EUROPEAN CENTRAL BANK

EUROSYSTEM

WORKING PAPER SERIES

NO 1707 / AUGUST 2014

THE FINANCIAL AND MACROECONOMIC EFFECTS OF OMT ANNOUNCEMENTS

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In 2014 all ECB publications feature a motif taken from the €20 banknote.

Acknowledgements
We would like to thank Günter Coenen, Philipp Hartman, Geoff Kenny, Tobias Linzert, Roberto Motto, Massimo Rostagno, Frank Smets, Jamus Lin, Luca Dedola, and Giovanni Vitale as well as participants at several seminars and conferences, for their comments. The opinions in this paper are those of the authors and do not necessarily reflect the views of the European Central Bank and the Eurosystem.

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ISSN	1725-2806 (online)
ISBN	978-92-899-1115-3 (online)
EU Catalogue No	QB-AR-14-081-EN-N (online)

Abstract

This study evaluates the macroeconomic effects of Outright Monetary Transaction (OMT) announcements by the European Central Bank (ECB). Using high-frequency data, we find that OMT announcements decreased the Italian and Spanish 2-year government bond yields by about 2 percentage points, while leaving unchanged the bond yields of the same maturity in Germany and France. These results are used to calibrate a scenario in a multi-country model describing the macro-financial linkages in France, Germany, Italy, and Spain. The scenario analysis suggests that the reduction in bond yields due to OMT announcements is associated with a significant increase in real activity, credit, and prices in Italy and Spain with relatively muted spillovers in France and Germany.

JEL Classification: E47, E58, C54

Keywords: Outright Monetary Transactions, event study, news, multi-country vector autoregressive model.

Non-technical summary

Since the onset of the financial crisis in August 2007, the Eurosystem has engaged in several unconventional monetary policy measures to ensure the correct pass-through of the monetary policy stance to the economy. After an initial phase in which the non-standard measures were mostly intended to address impairments in the interbank markets, the financial fragmentation stemming from the sovereign debt crisis and the resulting concerns of international investors about excessive national debt in several euro area countries led to an extension in the scope of intervention to the secondary sovereign bond markets. Among other forms of interventions intended to safeguard orderly monetary policy transmission, during the period July to September 2012, the Governing Council of the ECB announced that the bank might engage in outright monetary transactions (OMTs) in the secondary markets for government bonds. The most relevant technical features of OMTs are as follows: no ex ante quantitative limits would be considered for outright transactions in secondary sovereign bond markets; purchases would concentrate on bonds with remaining maturities of up to three years, and without seniority (*pari passu*); and bond purchases would be conditional. Although none of the euro area countries has asked to activate the OMT program, asset prices such as bond prices should have, at least in part, incorporated the information publicly available to market participants. In turn, changes in financial prices may alter the behaviour of private agents, potentially affecting the rest of the economy. This study aims to quantify the financial and macroeconomic impact of OMT *announcements* in four euro area countries: Germany, France, Italy, and Spain.

The evaluation is conducted in two stages. First, we look at daily data on bond yields and conduct an event study to isolate the effects of the announcements on financial prices. The main idea is to assess the effects of policy announcements. We do so by regressing sovereign bond yields on event dummies (which take the value of one for the date of the event, the OMT announcement, and zero for other days) while, at the same time, controlling for all the other relevant "news" made publicly available in the period under analysis. According to our findings, announcements that the Eurosystem might engage (under specific conditions) in outright monetary transactions had a sizeable impact on financial markets. Indeed, such announcements have led to a decrease of about 200 basis points in the 2-year government bond rates in Italy and Spain, while leaving German and French bond yields for comparable maturities largely unaffected.

Second, we employ a multi-country macroeconomic model to assess the macroeconomic impact of the previously estimated changes in bond yields due to OMT announcements. For each of the four countries in our study, the model includes six variables (real GDP, consumer prices, M3, retail credit, and government bond rates for 2- and 10-year maturities) as well as a measure of the ECB policy rate and expected euro area aggregate bond market volatility. We assess the likely macroeconomic effects of OMT announcements over a horizon of three years after the announcements by comparing two scenarios, defined as "*OMT*" and "*no-OMT*" scenarios. The two scenarios mostly differ in the dynamics of the yield curve, which, as we conclude from the event study previously described, were strongly affected by the OMT announcements. In particular, for the whole horizon of three years, we

assume that the 2-year bond yields in Italy and Spain are about 2 percentage points lower in the OMT scenario than in the no-OMT scenario, while they are the same in France and Germany. To isolate as much as possible the effects of non-standard policy, we also assume that the standard monetary policy is the same in the two scenarios. Our evaluation suggests that OMT announcements have statistically significant and economically relevant effects on credit, as well as on economic growth in general, in Italy and Spain, with relatively limited spillovers in France and Germany.

1. Introduction

Since the onset of the financial crisis in August 2007, the Eurosystem has engaged in several unconventional monetary policy measures in order to ensure a correct pass-through of the monetary policy stance to the economy.

The non-standard measures in the first phase of the crisis were mostly intended to address impairments in the interbank market. The major concern was to avoid a credit crunch stemming from liquidity and funding problems for banks. In this respect, the introduction of the fixed rate full allotment liquidity provision significantly contributed to limiting bank funding stress. By accommodating all bids in the liquidity operations, this policy resolved banks' wholesale funding problems related to the freezing of the interbank market. However, with the financial fragmentation associated with the sovereign debt crisis of 2010 and the resulting concerns of international investors about excessive national debt in several Eurozone countries, intervention activities have expanded to the secondary sovereign bond markets. Moreover, the initial increase in bond yields in Greece, Ireland, and Portugal subsequently spread to Italy and Spain, which faced high servicing costs for their debt, arguably higher than would be justified by economic fundamentals (see Hördal and Tristani, 2013, for an empirical illustration of this point).

Among other forms of intervention aimed at avoiding impairments in monetary policy transmission[1], in the period July to September 2012, the Governing Council of the ECB announced that the bank might engage in outright monetary transactions (OMTs) in the secondary markets for government bonds. In particular, on July 26, 2012, during a conference in London, President Draghi said that the ECB was ready to do "whatever it takes" to preserve the euro within the limits of its mandate. On August 2, 2012, during the press conference after the Governing Council meeting, President Draghi announced, "ECB may undertake outright open market operations." Finally, on September 6, 2012, the ECB's Governing Council announced a number of technical features of the OMT program. More precisely, the ECB stated that no ex ante quantitative limits would be considered for outright transactions in secondary sovereign bond markets, that purchases would concentrate on bonds with remaining maturities of up to three years, and without seniority (*pari passu*), and that bond purchases would be conditional.

After almost two years since its announcement, none of the euro area countries has asked to activate the OMT. However, asset prices such as bond prices should have, at least in part, incorporated the information publicly available to market participants. Indeed, casual observation suggests that OMT announcements may have had a significant impact on the financial sector (see, for example, Draghi, 2013). In turn, changes in financial prices may have altered the behavior of private agents, potentially affecting real economic activity. This study aims to quantify the financial and

[1] See, for example, Eser and Schwaab (2013), Ghysels, Idier, Manganelli, and Vergote (2014), Rivolta (2012), Szczerbowicz (2012), and Falagiarda and Reitz (2013) for a discussion and an evaluation of unconventional monetary policy and, in particular, the effects of the Securities Markets Programme (SMP).

macroeconomic impact of OMT *announcements* on four euro area countries: Germany, France, Italy, and Spain. We conduct our evaluation in two stages.

First, in order to isolate the effects of the announcements on financial prices, we look at daily data on bond yields and conduct an event study along the lines of Altavilla and Giannone's (2014) study on the effects of the Federal Reserve's Large Scale Asset Purchases (LSAPs). The main idea is to assess the effects of the policy announcements by regressing sovereign bond yields on event dummies (which take the value of one for the date of the event, the OMT announcements, and zero for other days) while, at the same time, controlling for all other relevant "news" made publicly available in the period under analysis. The "news" is the surprise component of macroeconomic and other relevant releases, that is, the difference between the data release and the corresponding expectation of market participants (evaluated by looking at 151 categories of releases for the euro area, France, Germany, Italy, and Spain, made available by Bloomberg). We evaluate the impact of OMT announcements on a measure of the "target" bond yields—assumed here to be the 2-year government bond rate—and on 10-year government bond rates. The main outcome of the event study is that OMT announcements had significant impacts on bond yields in Italy and Spain, particularly within the range of maturities indicated by the ECB as the target of the measure. Italian and Spanish 2-year bond yields declined by about 2 percentage points. At the same time, yields for similar maturities of Germany and France were not significantly impacted.

Second, we employ a multi-country macroeconomic model to assess the macroeconomic impact of the previously estimated changes in bond yields due to OMT announcements. For each of the four countries in our study, the model includes six variables (real GDP, consumer prices, M3, retail credit, and government bond rates for 2- and 10-year maturities) as well as a measure of the ECB policy rate and the expected euro areabond market volatility. We allow for country heterogeneity, cross-country spillovers of policy effects, and rich dynamics among countries/variables by adopting a flexible vector autoregressive (VAR) specification in (log-)levels and with five lags. For the VAR estimation, we address the high-dimensional data problem (26 variables, 5 lags, and a quarterly sample starting with 1999Q1) and use Bayesian shrinkage as suggested in Banbura, Giannone, and Reichlin (2010). In practice, the assessment of the likely macroeconomic effects of OMT announcements is conducted over a horizon of 3 years after the announcements by comparing two scenarios, defined as "*OMT"* and "*no-OMT"* scenarios. The two scenarios mostly differ in the dynamics of the yield curve, which, as we conclude from the event study previously described, were strongly affected by OMT announcements. In particular, for the whole horizon of 3 years, we assume that the 2-year bond yields in Italy and Spain are about 2 percentage points lower in the OMT scenario than in the no-OMT scenario, while they are the same in France and Germany. To isolate the effects of non-standard policy as much as possible, we also assume that the standard monetary policy in the two scenarios is the same. Our evaluation suggests that OMT announcements are likely to be associated, in the 3 years following the announcements, with relevant increases in the real economy, consumer prices, and credit in Italy and Spain. France and Germany are moderately affected by OMT

announcements. The euro area bond market volatility is likely to be lower in the OMT scenario compared to the no-OMT scenario.

A growing amount of research has focused on the financial effects of non-standard measures implemented in different countries. For the US, Gagnon, Raskin, Remache, and Sack (2011) found, using the event-study methodology, that the first round of quantitative easing (QE1) decreased bond rates by 91 basis points (bps). Focusing on both QE1 and QE2, Krishnamurthy and Vissing-Jorgenses (2011) estimate that the impact of the first program on the safety-premium reduced yields by more than 100 bps, with the second program having a more muted effect (about 20 bps). D'Amico and King (2013) estimate that the effects of Fed purchases of Treasury securities during QE1 ($300 billions) produced a decrease of almost 50 basis points in the 10-year Treasury yield. Joyce, Lasaosa, Stevens, and Tong (2011) suggest that QE measures adopted in the UK lowered long-term gilt yields by about 100 basis points and that most of the decline was generated by portfolio balance effects. Estimating the overall effect of the non-standard measures implemented in the US, that is, QE1, QE2, QE3, and Forward Guidance, Altavilla and Giannone (2014) find a significant decrease of about 200 bps in the long-term interest rate. Finally, for the euro area, Eser and Schwaab (2013), Ghysels, Idier, Manganelli, and Vergote (2014), Rivolta (2012), Szczerbowicz (2012), and Falagiarda and Reitz (2013) show that the Securities Markets Programme of the Eurosystem succeeded in lowering yields relative to a no-intervention situation, reducing market volatility, and improving market functioning.

For the euro area, Lenza, Pill, and Reichlin (2010) estimated the effects of the after-Lehman unconventional liquidity policy by evaluating the elasticity of unemployment and industrial production to changes in money market rates in a setup that bears some resemblance to the one in this study.

In this study, we carry out an event study to assess the financial effects of the ECB's unconventional policy in order to quantify asset price changes between the policy and no-policy scenarios, using a novel multi-country model. The model presented in the paper also allows for cross-country heterogeneity. The elasticity to changes in bond yields implied by the estimated macroeconomic effects of the OMT announcements for Italy and Spain lie broadly in the middle of the range of estimates of the effects of LSAP policies in the US and QE in the UK. For the US, Chen, Curdia, and Ferrero (2012) provide the lower boundary while Chung, Laforte, Reifschneider, and Williams (2012) and Baumeister and Benati (2013) provide the upper boundary. For the UK, Kapetanios, Mumtaz, Stevens, and Theodoridis (2012) find that a permanent decrease in the term spread by 100 basis points would imply an increase in the GDP level ranging between 0.7% and 2.7%.

The remainder of this paper is structured as follows. Section 2 elaborates on the event study-based estimation of the impact of OMT announcements on the yield curve of France, Germany, Italy, and Spain. Section 3 describes the multi-country VAR model and illustrates the macroeconomic impact of the OMT announcements. Section 4 concludes.

2. The financial effects of OMT announcements

To assess the effects of OMT announcements on the Treasury bond markets in France, Germany, Italy, and Spain, we estimate for each country (for the sample period January 2007 to February 2013) the following equation:

$$\Delta y_t = c + \alpha D_t + \beta News_t + \varepsilon_t \quad (1)$$

Equation (1) relates the daily changes in the financial variables of interest Δy_t (the changes in the 2-year or 10-year bond yields) to a vector of event dummies D_t (i.e., variables with the value of one on the "event days" and zero on the other days). Precisely, the dummies take the value of one on the day of the announcement and the day after—we assume a two-day event window. Such a choice is driven by the consideration that, during a period of low liquidity, the prices of bonds may react slowly in response to an announcement. The event dummies reflect the three major OMT announcement-related events that occurred between July and September 2012. The estimation is carried out by means of standard regression techniques.

We augment the classical event study analysis by controlling for the main news stemming from economic releases, $News_t$, which could have influenced bond rates (see Altavilla and Giannone, 2014, for a more detailed explanation of this method). More precisely, the "controlled" event-study analysis aims to consider all macroeconomic news within each event window that could have possibly influenced the 2- and 10-year government bond rates in that particular time window. For this purpose, the analysis uses a real-time data flow that captures the information available to market participants at each point in time. To address the challenging task of reconstructing the information set of market participants, we use a dataset available in Bloomberg. This dataset provides, for each economic release at any point in time, the corresponding expectations of a panel of market participants. The expected values are median (consensus) forecasts collected before (up to one day) the official data release. For each of the 151 variables included in Table A.1 (see appendix), a time series of (standardized) daily news can be computed as the difference between the first-released (real-time) data and their expected values. This time series represents a measure of the news content of all the most relevant releases on economic data in the period under analysis. In fact, if a certain release is perfectly forecasted, then the release cannot be considered as "news" to market participants, and would hardly affect asset prices. On the contrary, if a certain release is imperfectly forecasted, it contains some "news" for market participants and, hence, is likely to affect asset prices.[2] The estimated α coefficients return the effects of the policy measure. Standard tests can be used to evaluate whether the sum of the coefficients of event dummies is statistically different from zero. The results are reported in table 1 for two different specifications of equation (1): in the "classical" specification, the alternative news is not included in the regression, while in the "controlled" specification it is included.

[2] Appendix A provides some more details on the macroeconomic news we control for in our exercises.

Table 1: The effects of OMT announcements on sovereign bond markets (in basis points)

Country	Maturity	1st Announcement		2nd Announcement		3rd Announcement		
		26/07/12	27/07/12	02/08/12	03/08/12	06/09/12	07/09/12	**Total**
Classical								
DE	2 Years	0	1	-2	5	4	1	**8**
FR	2 Years	-7	-4	2	1	5	1	**-4**
IT	2 Years	-83	-24	-8	-61	-12	-12	**-199** ***
ES	2 Years	-77	-43	-17	-70	0	-27	**-234** ***
DE	10 Years	4	7	-8	10	8	3	**23** *
FR	10 Years	-7	0	-3	3	1	-3	**-9**
IT	10 Years	-40	-12	33	-20	-21	-23	**-82** ***
ES	10 Years	-42	-24	28	0	-40	-37	**-115** ***
Controlled								
DE	2 Years	0	1	-2	5	1	2	**7**
FR	2 Years	-6	-5	2	1	2	1	**-5**
IT	2 Years	-72	-16	-7	-62	-8	-9	**-175** ***
ES	2 Years	-69	-30	-17	-71	2	-23	**-209** ***
DE	10 Years	6	6	-8	9	7	3	**23** *
FR	10 Years	-4	-1	-3	2	4	-2	**-4**
IT	10 Years	-33	-10	34	-21	-17	-22	**-69** ***
ES	10 Years	-37	-14	28	-1	-37	-36	**-97** ***

Note: The table reports the event study results for the day of the Outright Monetary Transaction (OMT) announcement and the following day. The last column reports the results of "Classical" and "Controlled" as a sum of changes on the announcement days based on a 2-day event window. Controlled event study refers to the event-study regression in equation (1), where the daily changes in each selected asset price are regressed on event dummies and 151 time series of macroeconomic news stories. *, **, and *** denote significance of the F-test for abnormal return at 10%, 5%, and 1%, respectively.

OMT announcements have been much more effective in reducing government bond rates in Italy and Spain than in Germany and France, whose bond markets have not significantly reacted to policy events. The reduction in the 2-year bond yields in both Italy and Spain is about 200 bps. while the effects on the 10-year bond rates in both countries are smaller, approximately 100 bps, consistent with the target of the policy measure, which explicitly focuses on the yields of bonds with remaining maturities of up to 3 years. Table 1 also reveals that once the effects of all macroeconomic news are taken into account, the estimated effects of OMT announcements do not significantly change. This suggests that the announcements are the most relevant news within the event window.

The reliability of event studies rests on the assumption that policy changes are immediately incorporated in prices and that their effects are persistent. These assumptions might not hold, especially in periods of financial turbulence. Another possible shortcoming of high-frequency analysis is the inability of capturing possible lagged effects and reversals because of the focus on a narrow time window.

To check whether the announcements of asset purchases may have had only a temporary impact on asset prices, we increase the size of the event window up to five consecutive days. Table 2 reports the cumulative changes in the 2- and 10-year government bond yields, estimated with both classical and controlled event-study analyses. The results suggest that the impact of the announcements has been very persistent with no signals of possible rebound in the following days.[3]

[3] Appendix B reports the same results for other asset prices.

Table 2: Asset price reactions to Outright Monetary Transaction announcements (in basis points)

Variable	Size of the Event Window									
	1-day		2-day		3-day		4-day		5-day	
	Classical	Controlled	Classical	Controlled	Classical	Controlled	Classical	Controlled	Classical	Controlled
2-year gov. bond										
Germany	1	-3	8	7	2	1	4	0	9	3
France	-1	-2	-4	-5	-8	-9	-8	-12	-7	-11
Italy	-103	-85	-199	-175	-190	-159	-154	-130	-190	-172
Spain	-94	-77	-234	-209	-325	-296	-286	-267	-291	-278
10-year gov. bond										
Germany	4	7	23	23	23	24	22	23	33	32
France	-8	2	-9	-4	-10	0	-20	-10	-19	-11
Italy	-27	-10	-82	-69	-74	-53	-80	-57	-107	-86
Spain	-53	-39	-115	-97	-158	-139	-144	-129	-145	-133

Note: The table reports the results (basis points) of the event-study analysis for different event window sizes.

3. The macroeconomic effects of OMT announcements

The OMT announcements contributed to a *statistically* significant reduction in the spreads of long-term bond yields of Italy and Spain with their German counterparts, allowing a more even pass-through of the ECB accommodative monetary policy stance across euro area countries. In this section, we provide an assessment of the *economic* significance of these effects on the yield curve spreads by evaluating the likely macroeconomic effects of OMTs.

3.1 Data and empirical model

The analysis of the macroeconomic effects associated with OMT announcements is based on a multi-country model of the macro-financial linkages in France, Germany, Italy, and Spain. More precisely, six variables (real GDP, harmonized index of consumer prices [HICP], M3, retail credit, rates of government bonds with remaining maturities of two and ten years) are included for each country. The model also includes, as a measure of the common standard monetary policy actions, the euro area overnight money market rate (EONIA) and a measure of expected euro area bond market volatility.[4] To allow for country heterogeneity, cross-country spillovers in the policy effects, and rich dynamics among countries/variables, we leave unrestricted all possible interactions among variables/countries by adopting a flexible vector autoregressive (VAR) specification in (log-)levels with five lags. For the estimation of the VAR, we address the high-dimensional data problem (26 variables, 5 lags) and use Bayesian shrinkage as suggested in De Mol, Giannone, and Reichlin (2008) and Banbura, Giannone, and Reichlin (2010). The latter show that if the data are collinear, as is the case for macroeconomic variables, the relevant sample information is not lost when over-fitting is controlled for by shrinkage via the imposition of priors on the parameters of the model to be estimated. The hyperparameters controlling for the informativeness of the prior distributions are

[4] Overall, the model includes 26 variables, available at quarterly frequencies over the sample period, 1999Q1–2014Q1. For more information on the data, see Appendix C.

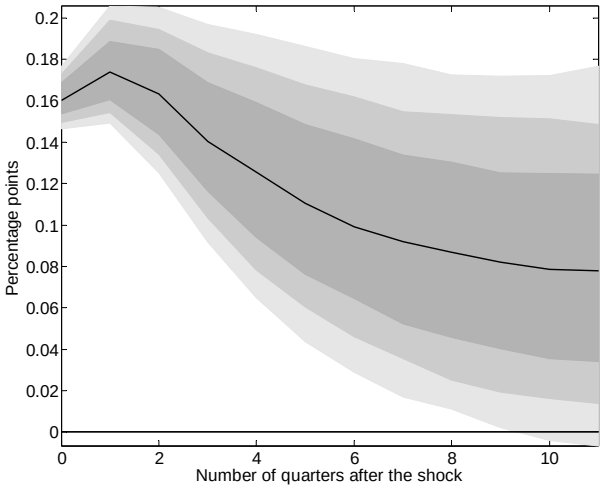
treated, as suggested in Giannone, Lenza, and Primiceri (2012), as random variables so that the uncertainty surrounding the prior setup in our evaluation is also accounted for. Appendix C sketches the main features of the setup.

3.2 An illustration of the VAR dynamics: the effects of a standard monetary policy tightening

As a preliminary step, we study the economic developments triggered by a tightening of the standard monetary policy in different countries to demonstrate that our approach can capture the main dynamic interrelationships between variables. More specifically, we estimate the reaction of GDP, consumer prices, credit, M3, the yield curve, and the euro area aggregate bond volatility to an exogenous monetary policy shock.

We use a recursive identification scheme to identify the monetary policy shock (see Christiano, Eichenbaum, and Evans, 1999, for an extensive discussion and economic interpretation of this type of identification schemes). The EONIA is assumed to proxy for the monetary policy rate. Our central assumption is that it takes at least one month for a change in the common euro area monetary policy rate to transmit to real GDP and consumer prices in the four countries under analysis. However, credit, M3, and the yield curve in all countries, as well as the euro area bond market volatility, can be affected contemporaneously by the change in the policy rate. Figure 1 shows the dynamics of the policy rate in response to an exogenous tightening of monetary policy.

Figure 1: Response of the euro area policy rate to monetary policy shock

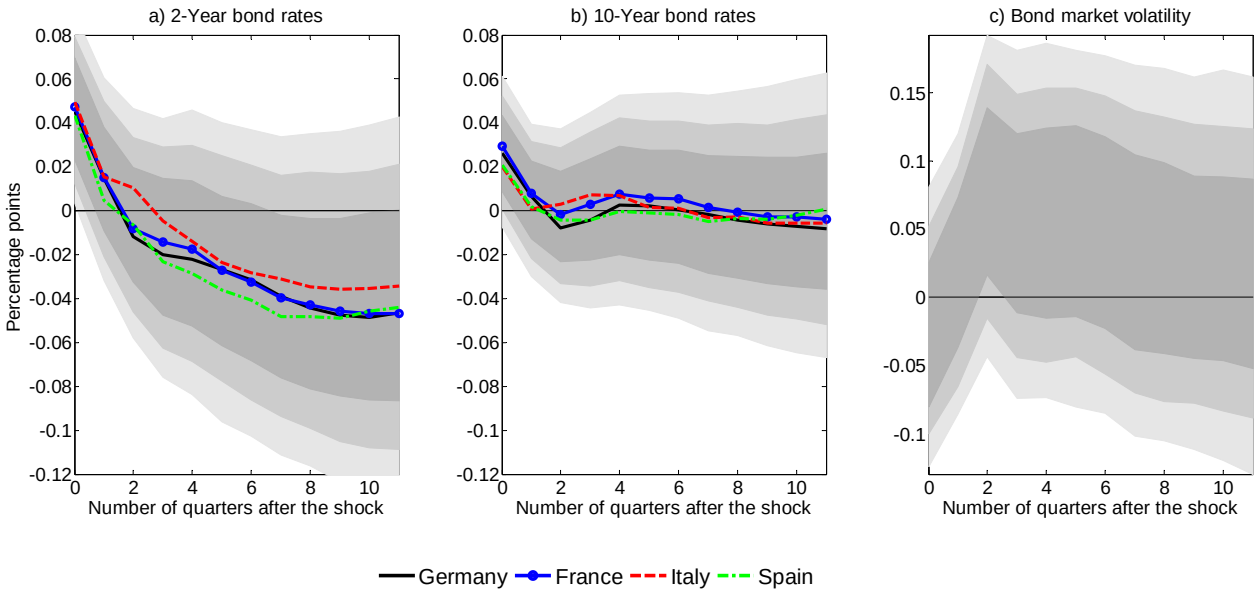


Note: The chart reports the distribution of impulse responses of the EONIA levels, trimming the quantiles below the 16th and above the 84th. The black solid line represents the median of the posterior distribution.

On impact, the policy rate increases by about 16 basis points, peaks one quarter after the shock, and then gradually decreases. Figure 2 reports the reaction of the long-term interest rates (panels *a* and *b*) and the measure of euro area bond market volatility (panel *c*) to the monetary policy

tightening. We report the distribution of impulse responses for the euro area (computed, in panel *a* and *b*, as the GDP-weighted average of the country responses) and the median of the individual country responses.

Figure 2: Response of the yield curve and bond market volatility to monetary policy shock

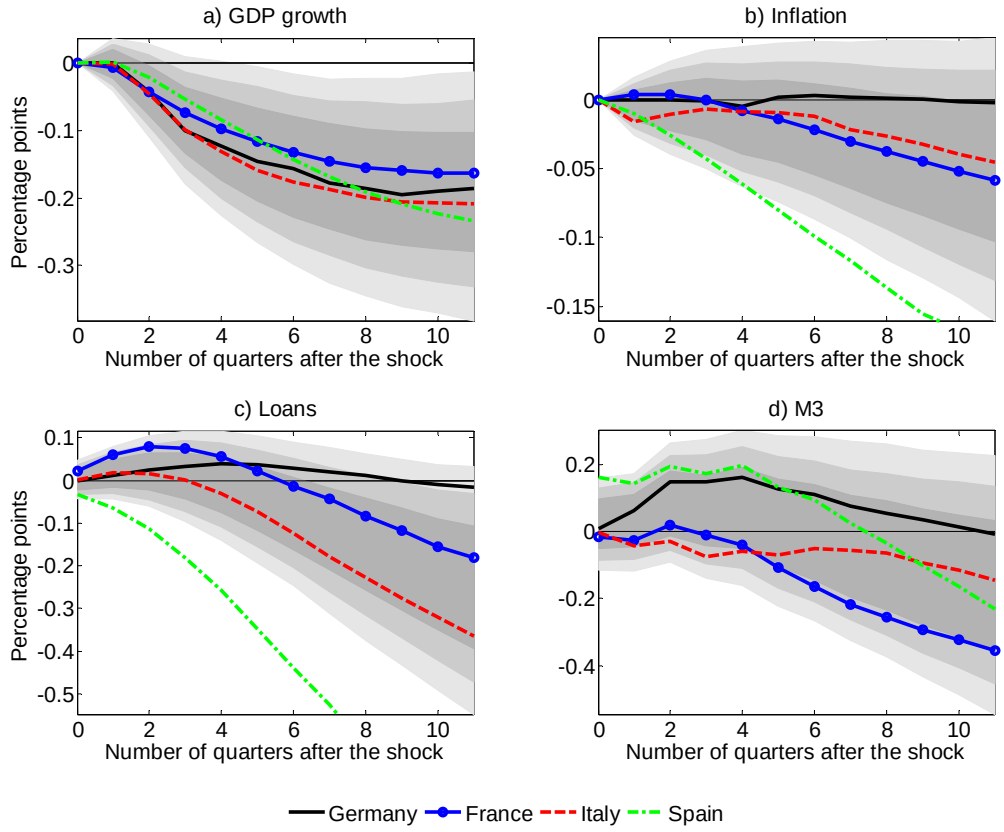


Note: The charts report the distribution of impulse responses of the levels of the variables in the euro area (GDP-weighted average of the four countries in panel *a* and *b*), trimming the quantiles below the 16th and above the 84th. The four lines in panel *a* and *b* refer to the median responses in each of the four countries.

The bond rates increase on impact and then tend to quickly revert to pre-tightening levels. These results imply that a 1% increase in the EONIA rate leads, on impact, to an increase of about 40 and 30 basis points in the 2- and 10-year bond yields, respectively. The results are broadly in line with previous studies on the effects of a federal funds rate shock on long-term bond yields. Kuttner (2001), for example, found similar values for the response of the 2- and 10-year bond yields: 61 and 32 basis points increase, respectively, for a 1 percentage point rise in the federal funds rate. Cochrane and Piazzesi (2002) found a larger reaction to the federal funds target: a 1% unexpected target change increases 10-year Treasury yields by 52 bps. Remarkably, the response of the yield curve to a tightening in the stance of the standard euro-area-wide monetary policy is quite homogenous across countries. Hence, standard monetary policy tools may not be able to address the issue of heterogeneous yield curve developments in the euro area sovereign crisis. The standard monetary policy does not seem to be able to significantly affect euro area bond market volatility either.

Figure 3 reports the responses of other variables in the model expressed in the y-o-y growth rate: GDP (panel *a*), the GDP deflator (panel *b*), Loans (to firms and households, panel *c*), and M3 (panel *d*).

Figure 3: Response of macroeconomic variables to monetary policy shock



Note: The charts report the distribution of impulse responses of the log-levels of the variables in the euro area (GDP-weighted average of the four countries, in all panels), trimming the quantiles below the 16th and above the 84th. The four lines in all panels refer to the median responses in each of the four countries.

Again, the shaded area represents the distribution of impulse responses in the euro area (computed as the GDP-weighted average of the country responses), while the four lines represent, respectively, the median responses in the four countries.

As expected, real GDP decreases in all countries in response to a tightening of the ECB monetary policy. Real GDP reaches its trough after about two years in all countries, with a similar path and size of reaction across countries. Consumer prices exhibit more cross-country heterogeneity, dropping in Italy, Spain, and France, while German prices are unaffected by the monetary policy tightening. Credit markets exhibit a more relevant extent of cross-country heterogeneity compared to real activity and prices. For example, Spain exhibits the most substantial drop in credit, while in Germany, Italy, and France loans initially increase (implying that aggregate loans also increase) before starting to drop after about one year (see den Haan, Sumner, and Yamashiro, 2007; Giannone, Lenza, and Reichlin, 2012, for a similar result on the US and the euro area and possible interpretations).

Finally, M3, on impact, increases on average across countries. This apparent "lack of liquidity effect" is not surprising and is explained by the fact that M3 dynamics are dominated by those of short-term monetary assets (time deposits, marketable instruments), whose returns are very sensitive

to the policy rate. Hence, a tightening makes these assets more attractive than alternative investment options (see Giannone, Lenza, and Reichlin, 2012, for an extensive discussion on this topic).

3.3 The evaluation of OMT effects

We evaluate OMT effects by comparing two scenarios, defined as the no-OMT and OMT scenarios.[5] The counterfactual analysis is performed starting from 2012Q3 (when the OMT was announced) with a projection horizon of three years, and is constructed as follows. The model is estimated over the sample period 1999Q1–2012Q3. The no-OMT scenario is simply given by the unconditional forecast of the VAR model for the following three years. The OMT scenario, however, has the features summarized in Table 3.

In particular, *relative to the no-OMT scenario paths*, the OMT announcements are assumed to decrease the 2-year bond rates in Italy and Spain over the entire 3-year projection horizon (by 1.75% and 2.09% in Italy and Spain, respectively, as estimated in the "controlled" event study). The 2-year bond rates in France and Germany are left unchanged (i.e., equal to no-OMT values).

To further isolate the OMT announcements as a source of the bond rate changes, we make two further assumptions. First, macroeconomic variables in all countries (real activity and prices) are not allowed to differ from comparable levels in the no-OMT scenario, at the time of the "OMT shock" (although they are allowed to change subsequently). Second, to exclude the possibility that the differences between the OMT and no-OMT scenarios are related to different paths of the standard monetary policy (characterized by the path of the short-term interest rate), we assume that the latter is the same in both scenarios.

Table 3: Assumptions for the OMT and no-OMT scenarios

Assumption A - Shift in the path of bond yields
Italy and Spain: 2-years bond rates decrease over the entire 3-year projection horizon (by 1.75 and 2.09 percent in Italy and Spain, respectively)
Germany and France: impose the same path between OMT and non OMT scenario
Assumption B – OMT only driver of changes in yields
Real activity and prices in all countries are not allowed to change at the time of the OMT announcement (GDP and Price changes are set to zero on impact).
Assumption C – Path of monetary policy
Impose the same path between OMT and non OMT scenario

Note: The table reports the assumptions used in the conditional forecasting exercise to retrieve the OMT and no-OMT scenarios. The length of the projection horizon used in the analysis is three years.

[5] Lenza, Pill, and Reichlin (2010); Giannone, Lenza, Pill, and Reichlin, (2012); and Kapetanios, Mumtaz, Stevens, and Theodoridis, (2012) apply a similar methodology to study the effects of the ECB liquidity and quantitative easing policies in the UK.

Our measure of the effects associated with OMT announcements is given by the difference between the OMT and no-OMT scenario paths for the variables. Given that the results are computed in terms of deviations in the OMT from the no-OMT scenarios in a linear VAR model, this assessment is independent of the path assumed for the no-OMT scenario.[6] Table 4 reports, for country (column 1) and variable (column 2) pairs, both (i) median results (column 3) and (ii) the probability (column 4) that the effects are positive, both evaluated three years after the announcement.

The general outcome of the analysis is that OMT announcements are very likely to be associated with positive and quite sizeable effects on real activity, loans, and consumer prices in Italy and Spain. The GDP and price effects are broadly in line with those estimated for the quantitative easing policies in the US and the UK.[7] The evidence reported in Table 4 points to moderate (positive) spillovers on real activity in France, and even smaller spillovers in Germany.

Table 4: The macroeconomic effects associated with OMT announcements

	Variables	Effect	Probability of Positive Effect
Germany	GDP	0.34	0.60
	Price	0.28	0.67
	Loans	1.08	0.90
France	GDP	0.46	0.64
	Price	0.28	0.68
	Loans	1.38	0.22
Italy	GDP	1.50	0.81
	Price	1.21	0.86
	Loans	3.58	0.82
Spain	GDP	2.01	0.80
	Price	0.74	0.65
	Loans	2.31	0.75

Note: The table reports the effects associated with OMT announcements in terms of percentage deviations in the OMT scenario relative to the no-OMT scenario at the end of the 3-year projection horizon. The last column reports the probability that the effects are positive.

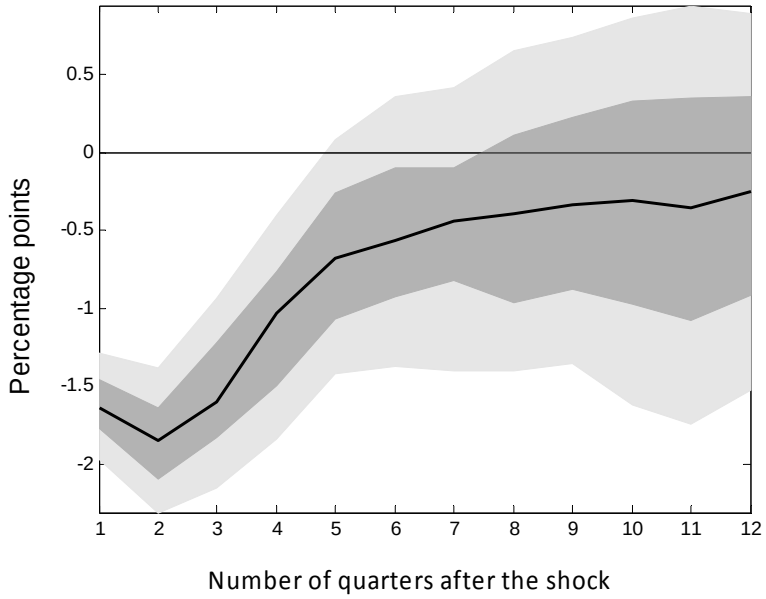
Figure 4 provides some additional evidence on the effects of OMT announcements on bond market volatility. The OMT announcements are shown to reduce expected bond market volatility, a

[6] The Kalman filter-based algorithm described in Banbura, Giannone, and Lenza (2014) is adopted to assess the reaction of the variables in the scenarios. The algorithm extracts the most likely combination of shocks that, given past regularities, could have generated the scenario paths. All the scenarios assume that the structure of the economy (reflected in the estimated coefficients) and the nature and relative importance of different shocks (reflected in the estimated covariance matrix of the shocks) remain the same as in the estimation sample.

[7] The elasticity implied in the estimates of the macroeconomic effects of OMT announcements for Italy and Spain lie broadly in the middle of the range of estimates of the effects of LSAP policies in the US and of QE in the UK. For the US, Chen, Cúrdia, and Ferrero (2012) provide the lower boundary, while Chung, Laforte, Reifschneider, and Williams (2012) and Baumeister and Benati (2013) provide the upper boundary. For the UK, Kapetanios, Mumtaz, Stevens, and Theodoridis (2012) find that a permanent decrease in the term spread by 100 basis points would imply a GDP increase ranging between 0.7% and 2.7%.

measure of uncertainty in the euro area bond market, by about 1.5 percentage points. Given the definition of the volatility index, the latter result implies a reduction of 35 basis points in the standard deviation of the expected euro area bond rates for the following month. This result is in contrast with the insignificant response of bond market volatility found for the effects of standard monetary policy.

Figure 4: The effects of OMT announcements on bond market volatility



Note: The chart reports the distribution of the responses of bond market volatility (trimming the quantiles lower than the 5th and higher than the 95th). The black solid line represents the median of the posterior distribution.

4. Conclusions

Announcements that the Eurosystem might engage (under specific conditions) in outright monetary transactions had a sizeable impact on financial markets in a period when monetary policy transmission was particularly impaired because of high redenomination risks perceived by market participants. We found that such announcements led to a decrease of about 200 basis points in the 2-year government bond rates in Italy and Spain, but left yields of German and French bonds of comparable maturities largely unaffected.

Evaluating the financial market effects on the real economy through the lens of a multi-country BVAR model for the largest Euro area countries, we found that the announcements have statistically significant and economically relevant effects on credit and on economic growth in general, in Italy and Spain, with relatively limited spillovers in France and Germany.

Over the last months, declining interest rates on sovereign bonds, improving financial market conditions, and a decreasing dependency of the euro area banking system on Eurosystem refinancing have signaled a gradual return to a normal phase in the euro area financial markets. Our findings attribute a part of these improvements to the announcement of the OMT programme.

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A Event study analysis: list of macroeconomic releases

Table A.1 reports the entire set of macroeconomic variables used in the high-frequency analysis to identify the effect of OMT announcements on government bond yields in Germany, France, Italy, and Spain.

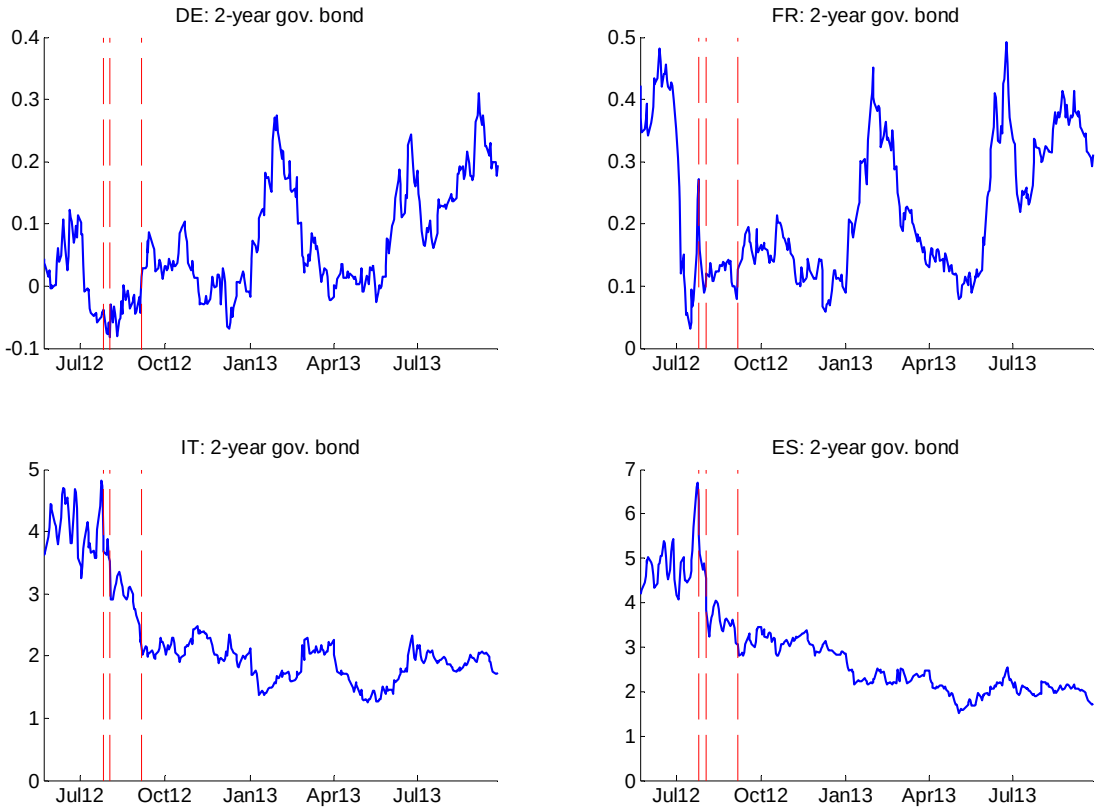
Table A.1: Macroeconomic variables included in the high-frequency analysis

Euro Area	France	Germany	Italy	Spain
Business Climate Ind.	Bank of France Bus. Sentiment	Budget (% of GDP)	Budget Balance (Year to date)	Adj. Real Ret. Sales YoY
ECB Interest Rates	Business Confidence Indicator	Capital Investment	Business Confidence	CPI (MoM)
Current Account SA	Central Govt. Balance (Euros)	Construction Investment	Consumer Conf. Ind. sa	CPI (YoY)
Consumer Conf.	Consumer Confidence Indicator	CPI (MoM)	CPI (NIC incl. tobacco, MoM)	CPI (Core Index) (MoM)
CPI -Core (YoY)	CPI (MoM)	CPI (YoY)	CPI (NIC incl. tobacco, YoY)	CPI (Core Index) (YoY)
CPI Estimate (YoY)	CPI (YoY)	Current Account (EURO)	Deficit to GDP	CPI (EU Harm.) (MoM)
Current Account nsa	Consumer Spending (MoM)	Domestic Demand	Government Spending	CPI (EU Harm.) (YoY)
Economic Conf.	Consumer Spending (YoY)	Exports	Hourly Wages (MoM)	GDP (Constant SA) (QoQ)
GDP s.a. (QoQ)	CPI	Exports SA (MoM)	Hourly Wages (YoY)	GDP (Constant SA) (YoY)
GDP s.a. (YoY)	CPI	Factory Orders MoM (sa)	Imports	House Price Index QoQ
Govt Debt/GDP Ratio	CPI Ex Tobacco Index	Factory Orders YoY (nsa)	Industrial Orders n.s.a. (YoY)	House Price Index YoY
Govt Expend (QoQ)	France Retail PMI	GDP nsa (YoY)	Industrial Orders s.a. (MoM)	Ind. Output WDA (YoY)
Gross Fix Cap (QoQ)	GDP (QoQ)	GDP s.a. (QOQ)	Ind. Prod. nsa(YoY)	PPI (MoM)
Household Cons (QoQ)	GDP (YoY)	GDP wda (YoY)	Ind. Prod. sa (MoM)	PPI (YoY)
Ind. Prod. sa (MoM)	Housing Perm. 3M YoY% Chg.	GfK Cons. Conf. Survey	Ind. Prod. wda(YoY)	Real Ret. Sales (YoY)
Ind. Prod. wda (YoY)	Housing Starts 3M YOY% Chg.	Government Spending	Ind. Sales n.s.a. (YoY)	Cons. Confidence
Indust. Conf.	ILO Mainland Unempl. Rate	IFO -Business Climate	Ind. Sales s.a. (MoM)	Trade Balance (Mln Euros)
Labour Costs (YoY)	ILO Unemployment Rate	Import Price Index (MoM)	PMI Manufacturing	Unempl. MoM Net ('000s)
M3 s.a. (YoY)	Imports (QoQ)	Import Price Index (YoY)	PMI Services	Unempl. Rate (Survey)
M3 s.a. 3 mth ave.	Ind. Prod. (MoM)	Imports	PPI (MoM)	
PPI (MoM)	Ind. Prod. (YoY)	Imports SA (MoM)	PPI (YoY)	
PPI (YoY)	Mainland Unemp. Chg. (000s)	Ind. Prod. YoY (nsa wda)	Private Consumption	
Ret. Sales (MoM)	Manuf. Prod. (MoM)	Ind. Prod. (YoY)	Retail Sales (YoY)	
Ret. Sales (YoY)	Manuf. Prod. (YoY)	Ind. Prod. MoM (sa)	Retail Sales s.a. (MoM)	
Services Conf.	Non-Farm Payrolls (QoQ)	PMI Manufacturing	Retailers' Confid. General	
Trade Balance	Own-Company Prod. Outlook	PMI Services	Total investments	
Trade Balance sa	PMI Manufacturing	Private Consumption	Trade Balance (Total) (Euros)	
Unempl. Rate	PMI Services	Producer Prices (MoM)	Trade Balance Eu (Euros)	
Ind. New Ord. NSA (YoY)	PPI (MoM)	Producer Prices (YoY)	Trade Balance Non-Eu (Euros)	
Ind. New Ord. SA (MoM)	PPI (YoY)	Retail Sales (MoM)	Unempl. Rate	
PMI Composite	Production Outlook Indicator	Retail Sales (YoY)	Unempl. Rate (s.a)	
PMI Manuf.	Total Jobseekers	Trade Balance	Unempl. Rate (SA)	
PMI Services	Trade Balance (Euros)	Unempl. Chg. (000's)		
ZEW Survey (Econ. Sent.)	Wages (QoQ)	Unempl. Rate (s.a)		

B Daily and intra-daily effect of OMT announcements

Figure 5 reports the interest rates on 2-year government bonds in Germany (DE), France (FR), Italy (IT), and Spain (ES) during the sample period of the event-study analysis, that is, from May 2012 to September 2013. Vertical gridlines indicate the announcement days.

Figure 5: The 2-year bond rate—daily frequency



Note: The figure reports interest rates on 2-year government bonds in Germany (DE), France (FR), Italy (IT), and Spain (ES) during the sample period of the event-study analysis, that is, from May 2012 to September 2013. Vertical gridlines indicate the OMT announcement days, that is, 26 July, 2 August, and 6 September 2012.

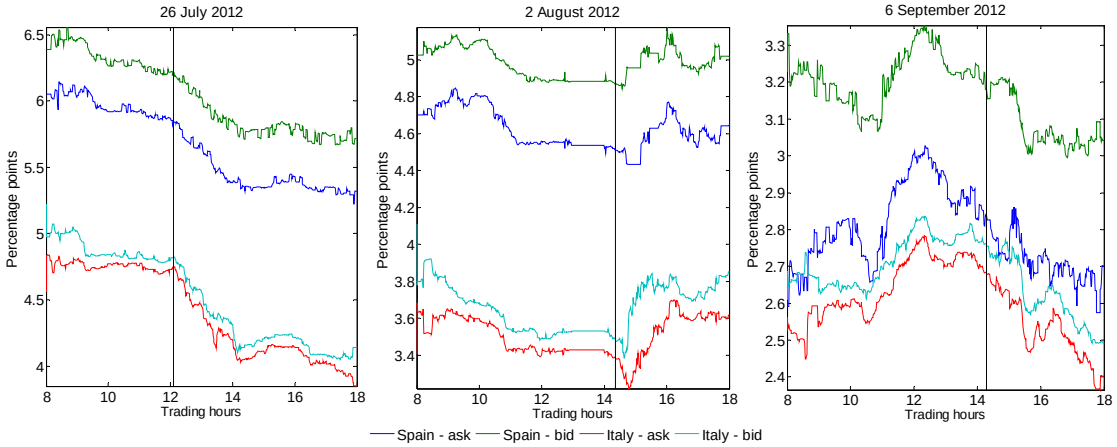
Changing the size of the event window might be interpreted as a test for possible reversal and lagged effects. In line with the results presented in Table 2, the estimated reaction of 5-year sovereign CDS in the four selected economies to the OMT announcements as well as the euro area bond and stock market volatility are not influenced by the length of the event window (see Table A.2).

Table A.2: Asset prices reactions to Outright Monetary Transactions

Variable	Size of the Event Window									
	1-day		2-day		3-day		4-day		5-day	
	Classical	Controlled	Classical	Controlled	Classical	Controlled	Classical	Controlled	Classical	Controlled
5-year CDS										
Germany	-5	-1	-16	-13	-21	-19	-20	-21	-23	-24
France	-9	-5	-35	-32	-41	-36	-43	-41	-51	-50
Italy	-41	-33	-154	-144	-154	-142	-163	-153	-175	-169
Spain	-40	-33	-156	-148	-178	-169	-177	-172	-202	-201
Euro area - Bond Volatility	-1.2	-1.3	-1.0	-1.2	0.0	-0.1	0.5	0.1	0.1	-0.1
Euro area - Stock Volatility	-5.3	-5.0	-9.8	-9.7	-5.9	-4.8	-5.9	-5.9	-6.6	-6.1

Figure 6 reports the time patterns of the 2-year bond bid and ask rates for Italy and Spain during the trading hours of the first OMT announcement. As depicted in the figure, these rates significantly drop after the announcement (the vertical line in the graph). This further corroborates the fact that the announcement was the dominant event during that day.

Figure 6: Intraday bid and ask rates for 2-year bonds on OMT announcement days



Note: The vertical lines indicate the time in London when Mr. Draghi commenced his speech: 12:09 on July 26 and 14:30 on August 2 and September 6.

C The multi-country VAR model

Let y_t be an n-dimensional vector of variables; the general equation of a VAR is

$$y_t = c + A_1 y_{t-1} + \ldots + A_p y_{t-p} + \varepsilon_t$$

$$\varepsilon_t - N(0, \Sigma)$$

where $A_1 \ldots . A_2$ are $n \times n$ matrices of coefficients, p (=5) the number of lags, and ε_t an n-dimensional vectorial white noise.

Table A.3 reports the definition and data transformations of the n (=26) variables we include in the VAR model. We estimate our model in (log-)levels. Quarterly data are available for the sample period, 1999Q1–2012Q3.

Retail credit is the sum of total credit to households and non-financial corporations. The implied bond volatility for the euro area is constructed by averaging the (end-of period) implied volatility on call and put options of the Eurex Generic 1st `RX` Future. This future contract is based on long-term notional debt securities issued by the German Federal Government with a term of 8.5–10.5 years.

Table A.3: VAR variable definitions

Country	Variable	Transformation
France (FR)	Real GDP	4*Log-levels
	HICP	4*Log-levels
	M3	4*Log-levels
	Retail Loans	4*Log-levels
	2-years bond rates	Raw
	10-years bond rates	Raw
Germany (DE)	Real GDP	4*Log-levels
	HICP	4*Log-levels
	M3	4*Log-levels
	Retail Loans	4*Log-levels
	2-years bond rates	Raw
	10-years bond rates	Raw
Italy (IT)	Real GDP	4*Log-levels
	HICP	4*Log-levels
	M3	4*Log-levels
	Retail Loans	4*Log-levels
	2-years bond rates	Raw
	10-years bond rates	Raw
Spain (ES)	Real GDP	4*Log-levels
	HICP	4*Log-levels
	M3	4*Log-levels
	Retail Loans	4*Log-levels
	2-years bond rates	Raw
	10-years bond rates	Raw
Euro Area (EA)	EONIA (overning money market rate)	Raw
	Bond Volatility	Raw

C.1 Estimation and conditional forecasts

The large cross-section of variables (26) and number of lags (5), coupled with the relatively small sample, implies that classical maximum likelihood techniques would provide unreliable estimates.

Hence, for the estimation of the VAR, we address the high-dimensional data problem by adopting Bayesian shrinkage as suggested in De Mol, Giannone, and Reichlin (2008) and Banbura, Giannone, and Reichlin (2010). The latter show that if the data are collinear, as is the case for macroeconomic

variables, the relevant sample information is not lost when over-fitting is controlled for by shrinkage via the imposition of priors on the parameters of the model to be estimated.

More precisely, in this study, we consider conjugate priors belonging to the normal/inverse-Wishart family, where the prior for the covariance matrix of the residuals Σ is inverse Wishart and the prior for the autoregressive coefficients is normal.

For the prior on the covariance matrix of the errors, Σ, we set the degrees of freedom equal to $n + 2$, which is the minimum value that guarantees the existence of the prior mean, which we set as $E[\Sigma] = \Psi$, where Ψ is the diagonal.

The baseline prior on the model coefficients is a version of the so-called Minnesota prior (see Litterman, 1979). This prior is centered on the assumption that each variable follows an independent random walk process, possibly with drift, which is a parsimonious yet "reasonable approximation of the behavior of an economic variable."

The prior moments for the VAR coefficients are as follows:

$$E\left[(A)_{ij} \middle| \Sigma, \lambda, \Psi\right] = \begin{cases} 1 \text{ if } \mathrm{i = j} \text{ and } \mathrm{s = 1} \\ 0 \qquad \text{otherwise} \end{cases}$$

$$\operatorname{cov}\left((A_s)_{ij}, (A_r)_{hm} \middle| \Sigma, \lambda, \Psi\right) = \begin{cases} \lambda^2 \dfrac{1}{s^2} \dfrac{\Sigma_{ih}}{\psi_j} \text{ if } \mathrm{m = j} \text{ and } \mathrm{r = s} \\ 0 \qquad \text{otherwise} \end{cases}$$

Notice that the variance of this prior is lower for the coefficients associated with more distant lags and that coefficients associated with the same variable and lag in different equations are allowed to be correlated. Finally, the key hyperparameter is λ; it controls the scale of all the variances and covariances, and effectively determines the overall tightness of this prior. The term $\frac{\Sigma_{ih}}{\psi_j}$ accounts for the relative scale of the variables. The prior for the intercept, *c,* is non-informative (a very high prior variance).

We complement the prior with an additional prior to implement a so-called inexact differencing of the data. More precisely, the VAR equation is rewritten in an error correction form:

$$y_t = c + \left(A_1 + ... + A_p - I_n\right) y_{t-1} + B_1 \Delta y_{t-1} + ... + B_p \Delta y_{t-p} + \varepsilon_t$$

where $B_s = -A_{s+1} - .... - A_p$.

A VAR in first differences implies the restriction $\Pi = 0$. We follow Doan, Litterman, and Sims (1984) and set a prior centered at 1 for the sum of coefficients on own lags for each variable and at 0 for the sum of coefficients on other variables' lags. This prior also introduces correlation among the coefficients of all variables in each equation. The tightness of this additional prior is controlled by the

hyperparameter μ. As μ goes to infinity, the prior becomes diffuse while, as it goes to 0, we approach the case of exact differencing, which implies the presence of a unit root in each equation.

Summing up, the setting of these priors depends on the hyperparameters λ, μ, and Ψ, which reflect the informativeness of the prior distributions for the model coefficients. These parameters have been usually set on the basis of subjective considerations or rules of thumb. Instead, we closely follow the theoretically grounded approach proposed by Giannone, Lenza, and Primiceri (2012). This involves treating the hyperparameters as additional parameters, in the spirit of hierarchical modeling. As hyper-priors (i.e., prior distributions for the hyperparameters), we use proper but almost flat distributions. In this setup, the marginal likelihood evaluated at the posterior mode of the hyperparameters is close to its maximum.

In order to compute conditional forecasts in our relatively large VAR, we use the Kalman filter-based algorithm described in Banbura, Giannone, and Lenza (2014), which is, in turn, based on the simulation smoother developed in Carter and Kohn (1994).