The financial and macroeconomic effects of the OMT announcements

Carlo Altavilla
(Universitá Parthenope, Napoli and European Central Bank)

Domenico Giannone
(Université Libre de Bruxelles, ECARES and CEPR)

Michele Lenza
(European Central Bank and Université Libre de Bruxelles, ECARES)

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Abstract

This paper evaluates the effects of the announcements of the Eurosystem outright monetary transactions (OMT) carried out in the course of 2012. By using an event study analysis, we find that the OMT announcements decreased the Italian and Spanish two years government bond yields by about two percentage points. This assessment is robust to controlling for all other relevant macroeconomic and financial news released at the time of the announcements. Moreover, by employing a novel multi-country vector autoregressive (VAR) model, we find that the reduction in bond yields is associated to a significant increase in real activity, credit and prices in Italy and Spain in the three years following the announcement.

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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 the correct pass-through of the monetary policy stance to the economy.

In the first phase of the crisis, the non-standard measures were mostly intended to address impairments in the interbank markets, and thus avoiding a credit crunch stemming from liquidity and funding problems for banks. For example, the fixed rate full allotment liquidity policy, dissipating the fears ensuing from the drain in interbank liquidity, contributed to reduce the spreads of money market rates with the official policy rates. In general, the provision of unlimited liquidity to the banking sector, the lengthening of the maturity of refinancing operations, the widening of the list of eligible collateral in the refining operations have all contributed to restore a well-functioning interbank market.

However, with the financial fragmentation primarily stemming from the sovereign debt crisis emerged in 2010 and the resulting concerns of international investors about excessive national debt in several eurozone countries, the intervention has 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 a high cost of servicing their debt, arguably higher than it would be justified by looking at economic fundamentals (see Hoërdal and Tristani, 2013, for an empirical illustration of this point).

Among other forms of intervention (see, for example, Eser and Schwaab, 2012; Ghysels, Idier, Manganelli, and Vergote, 2012; Szczerbowicz, 2012, for a discussion and en evaluation of the effects of the Securities Market Program, SMP), in order to safeguard orderly monetary policy transmission and the singleness of monetary policy, the Governing Council of the ECB announced, in the period July to September 2012, the possibility to engage in outright monetary transactions (OMT) 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 8, 2012, during the press conference soon after the Governing Council meeting President Draghi announced that ”ECB may undertake outright open market operations”.

Finally, on September 6, 2012, the ECB's Governing Council announced a number of technical features regarding the OMT. More precisely, the ECB announced that no ex ante quantitative limits would be considered for the outright transactions in secondary sovereign bond markets. Purchases will concentrate on bonds with a remaining maturity of up to three years, and without seniority (pari passu) and that bond purchases will be conditional (i.e. the ECB will only buy the sovereign bonds of countries that have entered an agreement with the euro area rescue vehicles, i.e. the European Financial Stability Facility, EFSF, and the European Stability Mechanism, ESM).

After more than one year since its announcement, none of the euro area countries has activated the OMT. However, asset prices such as bond prices should, at least in part, incorporate the information publicly available to market participants. Indeed, casual observation suggests that the OMT announcements may have had an impact on the financial sector (see, for example, Draghi, 2013). In turn, changes in financial prices may alter the behavior of private agents, potentially affecting the rest of the economy. This paper aims to quantify the financial and macroeconomic impact of the OMT *announcements* on four euro area countries: France, Germany, 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 (2013)'s study of the effects of the Federal Reserve's Large Scale Asset Purchases (LSAPs). The main idea is to assess the effects of the policy announcements through the regression of sovereign bond yields on event dummies (taking value one in the date of the event, the OMT announcements, zero elsewhere) while, at the same time, controlling for all the other relevant "news" made publicly available in period under analysis. The "news" are captured by the surprise component of macroeconomic and other relevant releases, i.e. the difference between the data release and the expectation of market participants for that specific data release. In this paper, we evaluate the impact of the OMT announcements on a measure of the "target" bond yields - assumed to be here the 2-year government sovereign bond rates - and on 10-year government bond rates. The news are evaluated by looking at 151 category of releases for the whole euro area economy and also France, Germany, Italy and Spain. The source for market expectations and data releases is Bloomberg.

The main outcome of the event study is that the OMT announcements had significant impacts on the bond yields of Italy and Spain, in particular within the range of maturities indicated by the ECB as the target of the measures: Italian and Spanish two years bond yields have declined by about two percentage points. At the same time, yields at similar maturities for Germany and France are not significantly impacted.

In the second stage of our study, we employ a novel multi-country macroeconomic model in order to assess the impact of the change in bond yields due to the OMT announcements. For each of the four countries in our study, the model includes six variables (real GDP, consumer prices, M3, retail credit, government bond rates for the two and ten years maturity) and, in addition, also a measure of the ECB policy rate and expected euro area aggregate bond market volatility. We remain agnostic about the transmission mechanism of shocks and allow for country heterogeneity, cross-country spill-overs in the 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 estimation of the VAR, we address the high dimensional data problem (26 variables, five lags, quarterly sample starting in 1999Q1) and use bayesian shrinkage as suggested in De Mol, Giannone, and Reichlin (2008) and Banbura, Giannone, and Reichlin (2010). We also account for the uncertainty in the degree of shrinkage by means of the hierarchical procedure suggested in Giannone, Lenza, and Primiceri (2012).

As an illustration of the main features of our multi-country model, we study the transmission of "standard" monetary policy by looking at the effects of a common monetary policy shock, i.e. the effects of an exogenous increase in the ECB policy rate. The effects of such a monetary policy shock appear well in line with the usual narrative of the effects associated to a policy tightening (see Christiano, Eichenbaum, and Evans, 1999, for an extensive discussion). Our multi-country approach also allows us to study the degree of country heterogeneity in the responses. We find that an ECB monetary policy tightening leads to similar drops in GDP and increases in the bond yields in the four countries under analysis, while consumer prices and, even more, credit markets display a relevant extent of heterogeneity, with a stronger sensitivity to monetary policy in Spain. The finding that standard monetary policy has quite homogenous effects on the yield curve is relevant because it suggests that the ECB could not simply rely on "standard policy" tools in order to address the issue of heterogeneity in the yield curve dynamics arisen in the sovereign crisis. Our estimates also suggest that bond market volatility is not significantly affected by standard monetary policy.

The final part of our work focuses on the likely macroeconomic effects of the OMT announcements over an horizon of three years after the announcements. The assessment is conducted by comparing the dynamics of France, Germany, Italy and Spain in 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. The latter results help to design the yield curve paths in the two scenarios. In particular, in the OMT scenario, for the whole horizon of three years, we assume that the two years bond yields in Italy and Spain are about two percentage points lower than in the no-OMT scenario, while they are the same in France and Germany in the two scenarios. In order to isolate as much as possible the effects of non-standard policy, we also assume that standard monetary policy is the same in the two scenarios. Our evaluation suggests that the OMT announcements are likely to be associated, in the three years following the announcements, with relevant increases in the real economy, consumer prices and credit in Italy and Spain. France and Germany only show some very moderate spill-overs. Remarkably, differently from the outcome we found for the effects of standard monetary policy, 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 the non-standard measures implemented in different countries. For the US, using event-study methodology, Gagnon, Raskin, Remache, and Sack (2011) found that QE1 decreased the Bond rates by 91 bps. Krishnamurthy and Vissing-Jorgenses (2011), focus on both QE1 and QE2. They 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), instead, estimate the effects of Fed purchases of Treasury securities during QE1 ($300 billions) has produced a decrease in the 10-year Treasury yield of almost 50 basis points. Joyce, Lasaosa, Stevens, and Tong (2011) suggest that QE measures adopted in UK lowered long-term gilt yields by about 100 basis points and that most of the decline was generated by portfolio balance effects. Altavilla and Giannone (2013) find that the overall effect of the non-standard measures implemented in US, i.e. QE1, QE2, QE3 and Forward Guidance, have significantly decreased the long-term interest rate of about 200 bps. Finally, for the euro area, Eser and Schwaab (2012), Ghysels, Idier, Manganelli, and Vergote (2012) and Szczerbowicz (2012) show that the Securities Market Programmes (SMP) of the Eurosystem were successful at lowering yields relative to a situation of no intervention and at 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 elasticities of euro area unemployment and industrial production to changes in money market rates in a setup which bears some resemblance to the one in this paper. Compared to that paper, we also carry out a sophisticated event study to assess the financial effects of the ECB unconventional policy in order to define the policy and no-policy scenarios and we employ a novel multi-country model which allows also the study of country heterogeneity. The elasticities to changes in the 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, Cúrdia, and Ferrero (2012) provide the lower boundary while Chung, Laforte, Reifschneider, and Williams (2012) and Baumeister and Benati (2012) 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 level of GDP which ranges between 0.7 and 2.7%.

The structure of the paper is the following. 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 the OMT announcements

In order to assess the effects of the OMT announcements on the yield curve of France, Germany, Italy and Spain, we estimate for each country (in the sample from January 2007 to February 2013) the equation:

$$\Delta y_t = c + \alpha D_t + \beta News_t + \varepsilon_t \tag{1}$$

which relates the daily changes in the financial variables of interest Δy_t (the changes in the 2-year or 10-year bond rates) to the vector of event-dummies D_t (i.e. variables with value one in the "event days", zero elsewhere)[1] and to all other news stemming from economic releases, $News_t$, which could have influenced bond rates (see Altavilla and Giannone, 2013, for a more detailed explanation of this method). The event dummies reflect the three major events related to the announcement of the OMT and occurred between July and September 2012, described in the introduction. The estimation is carried out by means of standard regression techniques. For each country, we use 151 data releases which could have affected the bond rates, apart from the OMT announcements, in the period under consideration.[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 on the event-dummies is statistically different from zero. Results are reported table 1 for two different specifications of equation (1): in the "classical" specification, the alternative news are not included in the regression, while in the "controlled" specification they are included.

Table 1: The effects of OMT announcements on sovereign bond yields

Country	Variable	Classical	Controlled
IT	Bond 2-year	-1.99***	-1.75***
ES	Bond 2-year	-2.34***	-2.09***
DE	Bond 2-year	0.08	0.10
FR	Bond 2-year	-0.04	-0.01
IT	Bond 10-year	-0.82***	-0.63***
ES	Bond 10-year	-1.15***	-0.96***
DE	Bond 10-year	0.23*	0.29*
FR	Bond 10-year	-0.09	0.04

Note: The table reports the results of the event-study based on 2-day event window. The last column, reports the results of the "Controlled" event study where the daily changes in each selected asset prices are regressed on event dummies and 151 macroeconomic news. *, **, and *** denotes significance of the F-test for abnormal return at 10%, 5%, and 1%, respectively.

OMT announcements have been much more effective in reducing the government bond rates in Italy and Spain than in Germany and France, where bond markets have not significantly

[1]Precisely, the dummies take value one in the day of the announcement and the day after, i.e. we assume a two days event window. Such 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.

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

reacted to the policy events. For all countries, the estimated effect for the 2-years bond rates is larger than the one estimated for the 10-years bond. This is consistent with the target of the policy measure, which explicitly focuses on the yields of bonds with remaining maturity up to three years. The reduction in the 2-years bond yields in both Italy and Spain is about 200 bps. The effects on the 10-years bond rates in both countries is approximately 100 bps. Table 1 also reveals that, once the effects of all macroeconomic news are taken into account, the estimated effects of the OMT announcements do not significantly change. This reflects the fact that the announcements are indeed the most relevant news within the event window. Appendix A produces some intraday evidence corroborating this finding.[3]

3 The macroeconomic effects of the 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 the ECB accomodative monetary policy stance to transmit more evenly across euro area countries. In this section, we provide an assessment of the *economic* significance of these effects on the yield curve spreads, by turning to the evaluation of the likely macroeconomic effects of the OMT.

3.1 Data and empirical model

The analysis of the macroeconomic effects associated to the OMT announcements is based on a multi-country model of the macro-financial linkages in France, Germany, Italy and Spain. More in details, for each country, six variables are included (real GDP, HICP, M3, retail credit, government bond rates for the two and ten years maturity). 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] In order

[3]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, because of the focus on a narrow time window, possible lagged effects and reversals.

[4]Overall, the model includes 26 variables, available at the quarterly frequency in the sample 1999Q1 - 2012Q4. For more information on the data, see Appendix C at the end.

to allow for country heterogeneity, cross-country spillovers in the policy effects and rich dynamics among countries/variables, all possible interactions among variables/countries are left unrestricted by adopting a flexible vector autoregressive (VAR) specification in (log-)levels and with five lags. For the estimation of the VAR, we address the high dimensional data problem (26 variables, five 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 it 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 hyper-parameters controlling for the informativeness of the prior distributions are treated, as suggested in Giannone, Lenza, and Primiceri (2012), as random variables so that we also account for the uncertainty surrounding the prior setup in our evaluation. The technical details can be found in Giannone, Lenza, and Primiceri (2012) while appendix C at the end sketches the main features of our setup.

3.2 Illustrating the model: the monetary transmission mechanism

In order to document the ability of our approach to capture the salient dynamic interrelationships between our variables, we study the economic developments in the different countries triggered by a tightening of standard monetary policy. More specifically, we estimate the reaction of GDP, consumer prices, credit, M3, the yield curve and of euro area aggregate bond volatility to an exogenous monetary policy shock.

In order to identify the monetary policy shock, we resort to a recursive identification scheme (see Christiano, Eichenbaum, and Evans, 1999, for an extensive discussion and economic interpretation of this type of indentification schemes). The overnight money market policy rate (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. Credit, M3 and the yield curve in all countries and euro area bond market volatility, instead, 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.

INSERT FIGURE 1 HERE

On impact, the policy rate increases by about 16 basis points, it peaks two quarters after the shock and then it gradually decreases. Figure 2 reports the reaction of the long-term interest rates (panel *a* and *b*) and a 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.

INSERT FIGURE 2 HERE

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 for a one percentage point rise in the federal funds rate, respectively. Cochrane and Piazzesi (2002) found a larger reaction to federal funds target: a 1% unexpected target change affects 10-year Treasury yields of 52 bp.

Remarkably, the response of the yield curve to a tightening in the stance of 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 arisen in the euro area sovereign crisis. Standard monetary policy also does not seem to be able to significantly affect euro area bond market volatility.

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

INSERT FIGURE 3 HERE

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 similar path and size of the 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 dramatic 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 it is explained by the fact that M3 dynamics are dominated by those of short-term monetary assets (time deposits, marketable instruments) whose return is 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 of this fact).

3.3 The macroeconomic effects of the OMT announcements

The evaluation of OMT effects is made by comparing two scenarios, defined as the no-OMT and the OMT scenarios (Lenza, Pill, and Reichlin, 2010; Giannone, Lenza, Pill, and Reichlin, 2012; Kapetanios, Mumtaz, Stevens, and Theodoridis, 2012, apply a similar methodology for the study of the effects of the ECB liquidity policy and the UK QE policies). The no-OMT scenario is simply given by the unconditional forecast of the VAR model. The OMT scenario, instead, has the features summarized in table 2. In particular, *relative to the no-OMT scenario paths*, the OMT announcements are assumed to permanently decrease the two years bond rates in Italy and Spain (by 1.75 and 2.09 percent in Italy and Spain, respectively, as estimated in the "controlled" event study). The 2 years bond rates in France and Germany are unaffected (i.e. equal to no-OMT values) over the whole horizon under analysis (three years). In order to further isolate the change in bond rates as mostly related to the OMT announcements, two further assumptions are also made; first, macroeconomic variables in all countries (real activity and prices) are not allowed to change at the time of the "OMT shock" compared to the no-OMT scenario (though, they are allowed to change subsequently). Second, in order to make sure that differences between the OMT and no-OMT scenario are not due to different paths of 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 2: Differences between the OMT and the no-OMT scenarios

Impact	GDP in IT,ES,DE,FR		Price in IT,ES,DE,FR	
	0		0	
Full path	2y bond rates IT	2y bond rates ES	2y bond rates DE, FR	EONIA
	-1.75	-2.09	0	0

Our measure of the effects associated to the OMT announcements is given by the difference of the path for the variables in the OMT and the no-OMT scenarios. Notice that, given that results are computed in terms of deviations in the OMT from the no-OMT scenarios in our linear VAR model, this assessment is independent of the path assumed for the no-OMT scenario.[5] Table 3 reports, for the country/variables pairs (column one/ two) both (i) the median results (column three) and (ii) the probability (column four) that the effects are positive, both evaluated three years after the announcement.

Table 3: The macroeconomic effects associated to the OMT announcements

[5] In order to assess the reaction of the variables in the scenarios, the Kalman Filter based algorithm described in Banbura, Giannone, and Lenza (2012) is adopted. 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 the relative importance of different shocks (reflected in the estimated covariance matrix of the shocks) remain the same as in the estimation sample.

Country	Variables	Effect	Probability of positive effect
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	0.60
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

Note: The table reports the effects associated to the OMT announcements in terms of percentage deviations in the OMT scenario relative to the no-OMT scenario. The last column reports the probability that the effects is positive.

The general outcome of the analysis is that the OMT announcements are very likely to be associated to positive and quite sizeable effects on real activity, loans and consumer prices in Italy and Spain. The size of the effects of GDP and prices is broadly in line with those estimated for the quantitative easing policies in the US and UK.[6] The evidence points to very moderate positive spill-overs on real activity in France and even smaller in Germany.[7] Figure 4 provides some complementary evidence on the effects of the OMT announcements on bond market volatility.

INSERT FIGURE 4 HERE

[6]The elasticity implied in the estimates of the 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, Cúrdia, and Ferrero (2012) provide the lower boundary while Chung, Laforte, Reifschneider, and Williams (2012) and Baumeister and Benati (2012) 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 level of GDP which ranges between 0.7 and 2.7%.

[7]Simulations similar to those carried out here have been also conducted in the context of the New Multi-Country (NMCM) models currently used in the (B)MPE. Results of comparable scenarios conducted by means of the NMCM are lower than the outcomes in this note. Notably, were the long-term bond rates to decrease on an horizon of three years by comparable amounts, the NMCM would suggest that Italian GDP would increase by 0.6 p.p. and the Spanish GDP by 0.9 p.p. However, one should consider that, contrary to the NMCM simulations, the simulations carried out in this note have two main differences: cross-country spill-overs are allowed and, in order to identify the OMT announcement effect, the assumptions highlighted in table 2 are imposed. Hence, the two sets of simulations cannot be considered as fully comparable. For a description of the properties of the NMCM model, see Dieppe, González Pandiella, Hall, and Willman (2011)

The OMT announcements are shown to reduce expected bond market volatility, a measure of uncertainty in the euro area bond market, by 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 following month expected euro area bond rates. This result is in contrast with the insignificant response of bond market volatility found for standard monetary policy.

4 Conclusions

The announcements that the Eurosystem might engage (under specific conditions) in outright monetary transactions had already a sizable impact on financial markets. Indeed, such announcements have led to the decrease by about 200 basis points in the two years government bond rates in Italy and Spain, while leaving German and French yields of bonds of comparable maturities largely unaffected. Such financial market effects will likely boost credit and, in general, economic growth in Italy and Spain with some relatively limited spill-overs in France and Germany.

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A Daily and Intra-daily effects of the announcements

Figure 5 reports the interest rates on the 2-year government Bond in Germany (DE), France (FR), Italy (IT), and Spain (ES) during the sample period of the event-study analysis, i.e. from January 2007 to February 2013. Vertical gridlines indicate the announcement days.

INSERT FIGURE 5 here

Figure 6 reports the time pattern 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 that the announcement was the dominant event during that day.

INSERT FIGURE 6 here

B Event study analysis, list of macroeconomic releases

The "controlled" event-study analysis aims at taking into account all macroeconomic news that materialised within each event window and that could have, possibly, influenced the two and ten year government bond rates beyond the exclusive effect of the OMT announcements in that particular time window. For this purpose, the analysis uses a real-time data flow dataset that captures the information available at each point in time to market participants. In order 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 on the same variable. 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, a time series of (standardised) daily news can be computed as the difference between the first-released (real-time) data and its expected value. This time-series represent a measure of the news content of all the most relevant releases on economic data happened 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. It would hardly affect asset prices. On the contrary, if a certain release is imperfectly forecasted, it contains some "news" information for market participants and, hence, it is likely to affect asset prices.

Table A.1: Macroeconomic releases included in the "controlled" event-study 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 - EU Harmonised (MoM)	Exports SA (MoM)	Hourly Wages (YoY)	GDP (Constant SA) (YoY)
GDP s.a. (YoY)	CPI - EU Harmonised (YoY)	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)		

C The multi-country VAR model

Let y_t be a n-dimensional vector of variables, the general equation of a VAR is:

$$y_t = c + A_1 y_{t-1} + ... + A_p y_{t-p} + \varepsilon_t, \quad \varepsilon_t \sim N(0, \Sigma),$$

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

Table $A.2$ reports the definition and data transformations of the $n(= 26)$ variables we include in the VAR model. We estimate our model in (log-)levels. The data are quarterly and are available in the sample 1999Q1-2012Q4.

Table A.2: VAR variables definition

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

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.

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 it 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 paper, 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 $\mathrm{E}[\Sigma] = \Psi$, where Ψ is 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:

$$
\begin{aligned}
E\left[(A_s)_{ij}\,|\Sigma,\lambda,\Psi\right] &= \begin{cases} 1 & \text{if } i=j \text{ and } s=1 \\ 0 & \text{otherwise} \end{cases} \\
cov\left((A_s)_{ij}\,,(A_r)_{hm}\,|\Sigma,\lambda,\Psi\right) &= \begin{cases} \lambda^2 \frac{1}{s^2}\frac{\Sigma_{ih}}{\psi_j} & \text{if } m=j \text{ and } r=s \\ 0 & \text{otherwise} \end{cases} .
\end{aligned}
$$

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 terms Σ_{ij}/ψ_j account 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, rewrite the VAR equation in an error correction form:

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

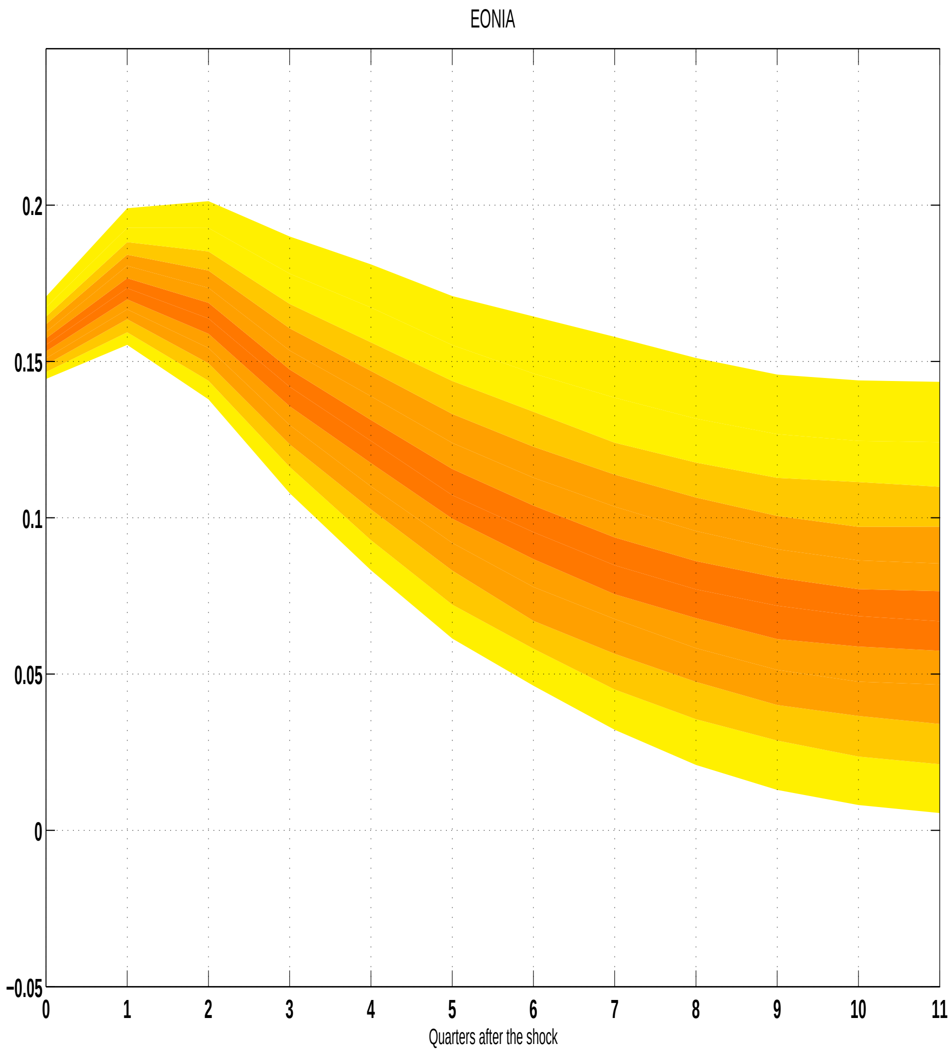
where $B_s = -A_{s+1} - \ldots - A_p$.

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 on each variable 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. We instead closely follow the theoretically grounded approach proposed by Giannone, Lenza, and Primiceri (2012). This involves treating the hyper-parameters as additional parameters, in the spirit of hierarchical modelling. As hyper-priors (i.e. prior distributions for the hyperparameters), we use proper but almost flat distributions. In this set up, the marginal likelihood evaluated at the posterior mode of the hyperparameters is close to its maximum.

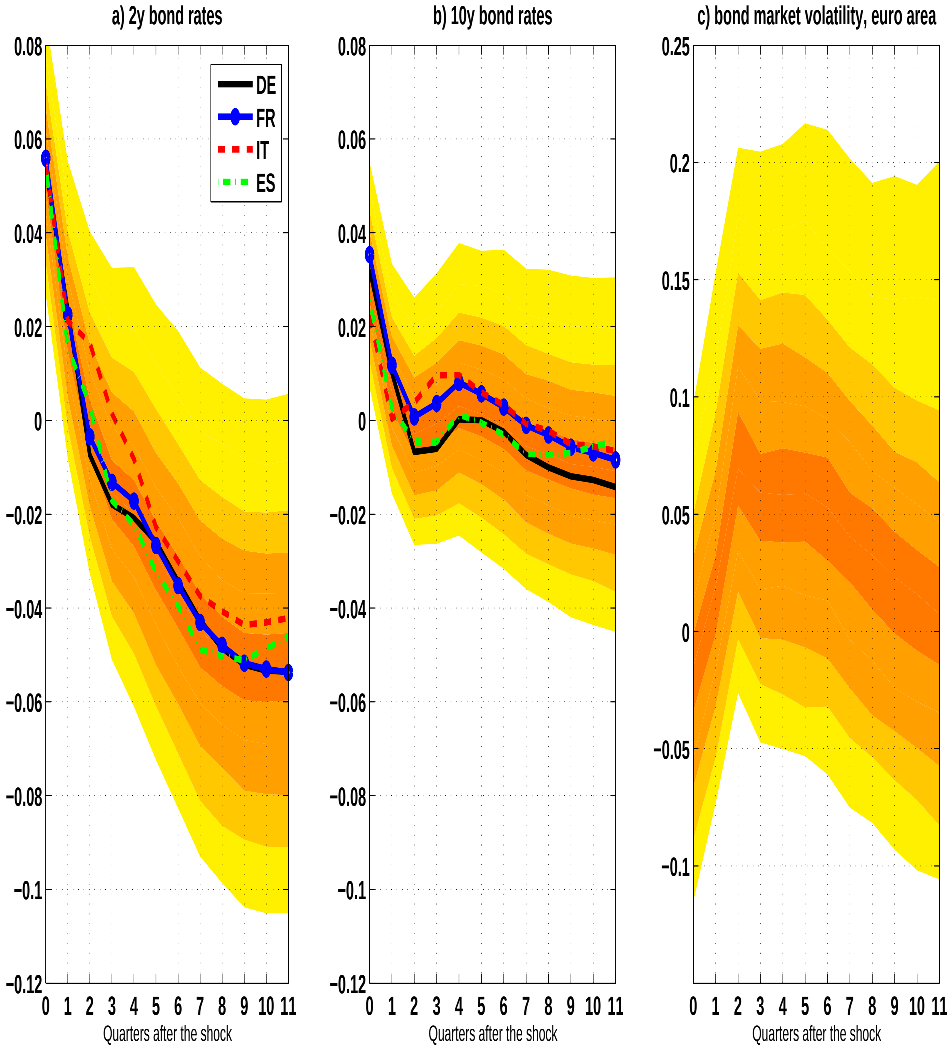
In order to compute conditional forecasts in our relatively large VAR, we use the Kalman filter based algorithm described in Banbura, Giannone, and Lenza (2012), which, in turn, is based on the simulation smoother developed in Carter and Kohn (1994).

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



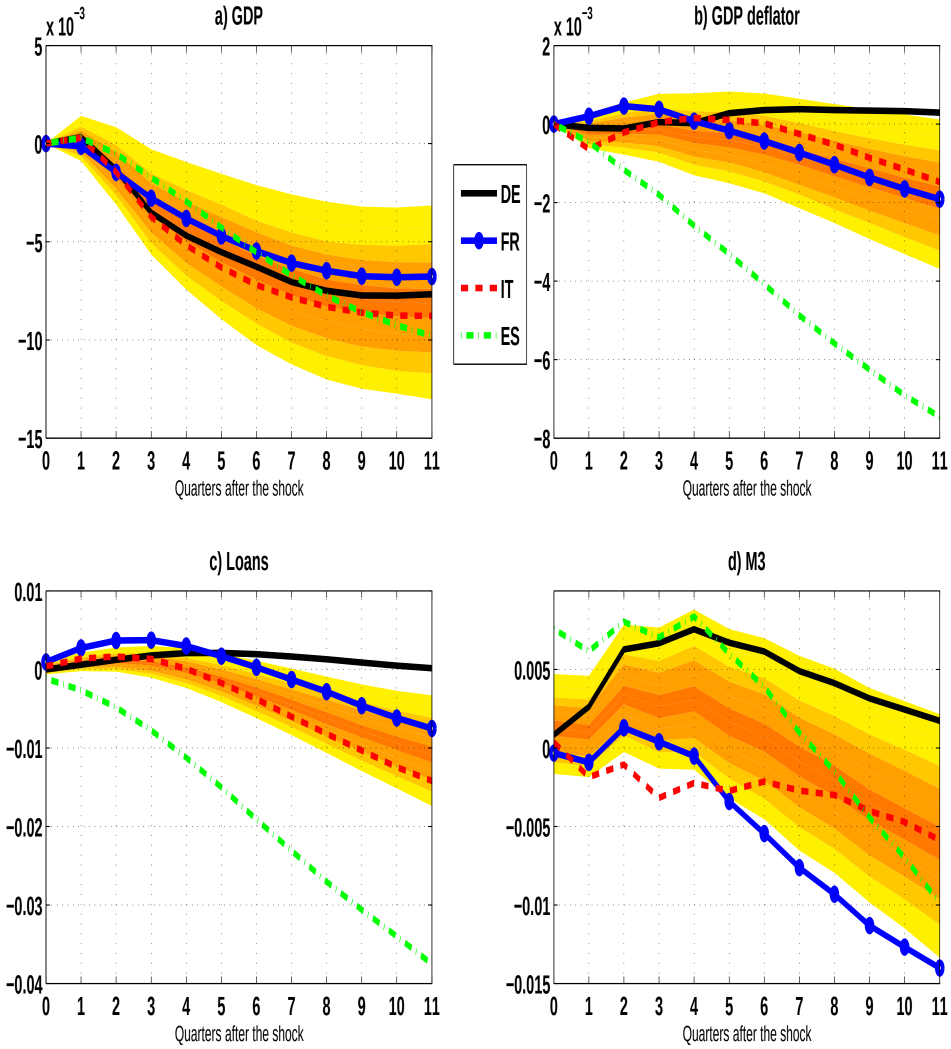
Note: The chart reports the distribution of impulse responses of the EONIA levels, trimming the quantiles below the 16th and above the 84th. Vertical axis: percentage points. Horizontal axis: quarters after the shock.

Figure 2: Response of the yield curve and bond market volatility



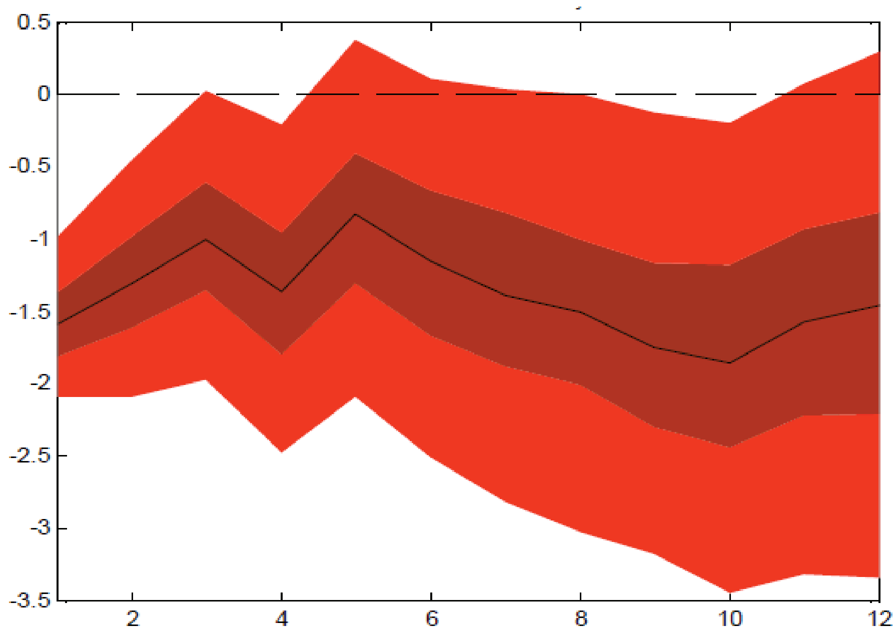
Note: The charts report the distribution of impulse responses of the levels of the variables in the euro area (GDP weighted average of the four countries in panel *a* and *b*), trimming the quantiles below the 16th and above the 84th. The four lines in panel *a* and *b* refer, instead, to the median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

Figure 3: Response of real GDP, consumer prices, credit and M3



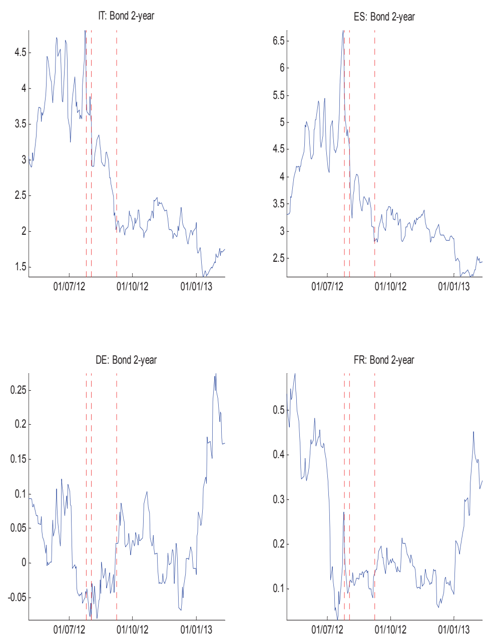
Note: The charts report the distribution of impulse responses of the log-levels of the variables in the euro area (GDP weighted average of the four countries, in all panels), trimming the quantiles below the 16th and above the 84th. The four lines in all panels refer, instead, to the median responses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

Figure 4: The effects on bond market volatility associated to the OMT announcements



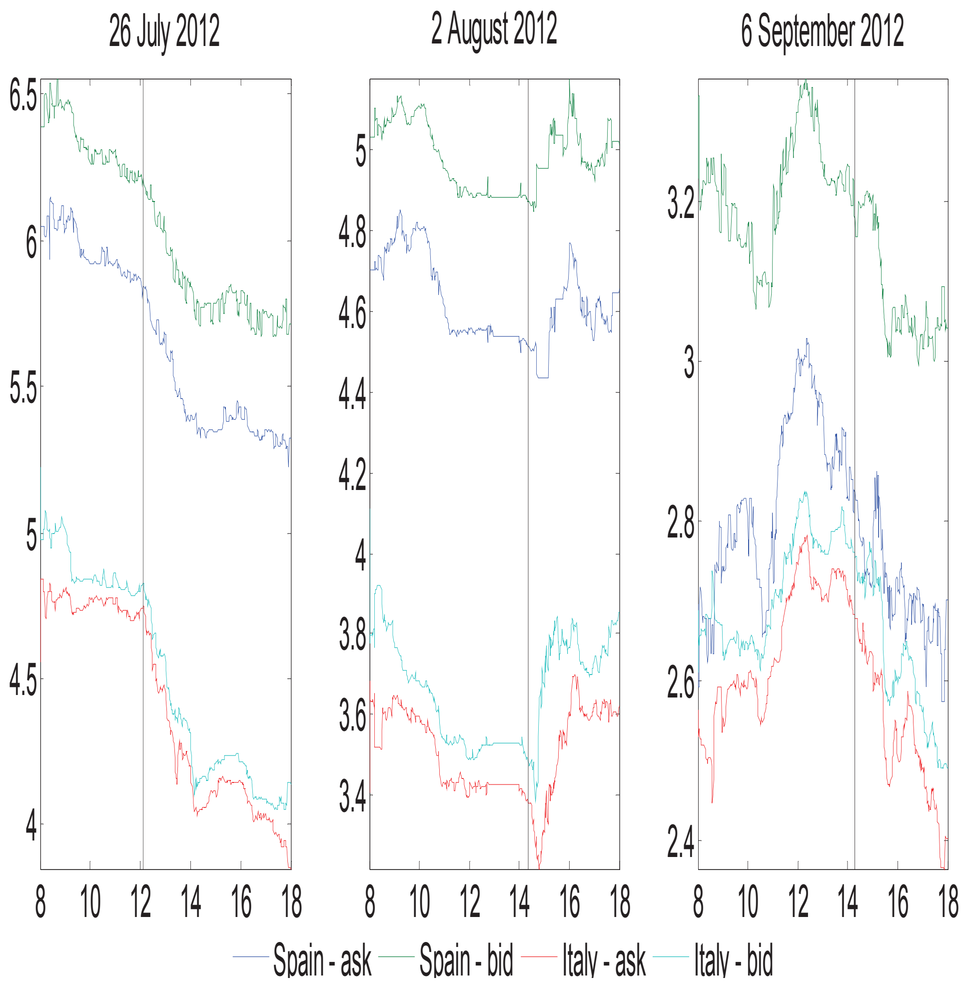
Note: The chart reports the distribution of the responses of bond market volatility (trimming the quantiles lower than the 16th and higher than the 84th). Vertical axis: percentage points. Horizontal axis: quarters after the shock.

Figure 5: 2-year bond rate - daily frequency



Note: the figure reports the interest rates on the 2-year government Bond in Germany (DE), France (FR), Italy (IT), and Spain (ES) during the sample period of the event-study analysis, i.e. from January 2007 to February 2013. Vertical gridlines indicate the announcement days.

Figure 6: 2-year Bond - Intraday Bid and ask in 26-July-2012



Note: The figures reports the value of the bid and ask 2-year Bond rates in Italy and Spain during the day of the three OMT-related announcements. Horizontal axis: trading hours. The vertical lines indicates the time when Mr. Draghi started to talk in London 26 July (12:09) and on 2 August and 6 September (14:30).