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An Analysis of the Euro Area

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The short-run effect of monetary policy shocks on credit risk*

An analysis of the Euro Area

Chi Hyun Kim[†] Lars Other[‡]

January 21, 2019

Abstract

We examine the credit channel of monetary policy from 2000 to 2015 in the Euro Area using daily monetary policy shock and credit risk measures in an autoregressive distributed lag model. We find that an expansionary monetary policy shock leads to a short-run increase in the credit risk of non-financial corporations. This dysfunctionality of the credit channel is driven by the crisis-dominated post-2009 period. During this period, market participants may have interpreted expansionary monetary policy shocks as a signal of worsening economic prospects. We further distinguish policy shocks aiming at short- and long-run expectations of market participants, i.e. target and path shocks. The adverse effect disappears for crisis countries when the European Central Bank targets long-run rather than short-run expectations.

JEL classification: C22, E44, E52, G12
Keywords: Credit Channel, Credit Spreads, Euro Area Financial Markets, Forward Guidance, Monetary Policy, Zero Lower Bound

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1 Introduction

The importance of the credit channel for the ECB's monetary policy transmission mechanism is highlighted in numerous speeches and remarks by Mario Draghi, President of the European Central Bank, during the European sovereign debt crisis.[1] Through this channel, the ECB is potentially able to influence directly the cash flows and the balance sheet positions of corporations, thus achieving a stronger impact on private sector borrowing rates than just through changes in riskless interest rates. Yet, it is not clear whether the credit channel functioned during the European sovereign debt crisis. The crisis period was characterized by important structural changes in the Euro Area financial markets. On the one hand, limited access to bank credit in the Euro Area resulted in increasing supply and demand for non-financial corporate bonds (De Fiore and Uhlig, 2015; Deutsche Bundesbank, 2017). This change in the nature of Euro Area corporate funding may have enhanced the demand-driven transmission mechanism of ECB monetary policy that works primarily through firm balance sheets (Ashcraft and Campello, 2007). On the other hand, as the ECB lowered its policy rates, eventually reaching the effective lower bound, it was no longer able to use conventional policy tools to further support the illiquid financial markets.

In this paper, we investigate the functionality of the credit channel in the Euro Area by analyzing the effect of monetary policy shocks on the borrowing conditions of non-financial corporations. We examine the credit channel of France, Germany, Italy, and Spain between January 2000 and November 2015. Our sample period enables us to analyze whether the efficacy of the credit channel changed during the Global Financial Crisis and its aftermath. Consequently, we divide the sample period into two distinct monetary policy regimes: (i) a period of "normal interest rates" and (ii) a period of low interest rates, characterized by prolonged expansionary monetary policy and the introduction of unconventional monetary policy operations. To investigate the effect of monetary policy on the credit risk, we use an autoregressive distributed lag model in combination with daily indicators of credit risk and

[1] See, *inter alia*, the hearing before the Plenary of the European Parliament in 2011 (Draghi, 2011).

high frequency measures of monetary policy shocks. We focus on the short-run dynamics since we want to capture the exogenous effect of monetary policy on fast-moving financial variables.

First, we construct an indicator of credit risk based on the spread between the borrowing rates of non-financial corporations and the riskless interest rate. This spread represents the credit risk assessment of market participants and, thus, reflects their expectations regarding the future economic activity in the Euro Area. Bleaney, Mizen, and Veleanu (2016) and Gilchrist and Mojon (2018) show, based on monthly data, that this approach yields a timely and reliable measure of borrowing conditions in the Euro Area. We extend this method to daily data and construct credit risk indicators of non-financial corporations of France, Germany, Italy, and Spain.

Second, we use the high-frequency identification method of Gürkaynak, Sack, and Swanson (2005) to identify two distinct dimensions of monetary policy shocks. As in the event study literature, we identify the surprise component of monetary policy actions by movements in the money market futures on the day of monetary policy announcements. By considering the change in a sufficiently narrow time window, we can rule out other economic events that may have additionally influenced the futures rates. The high-frequency identification method has an advantage over other conventional identification methods when using financial variables, e.g. recursive identification of SVAR, since it is able to account for the simultaneity problem between fast moving financial variables and policy shifts.

Since the prices of money market futures contracts are influenced by the expectations of investors regarding the future stance of monetary policy, we are able to capture the effect of monetary policy on the yield curve as a whole. Applying a factor model on a broad range of 3-month Euribor futures rates, we obtain a target shock and a path shock of monetary policy.[2] While the target shock exclusively represents the effect of current policy action on

[2] We follow the standard event study approach to identify the surprise component of ECB monetary policy announcements (see Bredin, Hyde, Nitzsche, and O'reilly, 2009; León and Sebestyén, 2012; Haitsma, Unalmis, and de Haan, 2016, among others). Different from the US, for which federal fund futures rates are available, there are no futures market instruments that track the Euro Area policy rate. Nevertheless,

the short-end of the yield curve, the path shock represents the change in the expectations of market participants, which is induced by the information of monetary policy announcements beyond the change in the current policy rate.

Our dataset enables us to include various dimensions into our analysis. First, the long-time span of our dataset allows us to compare the effect of ECB monetary policy before and after the Global Financial Crisis. Indeed, if the tensions in the financial markets resulted in a dysfunctional transmission mechanism in the Euro Area, we would detect different effects of ECB monetary policy on the borrowing conditions of non-financial corporations. Second, we group the countries into two distinct categories. The first group consists of Italy and Spain, which were severely hit by the crisis. The second group comprises France and Germany, which were less hit by the crisis and, consequently, were not the target of ECB operations during that time. Third, using high-frequency data, we are able to account for a potential endogeneity between corporate credit spreads and monetary policy (Caldara and Herbst, 2019).

Our results are twofold. First, we provide evidence for a short-run adverse effect of ECB monetary policy on credit risk during the low interest rate period. This indicates a short-run dysfunctional credit channel, which is a relevant issue for the ECB since the Global Financial Crisis. Apparently, monetary policy actions are differently evaluated by market participants, depending on which signal they process from the decision of the central bank.[3] In the post-2009 low interest rate environment, which is also characterized by high financial stress in the Euro Area, investors may interpret an expansionary shock as a signal for worsening economic prospects. For example, recent studies find that conventional monetary policy actions in the aftermath of the Global Financial Crisis had relatively small effects on real

Bernoth and Von Hagen (2004) show that 3-month Euribor futures rates are a reliable predictor for the policy rates of the ECB.

[3]While the literature for the Euro Area is quite thin, Wright (2012), Beckworth, Moon, and Toles (2010), and Cenesizoglu and Essid (2012) show for the US that corporate bond yield spreads react significantly to monetary policy shocks. Javadi, Nejadmalayeri, and Krehbiel (2017) provide evidence that the effect of the systematic component of monetary policy may lead to higher market uncertainty in crisis times and to an adverse response of corporate credit spreads.

activity but considerably increased market-based uncertainty measures (Hubrich and Tetlow, 2015; Jannsen, Potjagailo, and Wolters, 2019).

Second, our results show that when ECB monetary policy solely influences the long-term expectations of market participants, the adverse effect on the credit spreads disappears for Italy and Spain. This finding sheds light on two issues. First, ECB monetary policy may have a different impact across the heterogeneous Euro Area countries. While investors in the Italian and Spanish corporate bond market seem to evaluate the lower interest rates in a positive way, investors in the French and German corporate bond market have a rather pessimistic view over the same event. This can show how the signal of worsening economic prospects can dominate the positive effect of low interest rates for these non-crisis countries because the benefit of lower interest rates for them is much weaker than for the crisis countries. Second, forward guidance appears to be an effective instrument for the ECB to conduct their monetary policy during times of high economic uncertainty.

The paper is organized in the following manner: in section two, we describe our data and the econometric framework. In the data section we provide a detailed explanation of our identification strategy for our monetary policy shocks and credit risk indicator measures. In section three, we present the empirical results. The last section draws conclusions based on our results.

2 Data and model

2.1 Data

We conduct our econometric exercise for four Euro Area countries: France, Germany, Italy, and Spain. Using daily data, our sample period is January 1, 2000, through November 23, 2015.

2.2 Credit spreads

We adapt the method of Gilchrist and Mojon (2018) and construct daily measures of country-specific credit spreads. In particular, we extract the corporate bond-specific credit risk component by eliminating the riskless component of micro-level corporate bond yields. This represents the risk premia an investor requires in addition to the riskless interest rate as compensation for holding higher risk.

Specifically, the bond spread of a bond i of a country c at time t (cs_{it}^{c}) is defined as

$$cs_{it}^{c} = R_{ict} - ZCR_{t}^{DE}(Dur(i, c, t)), \tag{1}$$

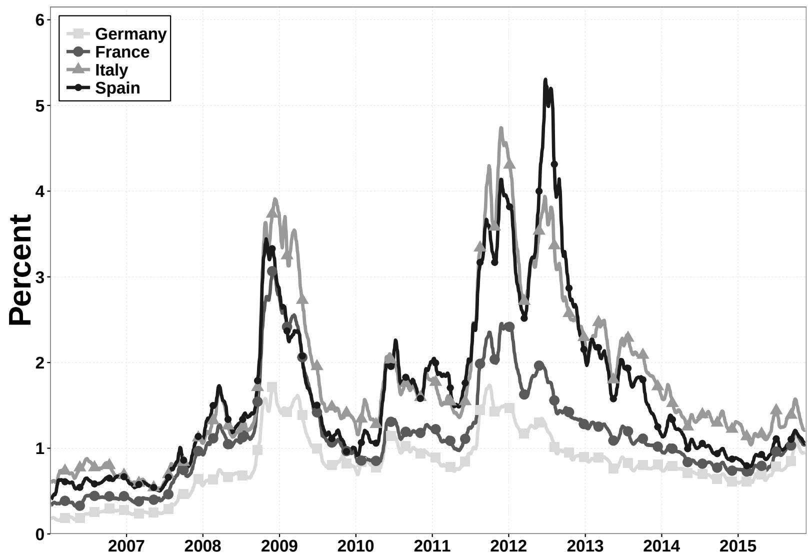
where R_{ict} is the yield of bond i issued in country c at day t, and $ZCR_{t}^{DE}(Dur(I, c, t))$ is the corresponding risk-free yield with matched duration. We use interpolation methods whenever daily data of the same duration is not available. The country-level bond spread at time t is then calculated as the weighted average across all bond spreads in a given country: $cs_{t}^{c} = \sum_{i} \omega_{ict} cs_{it}^{c}$, where the weight ω_{ict} is the ratio of the market value of a bond i at issuance of the security relative to the total market value at date t.

We use effective yield data of fixed-coupon, euro-denominated, non-callable, and non-guaranteed securities of non-financial corporations. In total, we have micro-level information for 767 bonds from 122 non-financial corporations. We use the German bund zero-coupon bond yield rates as a proxy for riskless interest rates of the Euro Area. The credit spreads of the four Euro Area countries are illustrated in Figure 1.

2.3 Monetary policy shocks

We apply the high-frequency identification method to obtain measures of ECB monetary policy shocks. This method identifies monetary policy shocks as the surprise component of monetary policy actions, measured by the movements in asset prices on days of monetary policy announcements. Specifically, we apply the factor model of Gürkaynak et al. (2005)

Figure 1
Credit spreads, four euro countries



Note: The daily credit spreads of France, Germany, Italy, and Spain are constructed with the method of Gilchrist and Mojon (2018). For a better visualization of the data, we smooth the credit spread measures with the 10-day Moving Average. Data source: Datastream.

to extract two distinct dimensions of monetary policy by using the information of a broad range of money market futures.

Formally, the factor model representation of the $T \times N$ data matrix of the money market futures X can be expressed as

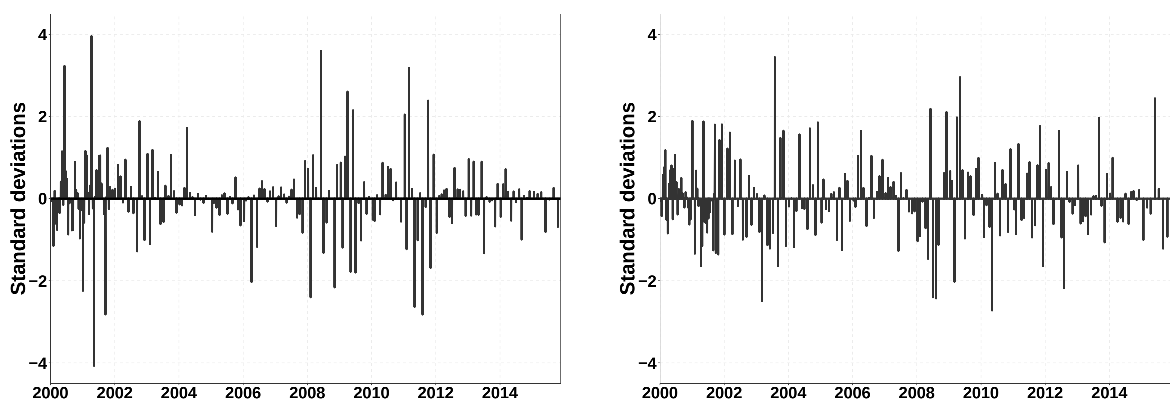
$$X = F\Lambda + \nu, \tag{2}$$

where F is the $T \times 2$ matrix of the two unobserved factors, Λ is a matrix of 2×2 factor loadings and ν is a $T \times N$ matrix of white noise errors. T represents the number of ECB board meetings in our sample and N is the number of money market futures rates included in the information set. After applying a principal component analysis, we use the rotation matrix of Gürkaynak et al. (2005) to obtain two factors $\tilde{f}_1$ and $\tilde{f}_2$.

The rotation builds on the assumption that the closest-to-deliver futures contract is not affected by changes in $\tilde{f}_2$. As a result, the obtained factors have a straightforward interpretation. The first factor, the target shock, can be interpreted as the surprise component of the current announcement. By construction, all the variation in the change of the Euribor futures rates with the shortest maturity is explained exclusively by this factor. As the two factors are orthogonal to each other, the second factor, the path shock, represents all other information released by the announcement above and beyond changes in the current short-term interest rate. Thus, the second factor is commonly interpreted as forward guidance.[4]

Figure 2 visualizes the obtained two measures of monetary policy shocks. During our sample period, there were 212 meetings of the ECB Governing Council regarding monetary policy. The size of shocks and, in particular, the target shock is higher around the 2001, the 2008/2009, and the 2012/2013 recessions, than during the other periods. The identified shocks are, however, not systematically expansionary during recessions, but there are frequent positive as well as negative shocks.

Figure 2
The two dimensions of monetary policy shocks



(a) Target shock (b) Path shock

[4]For a detailed description of the construction of the shocks using European data, see Appendix A

2.4 Model

We use a daily flexible autoregressive distributed lag (ARDL) model since we are interested in the short-run effect of monetary policy shocks on the Euro Area credit conditions. Due to the forward-looking nature of the financial markets, monetary policy should have an immediate effect on credit spreads. For each country, we run a daily regression with the respective credit spread and measures of the two dimensions of monetary policy shocks.

The Global Financial Crisis and the subsequent European sovereign debt crisis led to a structural change in the conduct of monetary policy and in the financing conditions of non-financial corporations. We take this into account in our analysis, distinguishing between two different regimes. The regimes are defined as:

1. regime A, where interest rates are *normal*, and
2. regime B, where interest rates are *low*.

We use the ECB Governing Council meeting on March 5, 2009, as the beginning of the low interest rate environment (Regime B). On this date, the ECB decided to cut the interest rate to a level below 2% for the first time in its history.[5]

Thus, the following two-regime ARDL model is:

$$\begin{aligned} cs_t^c =& I_t \left[\alpha_{A,0}^c + \sum_{i=1}^{p_A} \alpha_{A,i}^c cs_{t-i}^c + \sum_{j=0}^{q1_A} \beta_{A,1,j}^c shock_{1,t-j} + \sum_{k=0}^{q2_A} \beta_{A,2,k}^c shock_{2,t-k} \right] \\ &+ (1 - I_t) \left[\alpha_{B,0}^c + \sum_{i=1}^{p_B} \alpha_{B,i}^c cs_{t-i}^c + \sum_{j=0}^{q1_B} \beta_{B,1,j}^c shock_{1,t-j} + \sum_{k=0}^{q2_B} \beta_{B,2,k}^c shock_{2,t-k} \right] + \varepsilon_t^c, \end{aligned} \tag{3}$$

where t denotes all working days in our sample period. cs_t^c is the credit spread of country c, $shock_{1t}$ and $shock_{2t}$ are the target- and path shocks, respectively. ε_c^t is the error term. The

[5]The shadow rate of the ECB, developed by Wu and Xia (2017), is below 0.5% since February 2009, reaching negative values directly after the MRO interest rate decreased to 1.5%. The shadow rate of the ECB's benchmark rate anticipates the effects of quantitative easing (QE) and central bank forward guidance and, thus, is not bounded below by 0%.

high-frequency identification approach enables us to cleanly identify the impact of exogenous monetary policy shocks, so we do not need to include additional control variables for our model.

The dummy variable I_t takes the value 0 after March 5, 2009, and one otherwise. To fully assess the response of the dependent variable over time, we model all three variables as dynamic. The maximum lag length p, $q1$, and $q2$ are determined by the Akaike information criteria for every country separately and we allow the lag length to differ between the two regimes. However, our results are robust to a fixed lag structure.[6] The lag orders are reported in Table 1.

Table 1
Lag order of the two-regime ARDL model

	Germany	France	Italy	Spain
p_A	4	19	10	16
$q1_A$	5	3	5	3
$q2_A$	2	3	2	3
p_B	13	12	12	7
$q1_B$	5	18	5	5
$q2_B$	5	7	4	6

3 Results

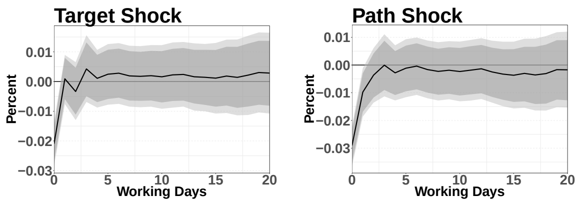
We separately examine the period of normal interest rates (regime A) and the period of low interest rates (regime B).[7] First, let us concentrate on the results of regime A. Figure 3 shows the impulse response functions of the credit spreads.[8] For all four countries, we observe a decrease in the credit spreads on impact. However, the response immediately

[6]The impulse response functions of the fixed lag structure model are available upon request.

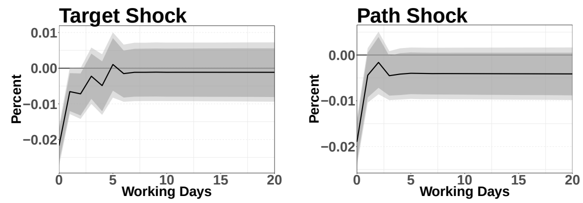
[7]To some degree, our results are sensitive to the inclusion of the ECB Governing Council meetings on October 2nd and 8th, 2008, which were directly after the collapse of Lehman Brothers. Therefore, we exclude these two meetings from our sample.

[8]As most of the dynamics happen in the first few response days, we show the impulse response functions for the first 20 business days. Longer IRFs are available upon request.

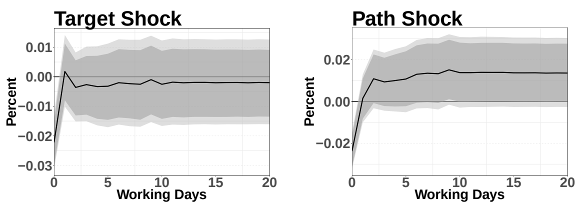
Figure 3
Estimated impulse responses in the two-regime ARDL model, regime A



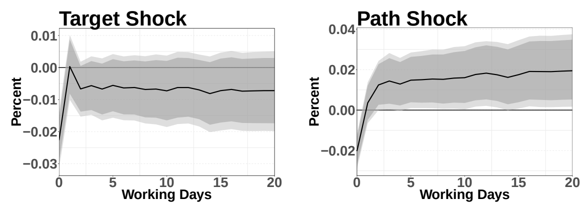
(a) France



(b) Germany



(c) Italy



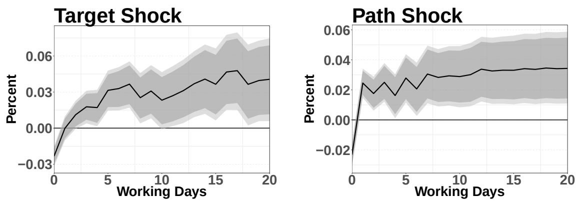
(d) Spain

Note: Impulse responses of the credit risk indicators to a one standard deviation expansionary monetary policy shock to the target factor and path factor, respectively. 90% (dark grey) and 95% (light grey) confidence intervals are produced by wild bootstrapping using the fixed design methodology (5000 replications). Sample period: January 1, 2000 - March 5, 2009.

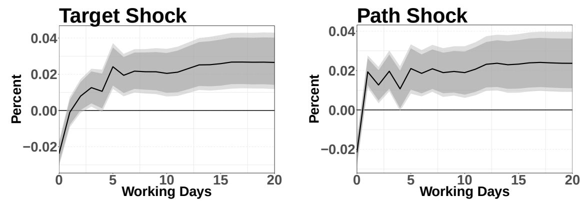
becomes insignificant. This holds for both target and path shocks, except for the positive response of the Spanish credit spread following an expansionary path shock. The mostly insignificant result is in line with the economic situation in regime A. At that time, bank loans were the primary financing instruments of European non-financial corporations (Ehrmann, Gambacorta, Martinez-Pagés, Sevestre, and Worms, 2003; von Beschwitz and Howells, 2016; Deutsche Bundesbank, 2017). Since the supply of bank loans adjusts only very slowly to a change in the interest rates and the demand for bank loans of non-financial firms is rather fixed, an expansionary monetary policy shock in regime A should not affect the short-term credit conditions as measured by the corporate bond market of the Euro Area countries.

In contrast, bank loans became limited and the markets for bonds of non-financial corporations in the Euro Area experienced strong growth in the aftermath of the Global Financial Crisis (De Fiore and Uhlig, 2015; Deutsche Bundesbank, 2017). Compared to bank loans, the cost of bond financing can vary on a daily basis because the demand for bonds in the

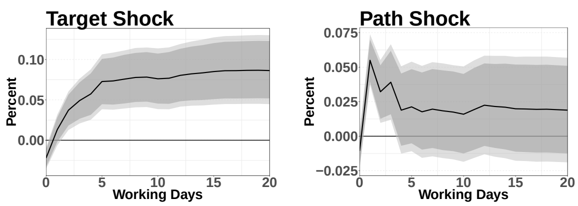
Figure 4
Estimated impulse responses in the two-regime ARDL model, regime B



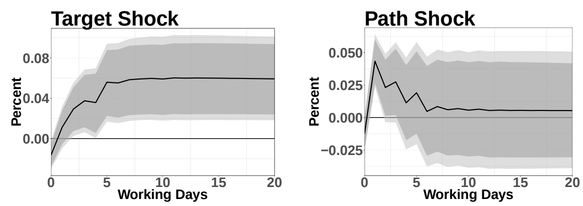
(a) France



(b) Germany



(c) Italy



(d) Spain

Note: Impulse responses of the credit risk indicators to a one standard deviation expansionary monetary policy shock to the target factor and path factor, respectively. 90% (dark grey) and 95% (light grey) confidence intervals are produced by wild bootstrapping using the fixed design methodology (5000 replications). Sample period: March 6, 2009 - November 23, 2015.

financial markets is driven by the current expectations of the investors. This can explain our significant responses of the credit spreads in regime B, which are presented in Figure 4. While an expansionary target shock leads to an immediate decrease in the credit spreads of all four Euro Area countries, the responses become significantly positive for at least the next 20 trading days. For the path shock, we observe differences in the responses across countries. Following a path shock, we detect significantly positive responses for the French and German credit spreads, while there is no significant change for Italy and Spain.

According to the theory of the credit channel, an expansionary monetary policy shock should lower borrowing costs of non-financial corporations more than the fall in the risk-free rate. However, when the credit spread increases, we observe the opposite response. There is growing evidence in the literature on this adverse response of credit conditions of the private sector following a monetary policy shock during the crisis period. For instance, Bertsch, Hull, and Zhang (2016) show that the liftoff of the Fed on December 16, 2015, led to an increase in the credit supply for households.[9] They explain this phenomenon by the fact that an increase in the federal funds rates following a long lasting low interest rate environment may have provided a positive signal regarding the future solvency of the borrowers. Javadi et al. (2017) find that not only is it the actual policy rate decision of central banks that is important for the corporate bond market, but also the nature of the policy action. They analyze the systematic component of monetary policy and show, for example, how no-action by the Fed (in terms of not changing the policy rate) during the Global Financial Crisis can lead to an increase in market uncertainty and widen corporate credit spreads.

One could think that the reassessment of investors' lending decision takes longer than the immediate change in the short-term interest rate following a monetary policy action. However, while the supply of bank loans adjust slowly to a change in the policy rate, the market price of corporate bonds should respond immediately to new information. Consequently, it seems unlikely that the adverse reaction of credit spreads is driven by a delayed response of investors.

Therefore, we consider how market participants evaluate the unexpected monetary policy action to explain this phenomenon. If interest rates are low due to weak economic conditions, how market participants evaluate a further surprising interest rate cut may instead be based on worsening economic prospects rather than on the ECB's intent of boosting economic activity. This can have a negative influence on the expectations regarding the creditworthiness of the non-financial corporations in the bond market and, in turn, affect the corporate borrowing rates. This interpretation matches with the growing literature that emphasizes the information effect of empirically identified monetary policy shocks (see i.e. Romer and Romer, 2000; Nakamura and Steinsson, 2018).

In a robustness exercise reported in Appendix B, we examine the macroeconomic consequences of a monetary policy shock identified with the high-frequency identification approach to our credit spread indicator. Using a monthly proxy SVAR similar to Gertler and Karadi

[9] By "Fed liftoff" we mean the date when the Federal Reserve raised short-term interest rates on December 16th for the first time since 2006.

(2015), the results show a significant increase in the credit spread that lasts about five months following a monetary policy easing shock, which is in line with our main analysis.[10] Moreover, the contractionary responses of industrial production on a similar horizon support the interpretation that monetary policy easing may have affected market participants' economic outlook.[11] After five months, however, the effect reverses: credit spreads decrease and macroeconomic variables are affected positively. Hence, while in the short run the credit channel is dysfunctional, in the medium run it works as the theory of monetary policy transmission predicts. Specifically, the pass-through of the decrease in the policy rate is amplified by the (i) improvement of the net worth of the borrower through the balance sheet channel and (ii) the increase in the liability of banks through the bank lending channel. These enhanced credit conditions have positive effects on economic activity, which is reflected in the increase of industrial production. Nevertheless, our results show that the transmission of ECB's monetary policy is hampered in the short run due to its effect on market participants' economic outlook and risk assessment.

Our heterogeneous effect of monetary policy across crisis and non-crisis countries during the low interest rate environment can provide further evidence on how ECB monetary policy actions are evaluated by the European corporate bond market. Especially interesting is the fact that an expansionary path shock, which represents a flattening of the yield curve, negatively affects the credit conditions of non-crisis countries, while this is not the case for crisis countries. This result indicates that the investors sin non-crisis countries evaluate the positive effect of lower interest rates in the future as less important than the negative signal of deteriorating economic prospects that may have led the ECB to the action. Different

[10] The country-specific monthly VARs include the following endogenous variables: 1- or 2-year rates on German government bonds, industrial production (IP), the harmonized index of consumer prices (HICP), and credit spreads of non-financial corporations. The lag length is 12. As the post Global Financial Crisis sample is too short for meaningful inference, we estimate the VAR for the period January 2000 - November 2015. For details on the proxy SVAR see Appendix B.

[11] In another robustness exercise, we replaced the all variables, except the policy indicator and the credit spread by five factors obtained from a large panel of macroeconomic variables. This FAVAR specification also shows the adverse reaction of the credit spread indicator. Consequently, the response of the credit spread indicator is not driven by information insufficiencies in the VAR. Results are available upon request.

from this, an expansionary target shock leads to an increase in the credit spreads of all four countries.

4 Conclusion

Our results provide evidence that, in times of crises and low interest rates, expansionary ECB monetary policy interventions can have an adverse short-run effect on the credit conditions of Euro Area non-financial corporations. In addition, ECB monetary policy targeting long-run interest rate expectations appears to mitigate these adverse short-run effects for countries that were strongly affected by the crisis.

Our results suggest important policy implications for monetary policy in the Euro Area. First, we provide evidence for potential side effects of ECB monetary policy interventions on the bond market, which may dampen the originally intended effect of the interventions. Taking into account the increasing importance of market-based funding opportunities for firms in the Euro Area, the effect of monetary policy on this type of external funding must be taken more into consideration. Second, we can show that the ECB is able to mitigate this distorting effect in the short-run, at least for the crisis countries, by relying on forward guidance and other measures that work primarily through the expectations channel of monetary policy. On March 10, 2016, the Governing Council of the ECB announced the Corporate Sector Purchase Programme. This operation aims to improve the financial conditions of corporations by buying their bonds on a large scale. In the light of our findings, this appears to be a promising venue to repair the monetary policy transmission mechanism of the Euro Area. In an early evaluation of the CSPP, De Santis, Geis, Juskaite, and Vaz Cruz (2018) show that the introduction of this program improved the financing conditions of non-financial corporations by significantly reducing credit risk premia and, thus, corporate bond spreads.

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Appendix A The construction of the ECB monetary policy shocks

We apply the factor model of Gürkaynak et al. (2005) to extract the surprise component of monetary policy announcements. Since we are analyzing the Euro Area, we use high frequency data of 3-month Euribor futures rates changes around an ECB monetary policy announcement date. Intra-daily data is unavailable to us, so we use the change in end-of-day closing prices surrounding ECB Governing Council decisions. In contrast to Federal funds futures, we do not require a scale factor for the Euribor futures to account for the days remaining in the month after a policy action (Bredin et al., 2009; Brand, Buncic, and Turunen, 2010). However, we account for illiquidity toward the maturity of the futures contracts and use the second closest-to-delivery contract instead of the current series whenever there are less than 5 days between the policy event and the next final settlement day. Moreover, we also include money market instruments with a longer time horizon. We consider German Treasury futures (Euro-Schatz, Euro-Bobl, and Euro-Bund futures as traded on the Eurex) in addition to the Euribor futures in the period after March 5, 2009, to account for a potential shift in the monetary policy regime since the ECB resorted to unconventional monetary policy measures. The yield changes of these Treasury futures are constructed as the daily return on the futures contract divided by the duration of the cheapest to deliver security in the deliverable basket.

Table 2 reports the loadings of the two shocks. Both factors are normalized to have a unit standard deviation over the respective regime.

Table 2
Normalized loadings

	Jan. 2000 - Mar. 2009		Mar. 2009 - Nov. 2015	
	Target Factor	Path Factor	Target Factor	Path Factor
1^{st} Futures	0.987	0	0.922	0
2^{nd} Futures	0.941	0.306	0.966	0.168
3^{rd} Futures	0.861	0.489	0.948	0.287
4^{th} Futures	0.779	0.622	0.901	0.401
5^{th} Futures	0.690	0.721	0.851	0.479
6^{th} Futures	0.619	0.774	0.802	0.539
Euro-Schatz			0.774	0.551
Euro-BOBL			0.522	0.838
Euro-Bund			0.280	0.913
Explained	89.8	8.6	82.2	11.6
Cum. Expl.	89.8	98.4	82.2	93.8

Appendix B Macroeconomic Implications

In this appendix, we investigate the macroeconomic implications of the effect of monetary policy on credit risk of non-financial corporations. We apply the SVAR approach proposed by Gertler and Karadi (2015). They combine the traditional VAR analysis with high-frequency identification using a monetary policy surprise measure as an external instrument to identify structural monetary policy shocks. We analyze France, Germany, Italy, and Spain separately using monthly data from January 2000 through November 2015.

The VAR model of each country includes the following endogenous variables: Industrial production (IP), the Harmonized Index of Consumer Prices (HICP), the credit spread of non-financial corporations of Gilchrist and Mojon (2018), as well as the 1- or 2-year rates on German government bonds. Following Coibion (2012) and Gertler and Karadi (2015), we set the lag order equal to 12 due to our monthly data .[12] The German government bond rate serves as the indicator for the stance of monetary policy, given that it is arguably a good proxy for the risk-free interest rate of the euro area. Furthermore, by using bonds with a maturity up to two years, we have a monetary policy indicator that also includes information regarding the change in expectations about the future path of monetary policy (see Gertler and Karadi, 2015).[13]

Following Gertler and Karadi (2015), we apply the external instrument method to identify exogenous monetary policy shocks within the VAR model (see also Olea, Stock, and Watson, 2012; Stock and Watson, 2012; Mertens and Ravn, 2013). An important feature of the instrument is that it is correlated with the true monetary policy shock, but not with other structural shocks. We use daily changes in the 3-month Euribor futures around monetary policy announcement dates as an instrument. Given that we consider a very narrow time window around a monetary policy announcement, the change in the futures rates should

[12]For a textbook treatment of lag length selection in VARs, see Kilian and Lütkepohl (2017). In general, none of the results are sensitive to setting the lag length to a smaller value.

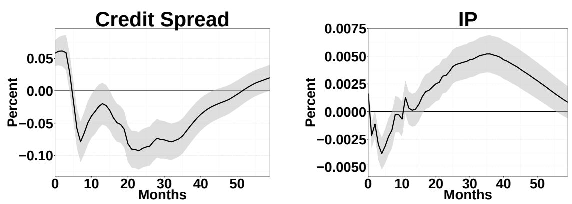
[13]The first-stage regression results show that the 1-year German government bond rate is a strong policy indicator for the analysis of Germany and France, while the 2-year German government bond rate is a better indicator for Italy and Spain. The first-stage results are available upon request.

exclusively represent the change in the expectations of financial market participants due to an unanticipated monetary policy action.

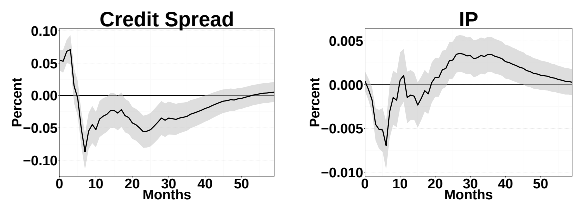
Figure 5 shows the impulse response functions of the credit risk indicators and industrial production from a one-unit expansionary monetary policy shock. In the mid- to long-run, the responses of the economic variables are consistent with the credit channel theory of monetary policy transmission and move in the expected direction. However, an expansionary monetary shock leads to an immediate increase in credit spreads for France, Germany, and Italy for up to 5 months.[14]

Figure 5

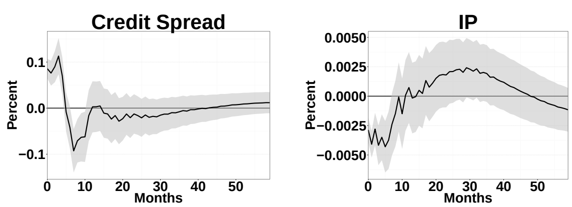
Estimated impulse responses in Proxy SVAR



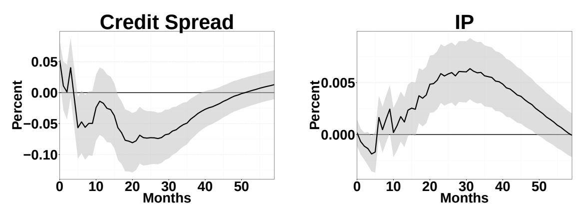
(a) France



(b) Germany



(c) Italy



(d) Spain

Note: Impulse responses from an expansionary monetary policy shock. 95% bootstrap confidence intervals (5000 replications). Sample period: January 2000 to November 2015. Data source: Datastream.

[14] To exclude the possibility of misspecification of our econometric model, we conduct robustness exercises by (i) including a time trend in the model, (ii) changing the lag structure, and (iii) applying the Factor Augmented VAR framework to control for a potential information insufficiency. Our results are qualitatively robust with respect to these exercises. The results are available upon request.