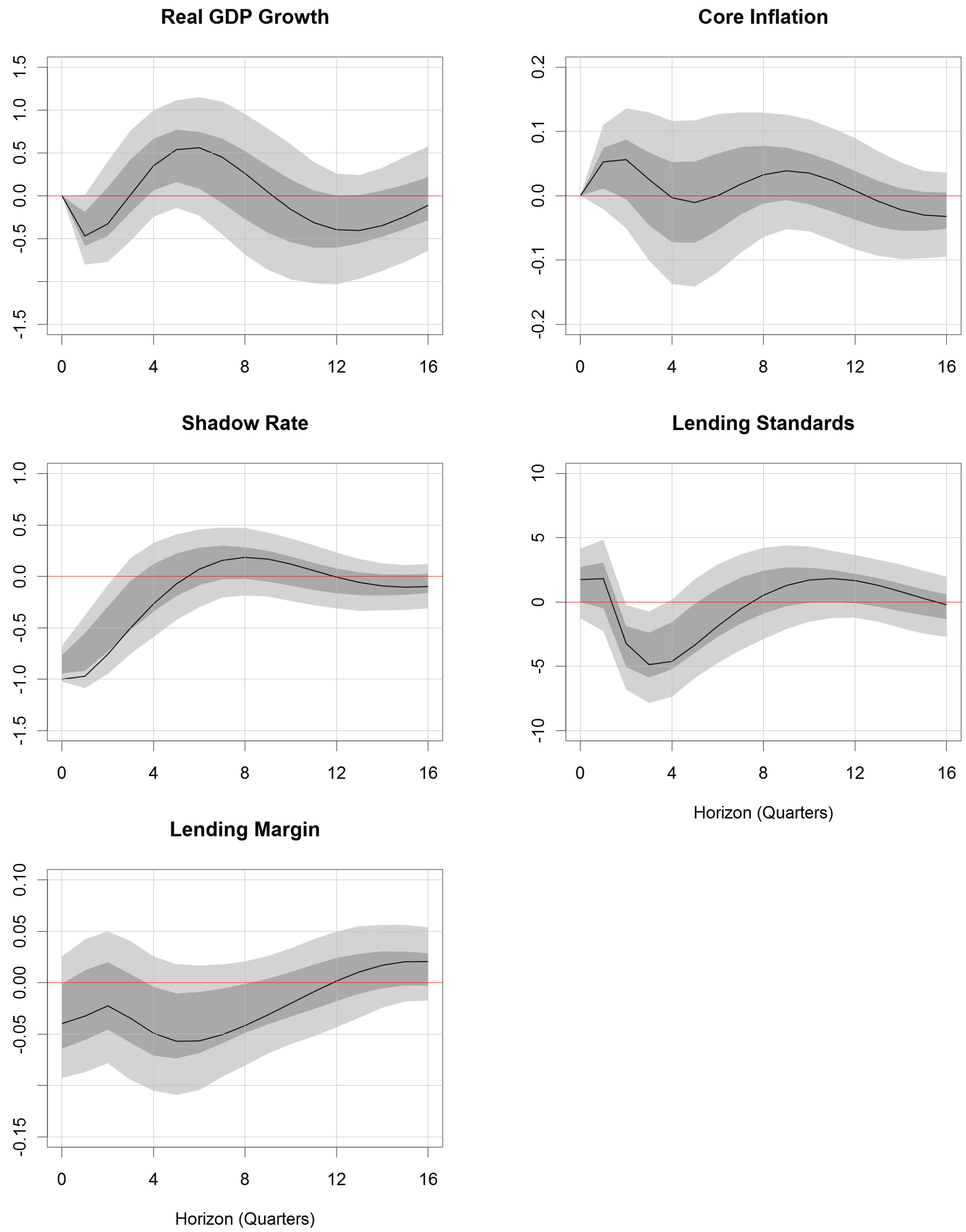
[11]This might be partly explained by the size of the unscaled shocks, which is roughly twice as large for the SR (34.0 bps) compared to the MRR (17.1 bps). To ensure comparability across models, we have transformed all impulse responses to a 100 bps shock, which implies a re-scaling with roughly factor six in the case of conventional monetary policy and with roughly factor three in the case of (un-)conventional monetary policy.

Figure 3: IRFs for Conventional Monetary Policy, Recursive Identification



Notes: Solid lines represent mean impulse responses (in percentage points) to a conventional expansionary monetary policy shock of 100 basis points based on recursive identification with the following ordering: (i) Real GDP growth, (ii) core inflation, (iii) MRR, (iv) lending standards, and (v) lending margin. Dark gray shaded (light gray shaded) areas indicate 68% (95%) confidence bands derived by bootstrapping and 5,000 replications.

Figure 4: IRFs for (Un-)Conventional Monetary Policy, Recursive Identification



Notes: Solid lines represent mean impulse responses (in percentage points) to a (un-) conventional expansionary monetary policy shock of 100 basis points based on recursive identification with the following ordering: (i) Real GDP growth, (ii) core inflation, (iii) SR, (iv) lending standards, and (v) lending margin. Dark gray shaded (light gray shaded) areas indicate 68% (95%) confidence bands derived by bootstrapping and 5,000 replications.

Following an expansionary monetary policy shock of 100 bps, real GDP growth increases after an outside lag of one year with a maximum impact of 1.89 percentage points (pp) after six quarters in the case of the MRR and 0.56 pp after seven quarters in the case of the SR. Core inflation does not show much of a significant effect, a result in line with Chen et al. (2012) and Joyce et al. (2012). Both papers conclude that inflation in the euro area is mainly driven by oil price shocks, which our measure of core inflation excludes. The peak effect is 13.9 bps after ten quarters for the MRR and 5.6 bps after a much shorter outside lag of two quarters for the SR.

The responses of both credit variables are consistent with the findings of other VAR papers dealing specifically with the United States(Abbate and Thaler 2015; Afanasyeva and Güntner 2014). The impulse responses for lending standards show that after a slight increase on impact, there is a downward adjustment that is significant even when considering the conservative 95% confidence bands. The peak effect is −14.32 pp after four quarters in the case of the MRR and −4.87 pp after three quarters in the case of the SR. To put these figures into perspective one should consider the standard deviation of lending standards in our sample (8.43 pp). Hence, banks lower their credit standards by more than 1.5 standard deviations after conventional monetary policy shocks. Our results, thus, indicate that banks drastically adjust their lending behavior and accept (much) more risk to prevent the lending margin from falling.

However, even with this increase in risk-taking, banks are not fully able to shield their lending margin from decreasing short-term interest rates, a result in line with Rajan (2006) and Buch et al. (2014). When considering the 68% confidence bands, we find that the lending margin decreases with peak effects are −9.6 bps after eight quarters (MRR) and −5.7 bps after five quarters (SR), respectively. These figures are also economically relevant as the standard deviation of the lending margin in our sample is 13.1 bps. Hence, we find a compression of roughly three-fourths of a standard deviation after conventional monetary policy shocks. Finally, it is worth noting that we find the lending margin increases for a very short time span after conventional monetary policy shocks. We will return to a more detailed analysis of the lending margin in

Section 4.1 where we analyze potential asymmetries in the effects of monetary policy shocks on lending rates and deposit rates.

Figures A3 and A4 in the Appendix show impulse responses based on sign restrictions for an expansionary 100 bps shock in the MRR and the SR, respectively. Our key results remain robust as the responses of the credit variables are qualitatively in line with those obtained via recursive identification (see Figures 3 and 4).[12] When focusing on lending standards, the peak effects of monetary policy shocks are found after three quarters. Banks reduce their lending standards by up to −19.2 pp in the case of the MRR and −6.5 pp in the case of the SR. However, their efforts to keep the lending margin stable is also unsuccessful in this robustness test as it decreases by −22.8 bps after six quarters (MRR) and −20.1 bps after five quarters (SR), respectively.

4 Extensions

4.1 Lending Rate versus Deposit Rates

All previously shown impulse response functions indicate a compression of lending margins four to eight quarters after an expansionary monetary policy shock. In addition, the lending margin is found to increase for a very short time span after conventional monetary policy shocks (see Figure 3). Hence, what follows is a more in-depth analysis where we replace the lending margin in our baseline model with its components, that is, the lending rate and the deposit rate.[13] Figure 5 shows the impulse responses of this six-variable VAR.[14]

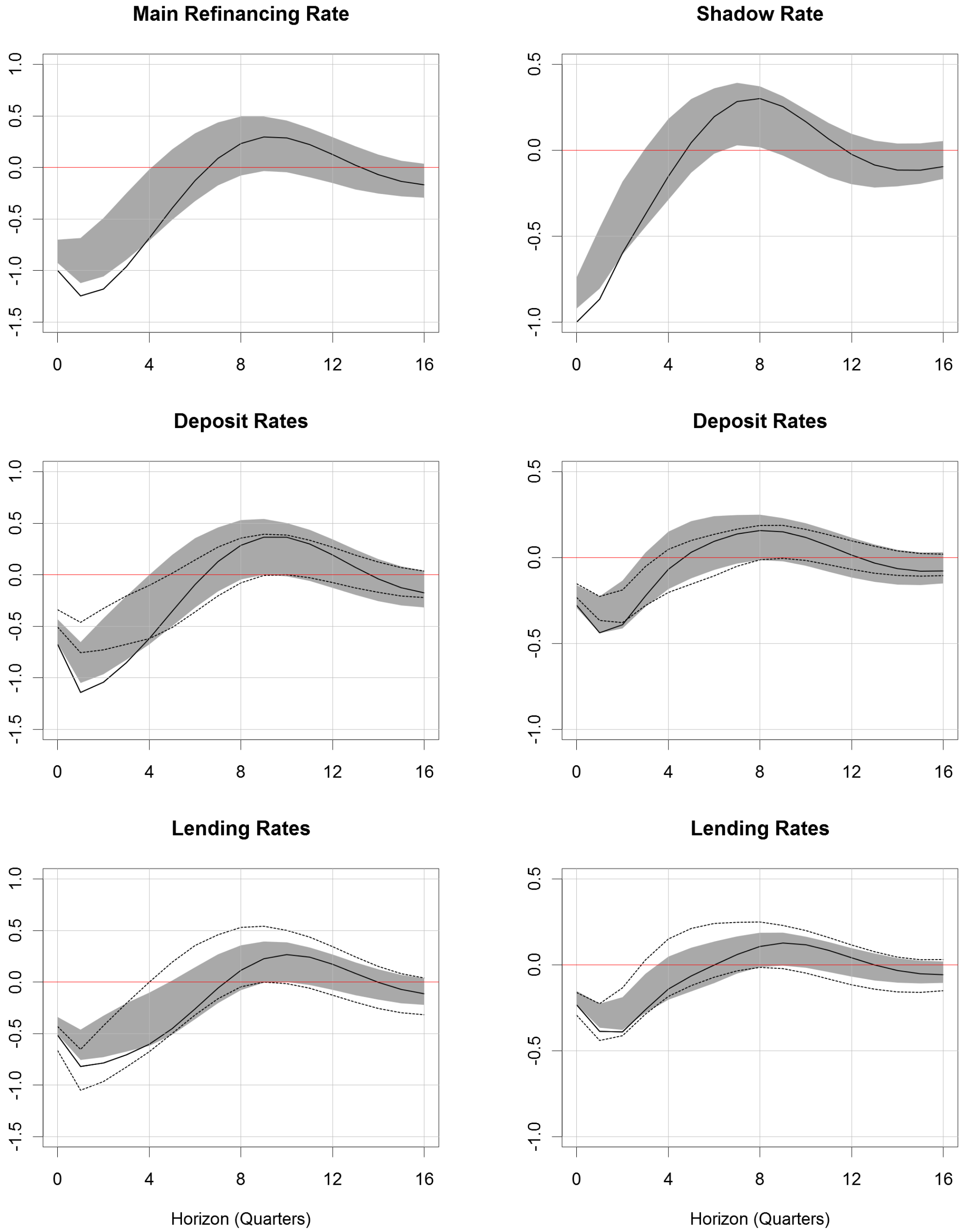
[12]We do not discuss the reaction of the standard monetary policy variables in detail since our identification scheme is not agnostic with respect to these.

[13]Figure A2 in the Appendix shows the evolution of lending rates and deposit rates over time.

[14]Note that the results are not sensitive to the ordering of the deposit rates and the lending rates.

Figure 5: IRFs for Lending Rates and Deposit Rates

Panel A: Conventional MP | Panel B: (Un-)Conventional MP



Notes: Solid lines represent mean impulse responses (in percentage points) to an expansionary monetary policy shock of 100 basis points based on recursive identification with the following ordering: (i) Real GDP growth, (ii) core inflation, (iii) MRR (left panel) or SR (right panel), (iv) lending standards, (v) deposit rate, and (vi) lending rate. Dark gray shaded areas indicate 68% confidence bands derived by bootstrapping and 5,000 replications. Dashed lines indicate the 68% confidence bands of the deposit rate in the figures for the lending rate, and vice versa. A full set of impulse responses is available on request.

In general, the deposit rate shows a stronger negative reaction during the first two (SR) to four (MRR) quarters than the lending rate. Thereafter, the picture reverses as the negative reaction of the lending rate appears to be more persistent than that of the deposit rate, that is, the compression of the lending margin is replicated in this extension. However, when comparing to the 68% confidence bands of the respective other variable, we can clearly see that the responses of the lending rates and the deposit rates are not statistically different (with the deposit rate in the first couple of quarters being the only exception).

When comparing the impulse responses of the deposit rate and the lending rate to those of the monetary policy indicator, one can see the pass-through of conventional monetary policy shocks (left panel) is slightly less than one-by-one over the first couple of quarters. In the case of conventional and unconventional monetary policy shocks (right panel), the pass-through is less than half the size of the shock. This indicates that, in particular, unconventional monetary policy measures do not transmit very well to banks' interest rates. However, this should not be much of a surprise, since deposit rates and lending rates are constantly falling towards the zero-lower bound between 2012 and 2016 and their cyclical component fluctuates around zero (see also Figure A2 in the Appendix).

4.2 Non-Crisis Countries versus Crisis Countries

Inspired by previous work on asymmetries in 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; henceforth: crisis countries) compared to the five remaining euro area economies for which we have data at hand for both banking sector variables and the complete sample period (Austria, Belgium, France, Germany, and the Netherlands; henceforth: non-crisis countries). For that purpose, we create separate indicators of lending standards and the lending margin for the crisis countries and the non-crisis countries. We aggregate the country-specific variables to group-specific ones using the countries' contribution to the ECB's capital key as weights.[15] In the VAR analysis, we replace the two euro area-wide credit variables with their group-specific counterparts, while leaving the standard monetary policy transmission variables at the euro area level. Figure 6 shows the impulse responses of this seven-variable VAR.[16]

The impulse responses for lending standards are qualitatively and even quantitatively almost the same for non-crisis countries and crisis countries. The peak effect for an expansionary shock to either of the monetary policy indicators and either group of countries is found after three quarters. Its size is slightly larger for crisis countries (−14.56 pp for the MRR; −6.49 pp for the SR) compared to the non-crisis countries (−12.97 pp for the MRR; −5.00 pp for the SR). When considering the larger standard deviation in crisis countries (9.75 pp) as compared to their non-crisis counterpart (8.09 pp), one can see that banks in both groups of countries lower their credit standards by roughly 1.5 standard deviations after conventional monetary policy shocks. This finding, and the finding that the adjustment is more than half of a standard deviation in the case of the SR, is in line with the main results in Section 3.

Turning to the impulse responses for the lending margin, the differences between both groups of countries are much more striking. On the one hand, we observe an initially increasing margin in non-crisis countries. On the other hand, we find a compression of the margin for crisis countries and most notably for the SR where the negative effect lasts for five quarters. This indicates that banks in crisis countries are put under much stronger pressure by expansionary monetary policy compared to their counterparts in non-crisis countries. To some extent, banks in non-crisis countries even benefit from the loosening of monetary policy. Nevertheless, it has to be noted that when considering conventional monetary policy shocks, banks in non-crisis countries are also not able to fully shield their margins from falling interest rates after seven to ten quarters.

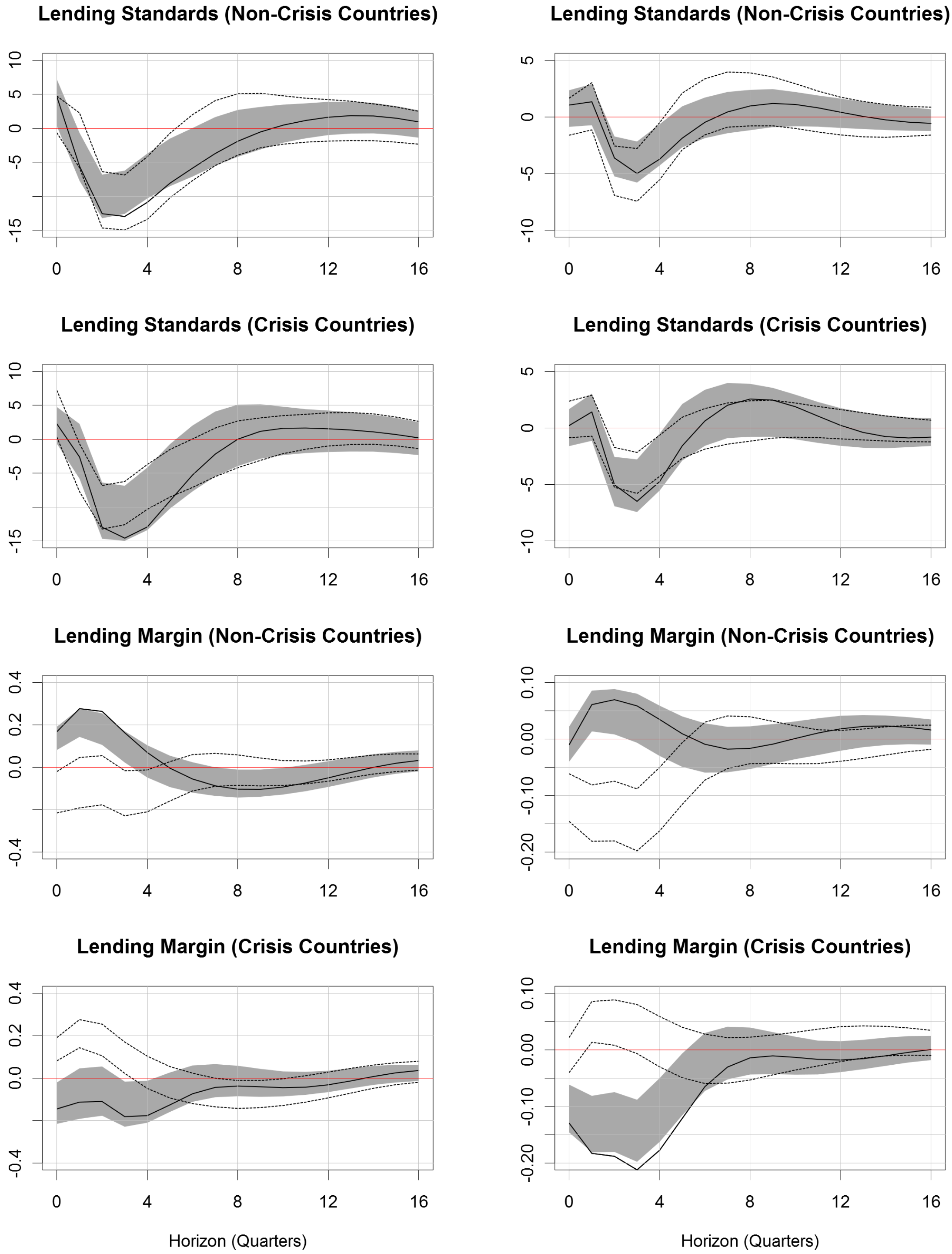
[15]The evolution of lending standards and the lending margin for both groups of countries can be found in Figure A5 in the Appendix.

[16]Note that the results are not sensitive to the ordering of the banking sector variables for the crisis countries and the non-crisis countries.

Figure 6: IRFs for (Non-)Crisis Countries

Panel A: Conventional MP

Panel B: (Un-)Conventional MP



Notes: Solid lines represent mean impulse responses (in percentage points) to an expansionary monetary policy shock of 100 basis points based on recursive identification with the following ordering: (i) Real GDP growth, (ii) core inflation, (iii) MRR (left panel) or SR (right panel), (iv) lending standards in non-crisis countries, (v) lending standards in crisis countries, (vi) lending margin in non-crisis countries, and (vii) lending margin in crisis countries. Dark gray shaded areas indicate 68% confidence bands derived by bootstrapping and 5,000 replications. Dashed lines indicate 68% confidence bands of the non-crisis countries' reaction in the figures for the crisis countries, and vice versa. A full set of impulse responses is available on request.

Similar to the baseline results in Section 3, the effects have economic relevance. This can again be illustrated by using the standard deviation of the lending margin as a yardstick (crisis countries: 17.6 bps; non-crisis countries: 17.1 bps). The peak positive effects for the lending margin in non-crisis countries are 27.6 bps after one quarter (MRR) and 6.9 bps after two quarters (SR).[17] The peak negative effects for the crisis countries are found three quarters after the shock and are larger than one standard deviation in the lending margin (18.1 bps for the MRR; 21.2 bps for the SR).

Finally, it is worth noting that the confidence bands are slightly larger for the crisis countries in all specifications. This might be indicative of more heterogeneity in this group of countries. Hence, we offer a more detailed analysis of the euro area countries' reaction in the following subsection.

4.3 Euro Area Countries

As a final step, we test for heterogeneous reactions across the ten euro-area countries for which we have country-specific banking sector data at hand. 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.[18] Table 2 summarizes the country-specific impulse responses, which can be found in Figures A6–A9 in the Appendix.

[17] Note that the peak negative effect for conventional monetary policy shocks in non-crisis countries is −10.4 bps after nine quarters.

[18] Note that we also tried to implement a global VAR for the euro area as a whole and the ten countries. However, the results turned out to be highly unstable, which is why we stick to the empirical setup below.

Table 2: Summary of Country-Specific Impulse Responses

	Conventional Monetary Policy (MRR)					**(Un-)Conventional Monetary Policy (SR)**				
	Lending Standards		Lending Margin			Lending Standards		Lending Margin		
	Peak	Rank	Peak	Rank	Increase	Peak	Rank	Peak	Rank	Increase
Austria	**−14.81** / 3Q	6	−9.41 / 4Q	9	yes	−6.08 / 0Q	6	−4.17 / 1Q	10	
Belgium	−9.59 / 2Q	9	−8.52 / 5Q	10	yes	−5.68 / 2Q	8	**−6.82** / 5Q	8	yes
France	**−15.28** / 2Q	5	**−14.39** / 8Q	7	yes	−5.95 / 2Q	7	−5.21 / 8Q	9	
Germany	−8.35 / 5Q	10	**−13.96** / 9Q	8	yes	−3.53 / 4Q	9	**−6.95** / 8Q	7	yes
Greece	−10.04 / 5Q	8	**−28.65** / 0Q	2		−2.87 / 4Q	10	**−16.44** / 1Q	4	
Ireland	**−20.68** / 2Q	4	**−21.01** / 3Q	5		−8.51 / 2Q	4	**−23.25** / 2Q	2	
Italy	−11.15 / 4Q	7	**−23.12** / 4Q	4		−7.01 / 3Q	5	**−16.92** / 3Q	3	
Netherlands	**−33.17** / 3Q	1	**−16.17** / 10Q	6	yes	**−11.68** / 2Q	1	**−7.41** / 10Q	6	yes
Portugal	**−22.20** / 4Q	2	**−25.72** / 9Q	3	yes	**−10.92** / 3Q	2	**−13.97** / 7Q	5	yes
Spain	**−22.12** / 3Q	3	**−42.54** / 1Q	1		−8.69 / 3Q	3	**−32.82** / 2Q	1	
Euro Area	−14.32 / 4Q		−9.61 / 8Q		yes	−4.87 / 3Q		−5.70 / 5Q		

Notes: Table 2 summarizes the impulse responses of both credit variables in the country-specific models in Figures A6–A9 in the Appendix. Column "Peak" shows the respective peak negative reaction alongside the number of quarters after which it is found. The responses of lending standards are measured in pp and those of the lending margin in bps. All peak responses, except that for lending standards in Greece when using the SR, are significant. Figures in bold indicate that the responses are significantly different from the respective euro area-wide response. Column "Rank" orders the peak responses from the strongest to the weakest (in absolute terms). Column "Increase" indicates if there is a significant increase in the lending margin during the first year after the monetary policy shock.

The strongest reaction of the lending standards can be found in a non-crisis country, the Netherlands (−33.17 pp for the MRR; −11.68 pp for the SR). However, the banking sector in the Netherlands consolidated after the onset of the Global Financial Crisis, as the ratio of banking assets to GDP decreased from 469% in 2008 (the largest among all non-crisis countries) to 360% in 2016.[19] Hence, the strong reduction in the lending standards might be indicative of the banks' effort to exempt themselves from that consolidation process. Three crisis countries (Portugal, Spain, and Ireland) rank second to fourth, with peak reactions between −20.68 pp and −22.20 pp to conventional monetary policy shock, and between −8.51 pp and −10.92 pp to (un-)conventional monetary policy shocks. In general, if we consider both unconventional and conventional monetary policy shocks (rather than just focusing on conventional measures), the peak responses of the lending standards are found to more homogeneous.

The strongest compressions of the lending margin can be found in the five crisis countries. In particular, the response in Spain (−42.5 bps for the MRR; −32.8 for the SR) stands apart from the reactions in the remaining four crisis countries (Greece, Ireland, Italy, and Portugal) that range between −21.0 bps and −28.7 bps for the MRR, and between −14.0 bps and −23.3 bps for the SR. All these peak compressions occur (with Portugal being the only exception) during the first year after the shock. The lending margin in non-crisis countries is found to be narrowed 1−2.5 years after the shock, indicating that banks in these countries are also unable to shield their margin from a loosening of monetary policy. Nevertheless, banks in some of the non-crisis countries (in particular, Belgium, Germany, and the Netherlands) tend to benefit from interest rate cuts during the first year after the shock as we find a widening of the margins.

[19] *Source*: ECB.

5 Conclusions

In this paper, we investigate the risk-taking channel of monetary policy in the euro area for the period 2003Q1–2016Q2 by augmenting a standard monetary policy transmission model with measures of lending standards and lending margins. Based on VAR models with (i) recursive identification and (ii) sign restrictions, we show that banks react aggressively to an expansionary monetary policy shock by lowering their lending standards. Hence, our paper provides evidence for a risk-taking channel of monetary policy transmission in the euro area that works through the relaxation of lending standards for borrowers. The banks' efforts to keep their lending margins stable, however, are not successful as we detect a significant compression. Our findings are in line with previous results for the United States (and the euro area). Further analysis reveals that there are no significant asymmetries in the reaction of lending rates and deposit rates.

Country-specific estimations show that banks in all euro area countries—in particular in the Netherlands, Portugal, Spain, and Ireland—lowered their lending standards after an expansionary monetary policy shock. The strongest compressions of the lending margin can be found in the five crisis countries (Greece, Ireland, Italy, Portugal, and Spain). Nevertheless, the lending margin in the remaining countries is found to be narrowed 1–2.5 years after the shock, indicating that banks in these countries are also unable to shield their margin from a loosening of monetary policy.

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, rather than decrease, instability in the financial system.

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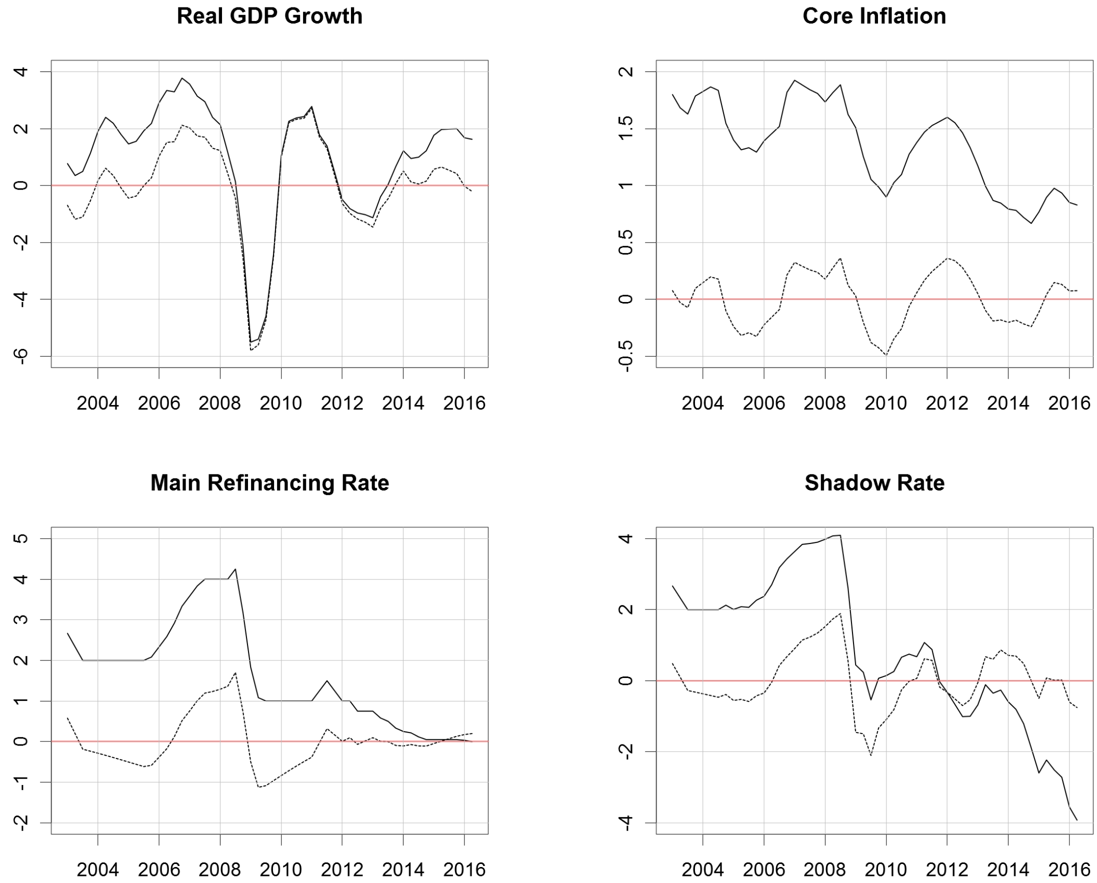
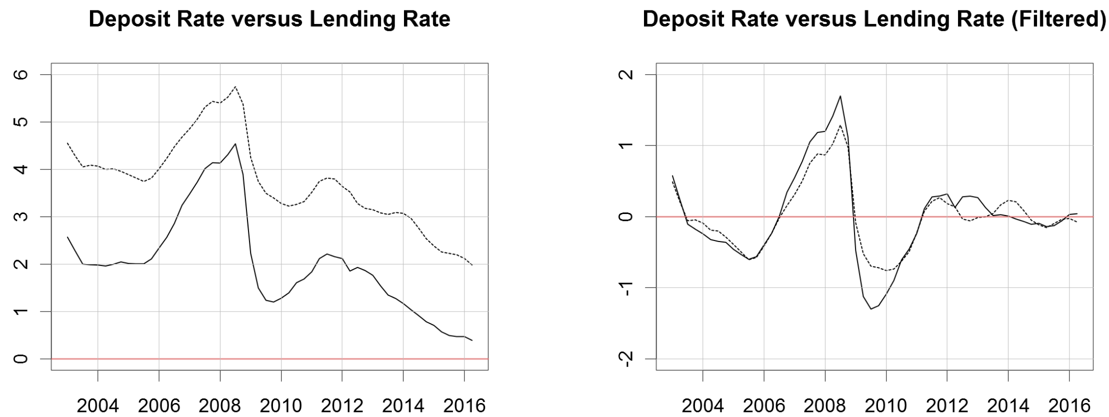
Appendix

Figure A1: Macroeconomic Variables for the Euro Area



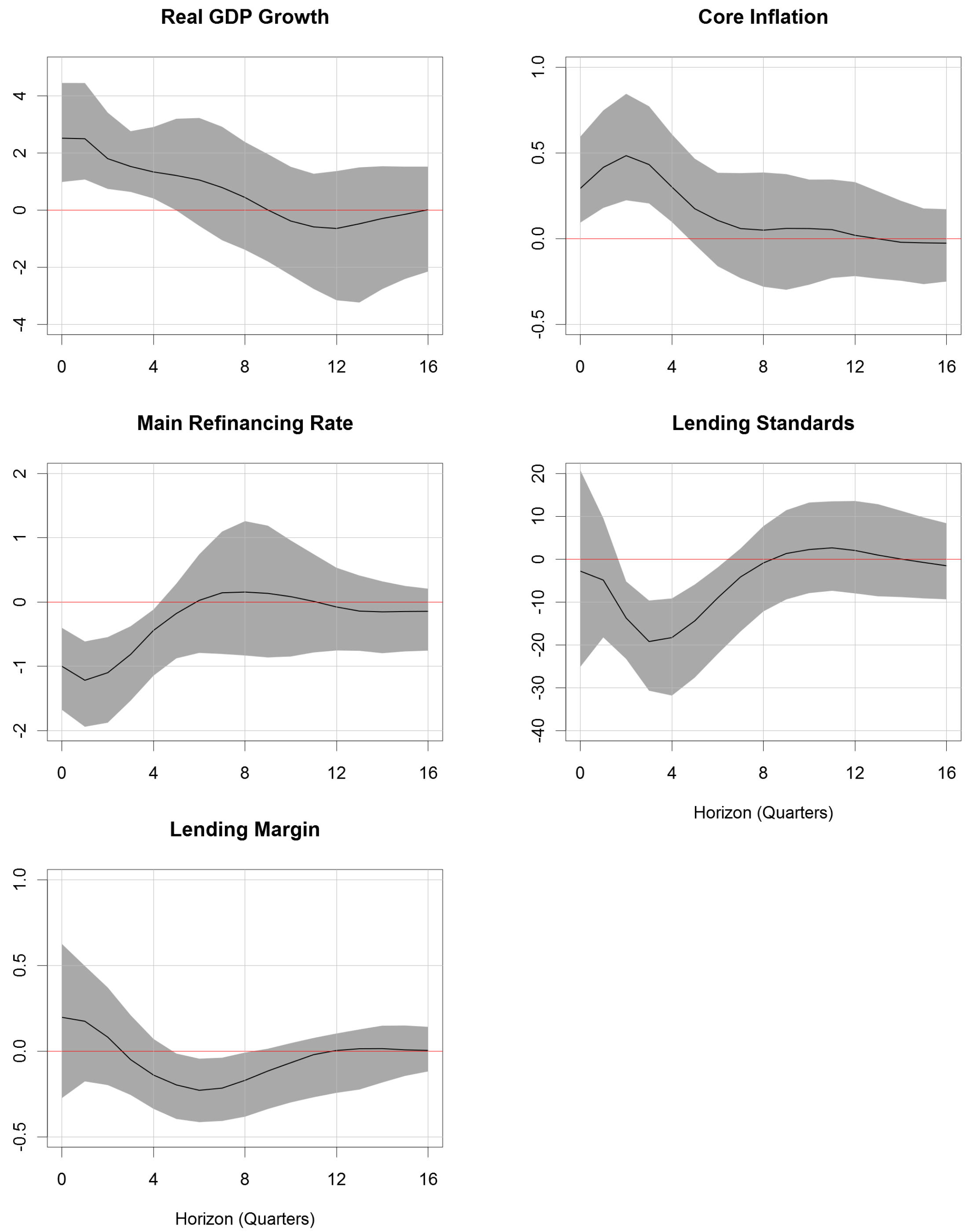
Notes: Solid lines show the actual series, dashed lines the HP-filtered ($\lambda = 1,600$) series. *Source*: ECB and Wu and Xia (2016) (shadow rate).

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



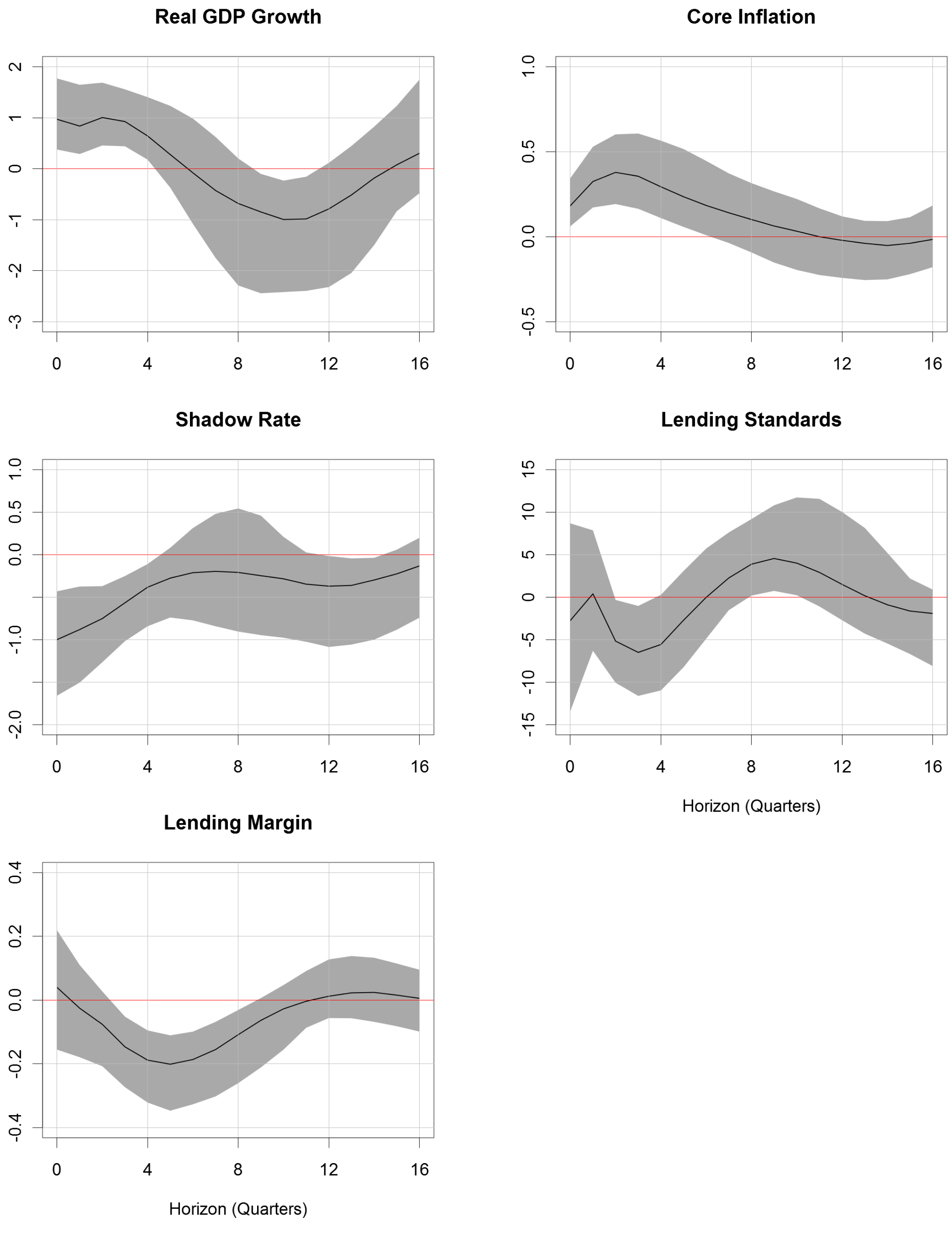
Notes: Solid lines: deposit rate; dashed lines: lending rate. Left panel shows the actual series, right panel the HP-filtered ($\lambda = 1,600$) series. *Source*: ECB.

Figure A3: IRFs for Conventional Monetary Policy, Sign Restrictions



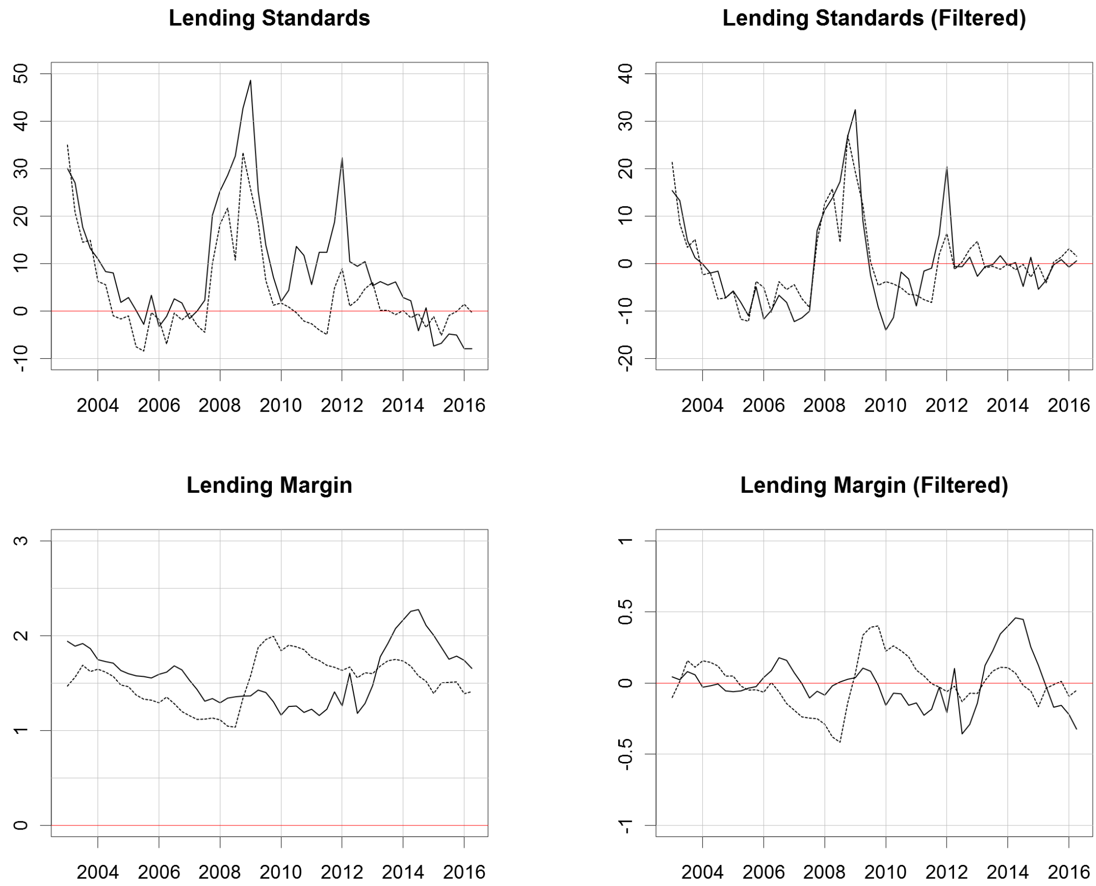
Notes: Solid lines represent median impulse responses (in percentage points) to an expansionary conventional monetary policy shock of 100 basis points based on the sign restrictions in Table 1. Dark gray shaded areas indicate the 16% and 84% quantiles of the posterior distribution based on 5,000 accepted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

Figure A4: IRFs for (Un-)Conventional Monetary Policy, Sign Restrictions



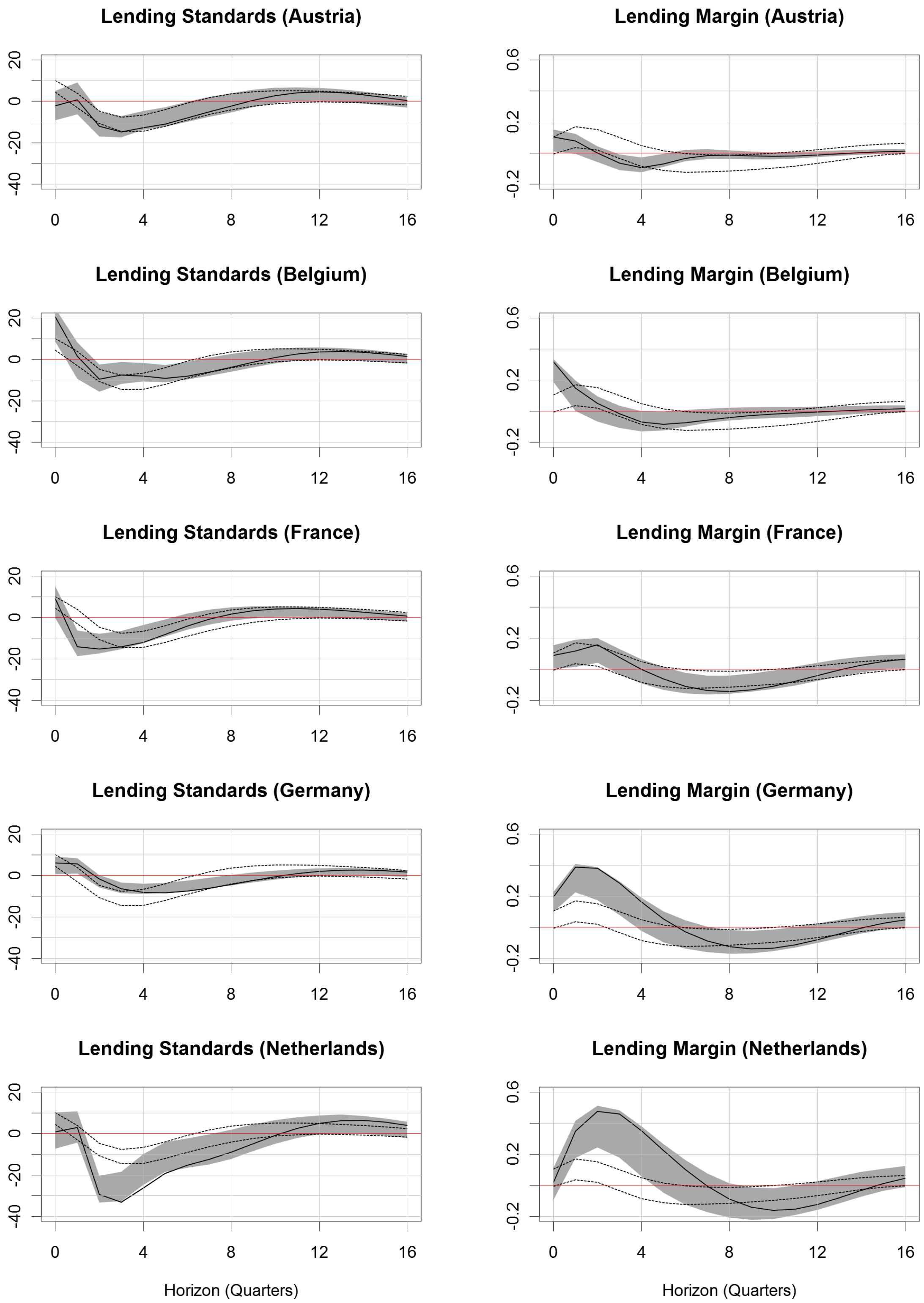
Notes: Solid lines represent median impulse responses (in percentage points) to an expansionary (un-)conventional monetary policy shock of 100 basis points based on the sign restrictions in Table 1. Dark gray shaded areas indicate the 16% and 84% quantiles of the posterior distribution based on 5,000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

Figure A5: Lending Standards and Lending Margin for Different Groups of Countries



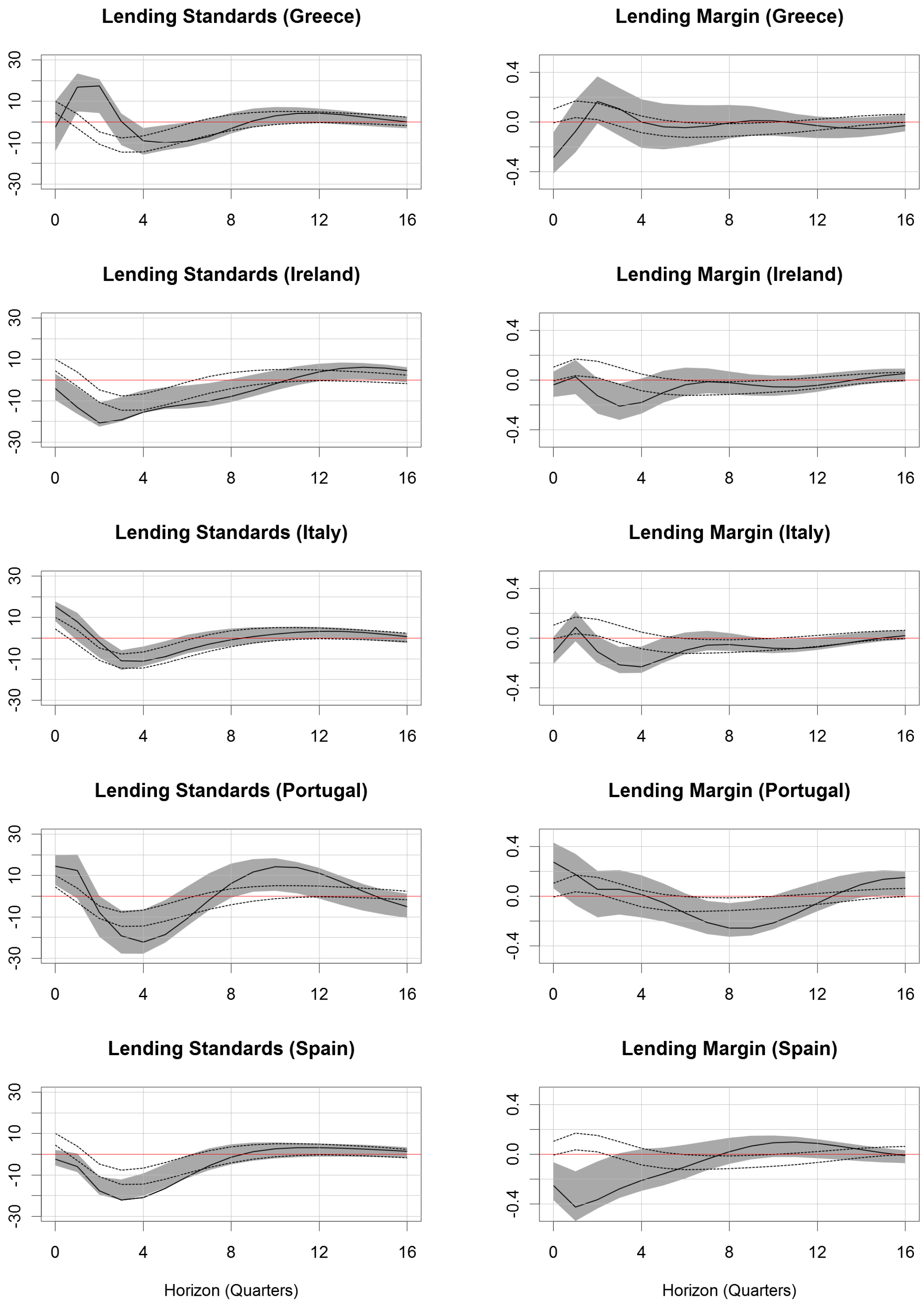
Notes: Solid lines: crisis countries (Greece, Ireland, Italy, Portugal, and Spain); dashed lines: non-crisis countries. Left panel shows the actual series, right panel the HP-filtered ($\lambda = 1,600$) series. *Source*: ECB.

Figure A6: IRFs for Conventional MP: Non-Crisis Countries



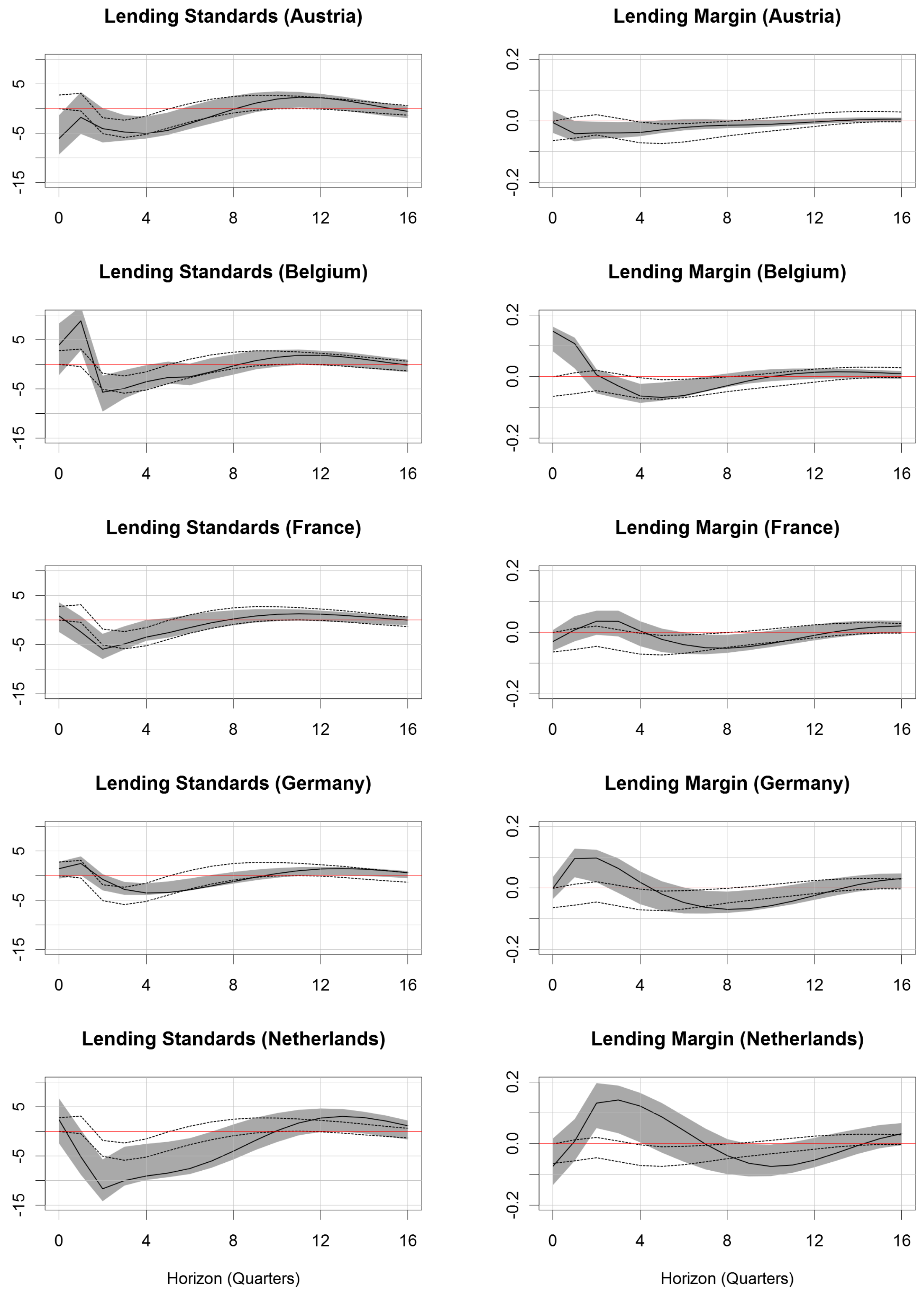
Notes: Solid lines represent mean impulse responses (in percentage points) to a conventional expansionary monetary policy shock of 100 basis points based on recursive identification. Dark gray shaded areas indicate 68% confidence bands derived by bootstrapping and 5,000 replications. Dashed lines indicate the 68% confidence bands of the results for the euro area-wide model. A full set of impulse responses is available on request.

Figure A7: IRFs for Conventional MP: Crisis Countries



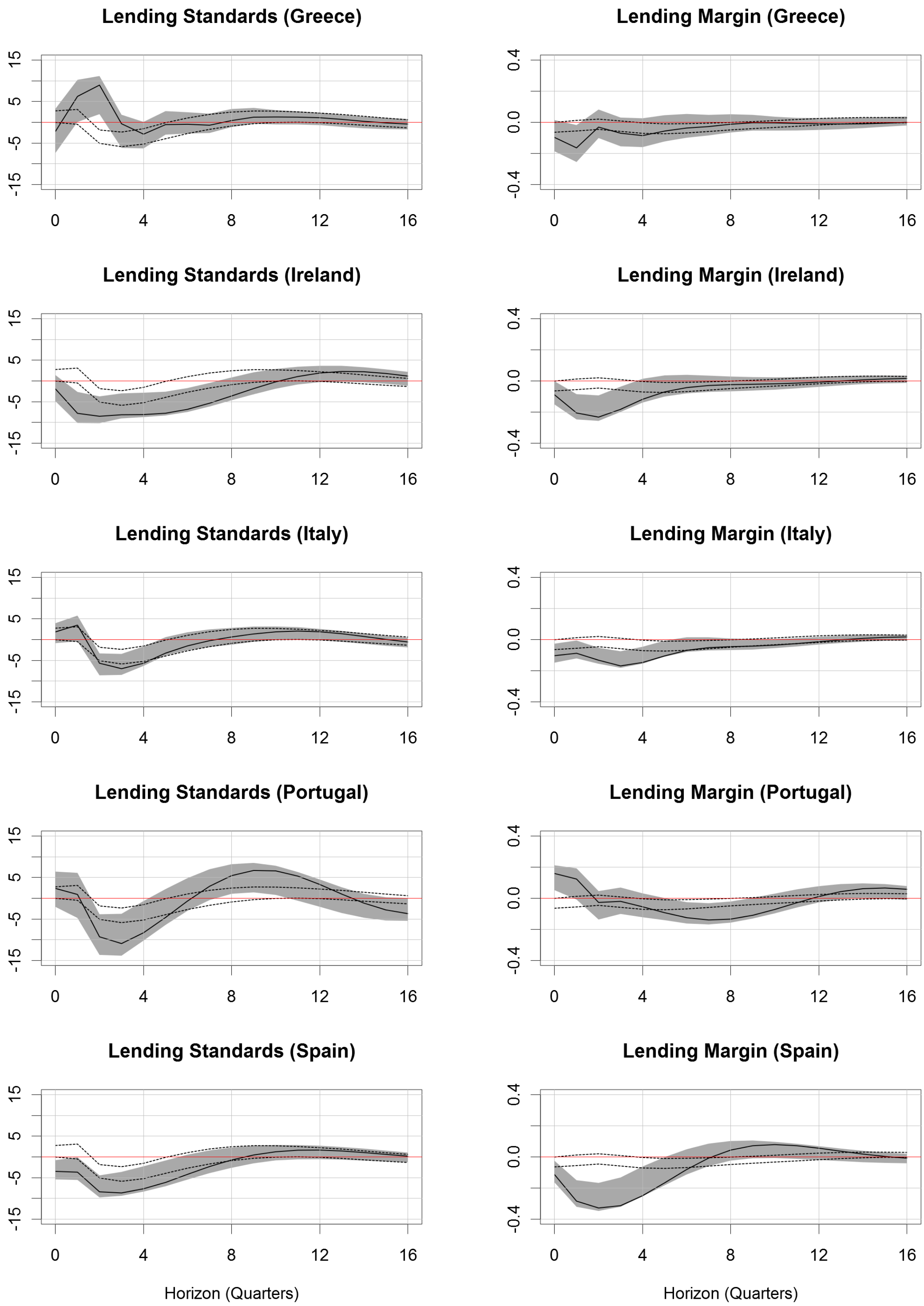
Notes: Solid lines represent mean impulse responses (in percentage points) to a conventional expansionary monetary policy shock of 100 basis points based on recursive identification. Dark gray shaded areas indicate 68% confidence bands derived by bootstrapping and 5,000 replications. Dashed lines indicate the 68% confidence bands of the results for the euro area-wide model. A full set of impulse responses is available on request.

Figure A8: IRFs for (Un-)Conventional MP: Non-Crisis Countries



Notes: Solid lines represent mean impulse responses (in percentage points) to a conventional expansionary monetary policy shock of 100 basis points based on recursive identification. Dark gray shaded areas indicate 68% confidence bands derived by bootstrapping and 5,000 replications. Dashed lines indicate the 68% confidence bands of the results for the euro area-wide model. A full set of impulse responses is available on request.

Figure A9: IRFs for (Un-)Conventional MP: Crisis Countries



Notes: Solid lines represent mean impulse responses (in percentage points) to a conventional expansionary monetary policy shock of 100 basis points based on recursive identification. Dark gray shaded areas indicate 68% confidence bands derived by bootstrapping and 5,000 replications. Dashed lines indicate the 68% confidence bands of the results for the euro area-wide model. A full set of impulse responses is available on request.