

# ECB Unconventional Monetary Policy and the Italian Economy during the Sovereign Debt Crisis\*

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We assess the impact of the main unconventional monetary measures adopted by the European Central Bank in 2011–12 (the Securities Markets Programme, the three-year longer-term refinancing operations, and the Outright Monetary Transactions) on the Italian economy. We first estimate the indirect effects on financial and credit markets and then we map them onto their macroeconomic implications. The results suggest that all operations have, to varying degrees, contributed to counteract the increase in government bond yields and to improve credit supply and money-market conditions. From a macroeconomic perspective, the measures have had a large positive effect, mainly through the credit channel, with a cumulative impact on GDP growth of 2.7 percentage points over the period 2012–13.

JEL Codes: E52, E58, E44.

## 1. Introduction

Since 2007, most central banks in advanced countries have implemented unconventional monetary measures to counteract the economic effects of the Global Financial Crisis. However, the definition of unconventional measures is far from being narrow, because the instruments used and the problems that they were intended to address have differed significantly across economies. Not

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surprisingly, the debate on the effectiveness of such measures is still open.

Most of the empirical literature on unconventional measures focuses on the United States and the United Kingdom and aims at estimating the impact of asset purchase programs designed to provide stimulus when short-term rates are close to zero. The general finding is that such interventions were effective in sustaining the economy. The evidence is, however, still scant on whether unconventional monetary policy also has an impact when it aims at addressing market disruptions, which could arise because of a crisis of confidence or the coordination of expectations on a worst-case scenario in a situation of multiple equilibria (Meier 2009; Stone, Fujita, and Ishi 2011).

From a theoretical perspective, Cúrdia and Woodford (2011) argue that targeted asset purchases by the central bank can be effective if the financial markets are sufficiently disrupted and are likely to be ineffective otherwise (see also Gertler and Karadi 2011). Similarly, the consensus among European monetary policymakers is that monetary policy is a powerful tool to address the sovereign crisis, although it cannot overcome it by itself (Visco 2013).

According to an opposite view, however, monetary interventions are less effective in the presence of extremely tight credit (Kozicki, Santor, and Suchanek 2011), and increasing the liquidity supply may not produce more lending when banks are under stress or the value of collateral is too low (Stiglitz 2012). Weidmann (2012) argues that both liquidity provision and outright monetary operations may be ineffective in the euro area because they fail to get at the causes of the crisis of confidence, namely the need for structural adjustments in banking and in public finances.

In this paper we address a specific case: the impact on the Italian economy of the main non-standard measures adopted by the European Central Bank (ECB) during the most acute phase of the sovereign debt crisis.

Italy offers an interesting viewpoint. While the focus on a single country clearly allows us to obtain only a partial assessment of the effectiveness of the measures implemented by the ECB, which were directed at the entire euro area, the analysis of an economy that was at the core of the sovereign debt crisis offers important insights. Our results may provide a new perspective into the effectiveness

of non-standard policies aimed at offsetting the impact on the real economy of financial market disruptions.

During the summer of 2011, sovereign debt market tensions extended to two large euro-area countries, Italy and Spain. The strains were widespread in the area, but they affected Italy directly and were rapidly transmitted to the banking sector and other segments of the domestic financial market. Corporate bond yields and money-market spreads soared, interbank loans dried up, and stock indexes plummeted. The effects were amplified both by the abrupt interruption of cross-border capital flows in the euro area and by the sudden funding freeze faced by banks on international markets. The adverse impact on the cost and availability of credit to the private sector led to a sizable drop in aggregate demand.<sup>1</sup> In the summer of 2012, fears of a possible breakup of the euro area aggravated financial tensions and further increased the cross-country disparities in monetary conditions.

In response, the ECB took several measures designed to support dysfunctional market segments, foster bank liquidity, avert a credit crunch, and dispel the fears of a euro-area breakup. It extended the Securities Markets Programme (SMP) to Italian and Spanish government bonds in August 2011; it granted three-year loans to banks (three-year longer-term refinancing operations, LTROs) in December 2011 and in February 2012; and it announced the Outright Monetary Transactions (OMTs) in September 2012. The main features of these measures are reported in table 1.

The SMP was set up in May 2010 and enhanced in August 2011, when purchases were reactivated and extended to Italian and Spanish government securities. Over the life of the program, interventions in the Italian sovereign bond market amounted to around €100 billion. In December 2011 the ECB announced two LTROs with an extended maturity of three years, tendered at a fixed rate with full allotment; at the same time, collateral eligibility criteria were substantially broadened to ensure that banks had enough borrowing

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<sup>1</sup>According to estimates by Albertazzi et al. (2012), in Italy the cost of lending increased by 2 percentage points in 2011 due to the movements in sovereign spreads. Aggregate and cross-country evidence of the effects of the sovereign debt crisis on euro-area economies is provided by Neri and Ropele (2013).

Table 1. The ECB's Three Main Unconventional Operations in 2011–12

	Description of the Measure	Date of Announcement	Date of Implementation	Objective	Details	Amounts: Euro Area and Italy
Securities Markets Programme	Outright transactions in the secondary euro-area public and private debt securities markets.	On May 10, 2010, the central banks of the Eurosystem started purchasing securities. On August 8, 2011, the program was enhanced, announcing that “the ECB will actively implement its Securities Markets Programme.”	Active from May 2010 (on Italian securities, from August 8, 2011) to February 2012. Formally terminated in September 2012.	To ensure depth and liquidity in those market segments that were dysfunctional, to restore an appropriate monetary policy transmission mechanism and effective conduct of monetary policy.	The impact of interventions is sterilized so as to ensure that the monetary policy stance is not affected.	Holdings of euro-area securities on December 2012 (nominal amount): €218 bn; holdings of Italian securities on December 2012 (nominal amount): €102.8 bn.

*(continued)*

Table 1. (Continued)

	<b>Description of the Measure</b>	<b>Date of Announcement</b>	<b>Date of Implementation</b>	<b>Objective</b>	<b>Details</b>	<b>Amounts: Euro Area and Italy</b>
Three-Year Longer-Term Refinancing Operations	Two longer-term refinancing operations with maturity of thirty-six months.	December 8, 2011	First auction: December 21, 2011, settlement December 22. Second auction: February 29, 2012, settlement March 1.	To avert a credit crunch, addressing the risk of a funding and liquidity crisis for the banking system.	Collateral eligibility was broadened. The operations were conducted as fixed-rate tender procedures with full allotment. The rate in these operations is fixed at the average rate of the main refinancing operations over the life of the respective operation. Banks are endowed with the option of early-repay three-year LTROs after one year.	Total gross borrowing by euro-area banks €1020 bn; total gross borrowing by Bank of Italy's counterparts: €255 bn.

*(continued)*

Table 1. (Continued)

Outright Monetary Transactions	Description of the Measure	Date of Announcement	Date of Implementation	Objective	Details	Amounts: Euro Area and Italy
	Outright transactions in secondary sovereign bond markets	First announced by Draghi's speech, July 26, 2012; guidelines announced on August 2, 2012; details announced on September 6, 2012.	Program is active but has not yet been used.	To serve as a backstop to contrast "tail risks" on the sovereign debt market due to fears of a euro-area breakup and a return to national currencies ("redenomination risk").	No ex ante quantitative limits. Implementation of OMT is conditional on member state being under an EFSF/ESM program. Interventions focused on sovereign bonds with a maturity of between one and three years. ECB accepts the same treatment (pari passu) as other creditors. Full sterilization of liquidity created is planned.	N/A

Sources: ECB and Bank of Italy.

capacity to satisfy their current and future liquidity needs.<sup>2</sup> Italian banks borrowed a total of close to €250 billion. Finally, in a speech given at the end of July 2012, ECB President Draghi announced that the ECB would “do whatever it takes” to preserve the euro. In the next two months, the ECB announced the guidelines and the operational details of the OMTs, i.e., secondary market purchases of government bonds with a maturity between one and three years, with no *ex ante* volume limit.<sup>3</sup> To date, the OMTs have not been activated for any country.

We assess the impact of these monetary policy actions on the Italian economy using a two-step approach. First, we estimate their direct effects on financial and credit markets using a specific econometric methodology for each measure so as to address the issue of heterogeneity among the policy instruments adopted. In detail, we use an event-study methodology to estimate the impact of the three-year LTROs on money-market interest rates and that of the OMTs on government bond yields, and we run several types of regressions to assess the effect of the SMP on government bond yields and of the three-year LTROs on credit availability. In the second step, we map the estimated effects on money-market interest rates, bond yields, and credit availability onto their macroeconomic implications using the Bank of Italy’s quarterly model of the Italian economy (BIQM). This model provides sound estimates of the impact of the unconventional measures on the main Italian macroeconomic variables; it also allows us to identify the transmission channels for each measure and isolate the specific contribution of changes in interest rates and in credit availability.

Our results suggest that the SMP, the three-year LTROs, and the OMTs have been effective in offsetting undue increases in government bond yields and easing money-market tensions, with a positive and significant impact on credit supply. Transmitted mainly through the credit channel, the policy measures induced a cumulative output

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<sup>2</sup>The availability of collateral was significantly reduced in some banking systems by increased borrowing, the fall in collateral asset prices, and more frequent margin calls.

<sup>3</sup>OMTs would be considered by the ECB if deemed necessary from a monetary policy perspective and may be carried out only for the securities of countries that request a financial assistance program and that comply with its conditions. The liquidity created with the OMT would be sterilized.

growth response equal to 2.7 percentage points in 2012–13. In considering these findings, however, one should bear in mind that a full counterfactual scenario is beyond the scope of this paper. The ECB's unconventional policies may have avoided a generalized collapse of financial and credit markets, which cannot be studied using the standard econometric tools insofar as the effects would have been very large and highly non-linear. Even though it cannot be ruled out, the possibility that financial tensions would have eased without the ECB intervention seems remote.

The paper contributes to the literature in a number of ways. First, we study the most acute phase of the sovereign debt crisis, which has not yet been covered by research on the macroeconomic effects of the ECB's unconventional measures. Second, empirical results for the so-called peripheral countries are almost non-existent, as to date the literature has focused on the euro area as a whole. Yet it is precisely those countries that have been affected most severely by the market disruptions, and they accordingly constitute the most suitable gauge for assessing the effectiveness of the measures. Third, our estimation strategy overcomes one crucial weakness of the existing literature on the impact of non-standard policy measures (mainly based on VAR models), namely the use of very rough proxies for ECB interventions (e.g., the change in the size of the Eurosystem balance sheet), which fail to capture the peculiarities of the different instruments (in contrast, existing studies of the local effects of specific measures stop short of evaluating the macroeconomic impact). On the contrary, our two-step approach combines appropriate estimation methodologies to evaluate the specific effects of each measure on financial markets and credit availability with a consistent mapping of these effects to their macroeconomic consequences, through the BIQM. Finally, the flexibility of the BIQM allows us to take fully into account the impact of the sovereign debt crisis on the monetary transmission mechanism. In particular, we take into consideration that the financial tensions impaired the standard transmission channels and activated new ones that do not normally play a significant role.

The remainder of this paper is organized as follows. Section 2 reviews the evidence on the effects of the measures adopted by the ECB during the financial and the sovereign debt crisis. Section 3 describes the main channels of monetary transmission included in

the structure of the BIQM and discusses how they have been affected by the sovereign debt crisis and by the ECB's measures adopted in 2011–12. Section 4 presents the estimates of the effects of the SMP, the two three-year LTROs, and the OMTs on market yields and on credit supply in Italy based on regression analyses and on high-frequency event studies. In section 5 we assess the overall effects of the measures on the main Italian macroeconomic variables using the BIQM and, in particular, by simulating the response of the economy to a set of shocks on interest rates and credit availability of the same magnitude as those estimated in section 4. Section 6 concludes.

## 2. Existing Evidence on the Effectiveness of the ECB's Unconventional Policy Measures

A large part of the empirical literature on the effectiveness of unconventional monetary policy seeks to gauge the impact of large-scale asset purchases in the United States and the United Kingdom designed to provide additional monetary stimulus when short-term rates are at the zero lower bound. The general finding is that the purchases did affect market yields and sustain the economy, but there is still considerable uncertainty about the effective magnitude of their contribution.<sup>4</sup>

The evidence on the macroeconomic effects of the non-standard measures adopted by the ECB during the most acute phase of the sovereign crisis (i.e., after 2011) is still scanty. Most of the existing papers focus on ECB interventions in the previous period, i.e., between the Lehman Brothers bankruptcy and the summer of 2011,

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<sup>4</sup>A survey of the impact of large-scale asset purchases on yields in the United States and in the United Kingdom is provided by Williams (2014). Surveys of the evidence on the macroeconomic impact of these measures are provided by Cecioni, Ferrero, and Secchi (2011), Gagnon and Hinterschweiger (2013), International Monetary Fund (2013), and Santor and Suchanek (2013). Chung et al. (2012) use stochastic simulations of the Federal Reserve's macroeconomic model (FRB/US) and find that QE1 and QE2 increased GDP by around 3 percentage points. Chen, Cúrdia, and Ferrero (2011) use a DSGE model and find a smaller effect of QE2 on U.S. GDP (0.3 percentage point). For the United Kingdom, Kapetanios et al. (2012) find a peak effect on GDP of around 1.5 percentage points.

therefore not bearing on the effectiveness of any of the unconventional measures we study.<sup>5</sup>

They mostly rely on VAR models augmented with very general proxies of the recourse to non-standard policy. Lenza, Pill, and Reichlin (2010) measure the impact of the liquidity-enhancing instruments adopted by the ECB after the collapse of Lehman Brothers with the reduction of the spread between unsecured and secured money-market rates and, relying on VAR-based forecasts, conclude that without the ECB intervention industrial output growth and inflation would have been 3 and 0.5 percentage points lower. Giannone et al. (2011) interpret their finding of no prediction error in an out-of-sample simulation of euro-area monetary and credit variables over 2008–10 as evidence of the success of the unconventional measures in offsetting the global shocks. Peersman (2011) estimates unconventional policy shocks based on changes in the size and composition of the Eurosystem balance sheet and finds that over 1999–2009 the effects on output and inflation are similar to those of conventional monetary policy shocks. Gambacorta, Hofmann, and Peersman (2012) use a similar approach in a panel VAR for eight advanced economies over the period from January 2008 to June 2011 and obtain similar results. Giannone et al. (2012) construct a gauge of the policy shock looking at the evolution of commercial banks' balance sheets and conclude that unconventional monetary policy increased industrial production by 2 percent two years after the Lehman Brothers collapse. Ciccarelli, Maddaloni, and Peydró (2013) suggest that the ECB unconventional measures partly mitigated the disruption of the credit channel in the distressed countries.

As for the sovereign debt crisis, there is an increasing amount of evidence on the “local” impact of the SMP asset purchases, i.e., on the sovereign yield on the specific market segment they were addressing, while there is very little evidence so far on the effect on the economy. De Pooter, Martin, and Pruitt (2013) use an asset pricing model to determine the liquidity premium implicit in sovereign bond prices and regress this premium on weekly SMP purchases;

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<sup>5</sup>Eser et al. (2012) provide a detailed description of the non-standard measures implemented by the ECB since 2009. Evidence on the financial market effects of the measures adopted by the ECB before 2011 is in Cecioni, Ferrero, and Secchi (2011) and in ECB (2011).

they find that each percentage point of outstanding bonds purchased lowered liquidity premia by around 20 basis points on impact. Eser and Schwaab (2013) find that on average €1 billion of purchases under the SMP lowered five-year Italian government bond yields by 1–2 basis points both on impact and in the long run. Ghysels et al. (2014), regressing yield changes on SMP interventions at high frequencies (fifteen minutes), find that a €100 million intervention has an immediate impact on bond yields of between 0.1 and 25 basis points, depending on the size of the market.

The overall impact of the SMP, the three-year LTROs, and the OMTs on the interbank market is studied by Dubecq et al. (2013), who use a quadratic term structure model of the EURIBOR-OIS spreads and conclude that the SMP had no effect on interbank premia, the announcement of three-year LTROs reduced liquidity premia by around 50 basis points, and the OMTs helped ease liquidity risk.

Darracq-Paries and De Santis (2013) are among the few papers that provide some evidence on the macroeconomic impact of the two three-year LTROs. They define the policy shock as the innovation in credit conditions as measured in the euro-area Bank Lending Surveys and, based on a panel VAR for eight euro-area countries, conclude that the LTROs lifted the prospects for real GDP, with a peak effect between 0.7 and 1.0 percentage points by mid-2013.

To the best of our knowledge, there is no comprehensive country-level evidence on the macroeconomic effects of the whole range of unconventional measures adopted by the ECB during the most acute phase of the sovereign debt crisis.

### **3. The Sovereign Crisis, the ECB Measures, and the Channels of Transmission in the Bank of Italy's Quarterly Model**

In order to estimate the macroeconomic impact of the ECB unconventional measures, we use the Bank of Italy quarterly model of the Italian economy.<sup>6</sup>

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<sup>6</sup>The BIQM is used to provide short- and medium-term projections for policy evaluation exercises, for counterfactual analyses, and for the coordination

The BIQM includes several channels that allow greater detail in taking into account how the ECB unconventional measures affected the Italian economy, as well as the way in which the sovereign debt crisis impaired the monetary transmission mechanism.

In the monetary transmission mechanism as captured in the BIQM, changes in the key ECB rates are transmitted to the term structure of interest rates. The BIQM measures this effect through variations in the one-year Treasury-bill rate (BOTs) and the long-term yield on Treasury bonds (BTPs), which proxy for short-term and long-term rates. Changes in the term structure affect bank lending rates, which directly influence investment in construction, through different mortgage rates, and inventories accumulation. Bank lending rates and long-term interest rates jointly affect the cost of capital, which has an impact on business investment; real long-term rates also affect households' intertemporal consumption decisions.<sup>7</sup>

The sovereign debt crisis altered the monetary transmission mechanism, interfering with the standard channels and activating new ones. There were three main effects. First, the usual relationship between the ECB-driven short-term interest rates and long-term rates broke down: an unprecedented increase of the spread between the yield on ten-year BTPs and the corresponding risk-free rate started in summer 2011 (see figure 1), reflecting both an increased sensitivity to domestic fundamentals (a "wake-up call" form of contagion: Giordano, Pericoli, and Tommasino 2013) and the upsurge in the perceived risk of a euro-area breakup (Di Cesare et al. 2012).

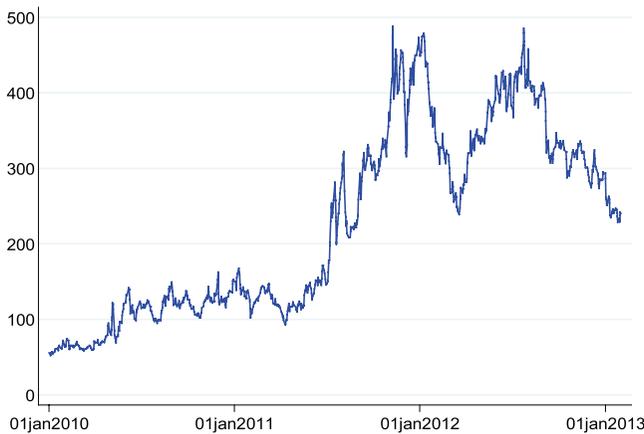
Second, the surge in credit and liquidity risk, which was associated with growing segmentation of interbank markets across national lines, resulted in an unprecedented rise in risk premia on money-market interest rates. Italian banks had to pay a large premium on their secured as well as their unsecured borrowing (see figure 2, top panels and bottom left panel). The increase in secured money-market

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of economic analysis within DG Economics, Statistics and Research at Banca d'Italia. Like most traditional macroeconomic models, it is Keynesian in the short run and akin to the Solow model of exogenous growth in the long run. It contains some 800 equations, nearly 100 of which are stochastic. See Busetti, Locarno, and Monteforte (2005).

<sup>7</sup>In the model, a decrease of 50 basis points of both the short- and long-term rates increases the GDP level by around 0.35 percent after two years.

**Figure 1. Evolution of Risk Premia on Italian Ten-Year Sovereign Bonds (daily data, basis points)**



**Source:** Bloomberg.

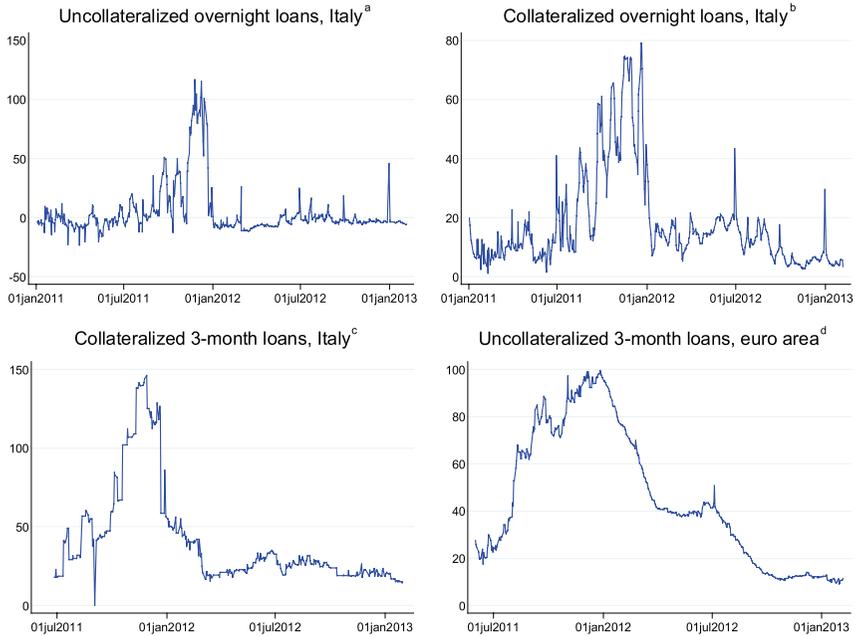
**Notes:** Spread between the yield on ten-year BTPs and the corresponding interest rate swap (IRS).

rates also reflected the lower collateral value of Italian sovereigns. On top of these country-specific shocks, in late 2011 tensions hit the whole area-wide interbank market, with a sharp rise in the spread between interest rates on unsecured three-month interbank loans and the risk-free rate of that maturity (the spread between EURIBOR and overnight indexed swaps, shown in figure 2, bottom right panel).

Third, the increase in sovereign yields and the tensions in the interbank market affected not only the cost but also the availability of funding for Italian banks. There ensued an unprecedented increase in quantitative constraints on the availability of credit to the private sector, exacerbating the disparity of monetary conditions between Italy and the countries less affected by the crisis. The index of credit supply restriction derived from the responses of Italian banks to the Bank Lending Survey peaked at end-2011 (see figure 3).

The BIQM can take account of the transmission of these changes. In the model, 90 percent of a change in government bond yields is transmitted to bank lending rates within six quarters, a feature that is broadly confirmed by recent studies on the pass-through of interest

**Figure 2. Evolution of Risk Premia on the Interbank Market (daily data, basis points)**



**Sources:** e-MID, RepoFund Rate - ICAP, European Banking Federation, and Reuters.

<sup>a</sup>Spread between the interest rate on Italian uncollateralized overnight interbank loans and the EONIA rate.

<sup>b</sup>Spread between the interest rate on Italian collateralized overnight interbank loans and the corresponding French and German interest rates (average, weighted by volume).

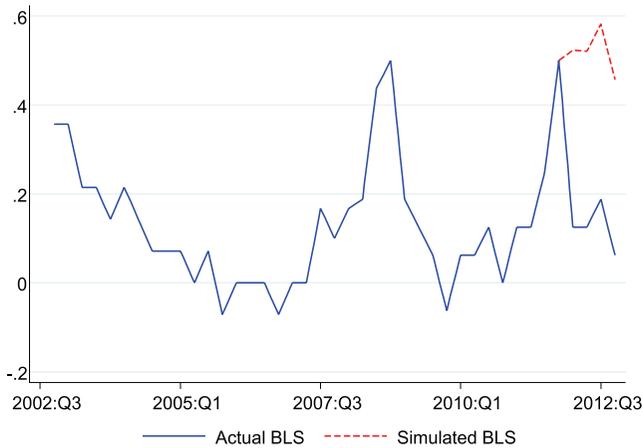
<sup>c</sup>Spread between the interest rate on Italian collateralized three-month interbank loans and the corresponding French and German interest rates (average, unweighted).

<sup>d</sup>Spread between the EURIBOR three-month and the rate on the corresponding overnight indexed swap.

rates during the sovereign debt crisis.<sup>8</sup> Higher money-market spreads also affect both short- and long-term rates and, in turn, aggregate demand. Finally, whereas in the BIQM quantitative constraints to

<sup>8</sup>If anything, the results of Albertazzi et al. (2012) suggest that the lending rate impact of movements in sovereign yields tends to be slightly greater during periods of financial turmoil.

**Figure 3. BLS Index of Credit Conditions: Actual and Simulated Dynamics (quarterly data, index)**



**Notes:** Simulations based on the estimates presented in table 5, assuming that three-year LTROs have neither a “direct” nor an “indirect” effect on credit conditions (see section 4.2). The BLS survey admits five ordered answers, namely “tightened considerably,” “tightened somewhat,” “basically unchanged,” “eased somewhat,” and “eased considerably.” The index presented in the figure is constructed as the simple mean of the responses provided by the banks after assigning values 1, 0.5, 0, -0.5, and -1, respectively, to the possible responses.

credit availability are not a relevant channel of transmission in normal times, recent research suggests that when they are binding they may have a significant and non-linear impact on investment.<sup>9</sup> We estimate and include these effects in the BIQM using the approach developed by Rodano (2011).

Simulations based on the BIQM confirm that these shocks played a major role in pushing the Italian economy into recession. Higher interest rates and tighter credit constraints cut about 1 percentage point from the growth rate in 2012 (see table 2), about one-third of the unexpected economic slowdown that year, an effect that would have been even larger if interest rates and credit constraints had not gradually receded from their peaks.

<sup>9</sup>The evidence provided in Gaiotti (2013), based on firm-level data, confirms that in recessions an increase in credit constraints has large effects on investment.

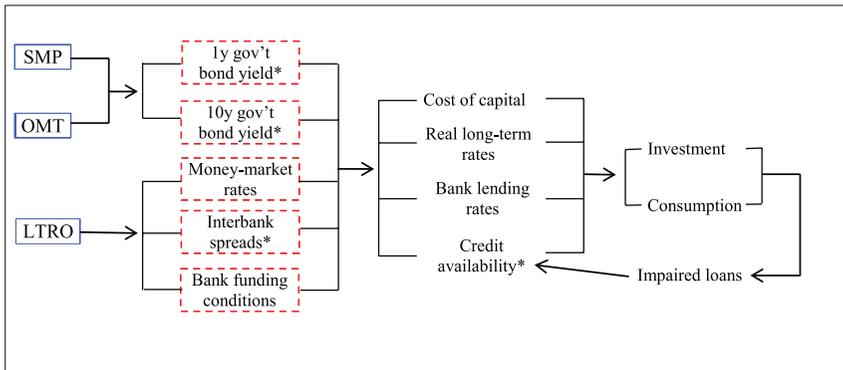
**Table 2. Determinants of the 2012 Recession in Italy  
According to the Bank of Italy Quarterly Model  
(percentage points)**

	<b>2012</b>
GDP Growth in a Scenario of No Sovereign Debt Crisis <sup>a</sup>	1.1
Determinants of the Revisions:	
Sovereign Interest Rates and Spreads	−0.4
Firms' Difficulties in Obtaining Credit	−0.6
Budgetary Measures	−1.1
Slowdown of the World Economy	−0.7
Uncertainty and Confidence	−0.6
Residual Component	−0.1
Actual GDP Growth	−2.4
<p><b>Source:</b> BIQM simulation, updated from Bank of Italy (2013).  <b>Notes:</b> The contribution of the factors presented in the table is computed comparing a simulation of the model where the exogenous variables are set at the profiles expected in the summer 2011 projection exercise, i.e., before the sovereign debt crisis accelerated, with a simulation using their realized values.  <sup>a</sup>GDP growth projection computed in July 2011.</p>	

The channels through which the ECB measures were intended to counteract the effects of the sovereign debt crisis and restore proper monetary transmission are shown in figure 4. The SMP was designed to counter undue yield volatility and ensure depth and liquidity in dysfunctional government bond market segments; in the BIQM, the consequent reduction in risk premia would correspond to lower short- and long-term yields on public securities<sup>10</sup> (with little impact on money-market interest rates because the liquidity effect was sterilized). The LTROs were intended to improve banks' liquidity conditions in order to defuse the threat of an impending funding crisis and avert a credit crunch; they ease credit availability conditions, which have a direct effect on investment, and decrease interbank market spreads, which affect the interest rate term structure (the increase in liquidity could also lower the overnight rate). By eliminating "tail risks" and precluding destructive scenarios in

<sup>10</sup>At the end of 2012 the average maturity of Italian sovereign securities in the SMP portfolio was 4.5 years.

**Figure 4. Transmission of Unconventional Measures in the Bank of Italy Quarterly Model**



**Notes:** Policy measures are reported in solid boxes, and variables directly affected by the sovereign debt crisis are reported in dashed boxes. The variables considered as exogenous in the simulations are indicated with an asterisk.

a context of multiple equilibria, the OMTs would affect mostly the shorter part of the yield curve, where they would operate, but long-term rates might also fall due to the attenuation of the perceived redenomination risk.

#### 4. Approach and Results

The methodology is in two stages. The first uses specific estimation approaches to gauge the impact of each of the ECB's measures on financial market conditions and the availability of credit. We estimate two regressions, based on detailed data on the purchases of Italian sovereign bonds under the SMP and on the reaction of individual banks' credit conditions to three-year LTROs; we also perform high-frequency event studies on the effects on short- and long-term interest rates of the announcements related to LTROs and OMTs. In the second stage, we map the estimated effects onto their macroeconomic implications for Italy using the BIQM.<sup>11</sup>

<sup>11</sup>Locarno and Secchi (2009) is related to our approach, although much more limited in time horizon and scope. They estimate the effect of the provision of

There is a general caveat to mention when “exogenously” inserting in a model changes in variables that arose for different reasons than those in the estimation sample. A specific issue is mentioned by Stein (2012), who argues that decreases in yields associated with large-scale asset purchases may have a different macroeconomic effect than those built into standard models, because they reflect a compression of term premia due to large-scale asset purchases, but not necessarily a change in expected future short rates, as is instead the case in normal times. However, this particular problem may be less relevant for our case: unlike the Federal Reserve large-scale asset purchases, ECB interventions were not aimed at decreasing term premia but rather at contrasting market disruptions, which would otherwise have caused a surge in yields.

Still, it is important to keep in mind that the BIQM is not completely immune to the Lucas critique because the impact of bond yields and credit constraints on other variables may have changed during the crisis, and this may bias the results of our simulations. In this respect, however, we take comfort from the comparison of the model’s main properties with micro evidence relative to the sovereign debt crisis, which is more robust to state-dependent changes in the transmission and seems to broadly confirm the magnitude of the relevant responses in the BIQM. Albertazzi et al. (2012), working with a panel of bank-level data during the crisis, find a full pass-through of movements in sovereign yields to bank lending rates; the magnitude of the impact of credit constraints on investment during the global crisis estimated by Gaiotti (2013) on a panel of firm-level data is also consistent with the effects included in the BIQM.

#### *4.1 Securities Markets Programme Interventions*

To evaluate the impact of the SMP on Italian government bond yields, we regress daily changes in bond yields on SMP purchases and a series of additional control variables.<sup>12</sup> The inclusion of control variables is important to address endogeneity. Yields and

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liquidity after the bankruptcy of Lehman Brothers on the spread between unsecured and secured interbank rates and on short-term lending rates in Italy, and then map it on output growth using the Bank of Italy quarterly model.

<sup>12</sup>The section updates results in Secchi (2012).

bond purchases under the SMP reacted to common factors, such as changes in market confidence and in risk appetite for Italian government bonds. Since valid instruments are not readily available, we include suitable control covariates that can proxy for the factors affecting yields.<sup>13</sup> The econometric specification can be written as

$$\Delta r_t = f(SMP\_purchases_t, \Delta r_{t-1}, \Delta X_t), \quad (1)$$

where  $\Delta r_t$  is the daily change in the yield on Italian sovereign bonds at either two-year or ten-year maturity; *SMP\_purchases* is the daily volume of purchases of Italian securities, in billions of euros; and  $\Delta X_t$  is a vector of covariates that control for other factors affecting Italian yields, which serves as a benchmark, i.e., the yield that would have obtained in absence of interventions, given actual economic and financial developments. In particular, these controls include a measure of the “risk-free” interest rate (interest rate swaps, or IRS), which is intended to capture the evolution of the economic outlook and the expected course of policy rates. In addition to IRS, we take a series of other variables, which proxy for the severity of tensions in Italian and other European financial markets (credit default swaps, or CDS, spreads on Italian bonds; the slope of the Italian yield curve, computed as the difference between yields on ten- and two-year BTPs; risk premia on private and public European securities as the French OAT-German bund spreads; the spread between BBB and AAA European corporate non-financial bonds; stock market indices; the spread between the IRS and the yield on German bunds; volatility indexes; and capital outflows measured via Italian Target2 flows). As a robustness control, we include an *SMP\_purchase\_dummy*.<sup>14</sup> This variable captures the average impact of unobservable factors (e.g., a change in confidence) that affected both yield dynamics and SMP interventions and, by their very nature, cannot be controlled by the other variables in the regression. A positive coefficient may indicate the presence of unobservable financial strains on the days when the Eurosystem decided to intervene in the Italian government bond market.

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<sup>13</sup>An analogous approach is adopted by Eser and Schwaab (2013).

<sup>14</sup>This dummy variable is equal to 1 in those days in which the SMP purchased Italian government bonds (0 otherwise).

The estimates of equation (1), reported in table 3, show a substantial effect of purchases of Italian securities on daily yield movements: €1 billion in bond purchases lower both the two- and the ten-year yields by between 2 and 5 basis points. Most of the control variables have the expected sign and in many cases are highly significant.<sup>15</sup> The results of the regressions are robust to the inclusion of the *SMP\_purchase\_dummy* (columns 2 and 5), to the exclusion of CDS spreads on Italian bonds and the slope of the BTP term structure (which may have been directly affected by SMP interventions) and of the covariates that are looser proxies for financial tensions (columns 3 and 6).<sup>16</sup>

The results are also robust to a range of further controls and specifications. In particular, the results are not sensitive to variations in the sample period, such as restricting it to the dates on which the SMP intervened in the Italian government bond market or considering only the period up to late February 2012 when the SMP made its last purchases; nor are they sensitive to the inclusion of extra covariates (e.g., a Monday dummy to control for recurrent patterns of financial market performance).

Overall, the magnitude of the effects is broadly consistent with the range of existing estimates of the effectiveness of the SMP mentioned in section 2. According to our most conservative estimates, the total impact comes to around 200 basis points for both two- and ten-year BTP yields, since the overall purchases of Italian securities over the whole life of the SMP amounted to slightly more than €100 billion. As a comparison, Eser and Schwaab (2013) conclude that SMP permanently reduced Italian yields by about 190 basis points; Ghysels et al. (2014) conclude that SMP permanently reduced Italian yields by 100 basis points.

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<sup>15</sup>As expected, increases in IRS and in Italian and other European risk premia increase BTP yields, while higher stock market returns and a steeper yield curve (which are inverse measures of financial market tensions) decrease BTP yields.

<sup>16</sup>Capital outflows measured via Italian Target2 flows, the spread between the IRS and the yield on German bunds, and the bund volatility index are almost never significant in the first two specifications (columns 1, 2, 4, and 5). A possible explanation is that settlements via Target2 also reflect commercial transactions, while changes in the other two variables were mainly due to the “flight to quality” associated with the high liquidity and strength of the bund.

**Table 3. Effects of SMP on Italian Government Bond Yields**  
(OLS regressions, daily data)

Yield Change On:→	BTP Two-Year			BTP Ten-Year		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable ↓						
SMP Purchases (bn euros)	-0.024*** (0.009)	-0.046*** (0.013)	-0.022* (0.013)	-0.024** (0.009)	-0.046*** (0.014)	-0.019** (0.009)
SMP Intervention Dummy <sup>a</sup>		0.051** (0.020)			0.051** (0.021)	
ΔYield 2y (10y), Lagged	-0.002 (0.041)	-0.001 (0.042)	0.092 (0.073)	0.043 (0.057)	0.034 (0.057)	0.082 (0.054)
ΔIRS 2y (10y)	0.447** (0.179)	0.421** (0.171)	0.613** (0.291)	0.298** (0.145)	0.282* (0.145)	0.182 (0.154)
ΔCDS Sov. 2y (10y), Italy	0.159*** (0.043)	0.163*** (0.041)		0.189*** (0.052)	0.195*** (0.051)	
ΔSlope BTP Term Structure	-1.108*** (0.091)	-1.108*** (0.090)		-0.109 (0.082)	-0.107 (0.082)	
ΔSlope BTP Term Structure, Lagged	-0.124 (0.095)	-0.100 (0.095)	-0.366** (0.162)	-0.095 (0.092)	-0.071 (0.092)	-0.139 (0.087)
ΔSpread OAT-Bund 2y	0.308 (0.235)	0.284 (0.233)	0.797* (0.422)	0.182 (0.220)	0.160 (0.219)	0.258 (0.205)
ΔSpread OAT-Bund 10y	0.506*** (0.129)	0.502*** (0.126)	0.536** (0.242)	0.707*** (0.136)	0.699*** (0.135)	0.762*** (0.140)

(continued)

Table 3. (Continued)

Yield Change On:→	BTP Two-Year			BTP Ten-Year		
	(1)	(2)	(3)	(4)	(5)	(6)
<b>Dependent Variable ↓</b>						
ΔSpread BBB-AAA, Non-Fin. Firms	0.158 (0.143)	0.151 (0.140)	0.508** (0.233)	0.147 (0.156)	0.137 (0.153)	0.231 (0.156)
Δ% Stock Market Index (banks), Italy	-0.010*** (0.002)	-0.010*** (0.002)	-0.027*** (0.005)	-0.011*** (0.002)	-0.011*** (0.002)	-0.016*** (0.003)
ΔVolatility Bund (options)	-0.029 (0.021)	-0.026 (0.019)		-0.030 (0.021)	-0.030 (0.020)	
ΔTarget Balance, Italy	-0.001 (0.001)	-0.001 (0.001)		-0.001 (0.001)	-0.001 (0.001)	
ΔSpread IRS – Bund 2y (10y)	0.036 (0.292)	0.021 (0.286)		-0.536*** (0.195)	-0.542*** (0.190)	-0.480** (0.194)
Constant	0.004 (0.008)	-0.001 (0.008)	-0.010 (0.012)	0.003 (0.008)	-0.001 (0.007)	0.001 (0.007)
Excluding August 8, 2011	Yes	Yes	Yes	Yes	Yes	Yes
Sample Start	Aug. 11					
Sample End	Sept. 12					
No. of Observations	283	283	283	283	283	283
R <sup>2</sup>	0.834	0.838	0.474	0.560	0.570	0.525

**Notes:** Standard errors are in parentheses; \*\*\*, \*\*, and \* denote statistical significance at the 1 percent, 5 percent, and 10 percent level, respectively. Dependent variable: daily change in yields on government bonds, percentage points.

<sup>a</sup>Dummy is equal to 1 in case of SMP intervention, 0 otherwise.

A comparison of our results with the existing evidence on the SMP, as well as with selected results on the effect of large-scale asset purchases in the United States surveyed by Williams (2014), is presented in table 4. The comparison systematically shows a larger effect on Italian yields, consistent with the conjecture that asset purchases are more effective when they are designed to fix a particular impairment in financial markets than when they are intended to provide additional stimulus at the zero lower bound. To properly compare the results, in the last column the effect of purchases equal to 1 percent of GDP is shown. The finding of a larger effect on Italian yields is confirmed: the range of estimates for the United States suggests that purchases of government bonds equal to 1 percent of GDP in the United States had an impact on ten-year Treasury yields between 3 and 8 basis points (except for D'Amico and King 2013, who estimate a larger effect), which compares with the estimates for Italy that range between 16 and 30 basis points.

Figure 5 compares the actual values of the two- and ten-year BTP yields with the values obtained simulating equation (1) under the assumption of no SMP purchases; it confirms that, according to our estimates, if SMP asset purchases had been held to zero, the yields on Italian government bonds would have been higher than those actually observed.

As the figure shows, the worsening of sovereign spreads was nonetheless not interrupted after the start of the SMP program but rather continued to widen throughout the second half of 2011, peaking in November, due to the deterioration in the covariates in the equation, which likely suffered from continuing uncertainty on the prospects for the Italian economy and on European policies.

#### *4.2 The Three-Year Longer-Term Refinancing Operations and Credit Supply*

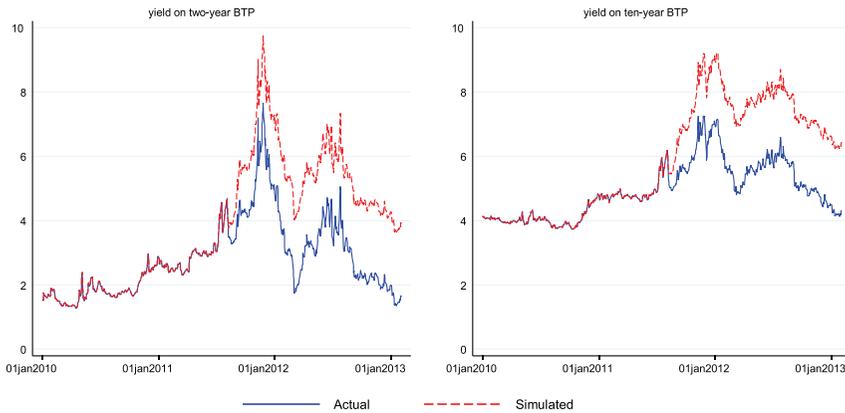
The effects of the three-year LTROs are estimated by two different approaches. First we use event studies, discussed in the next section, to evaluate the impact on Italian interbank interest rate spreads. Second, we exploit the Eurosystem's Bank Lending Survey (BLS) index of credit supply to estimate the effect on credit availability. These effects are both "direct," in that the LTROs relaxed banks' liquidity constraints, and "indirect" because they also eased

**Table 4. Selected Estimates of the Effects of Large-Scale Asset Purchases on Long-Term Rates**

<b>Study</b>	<b>Sample</b>	<b>Method</b>	<b>Estimates of Effect<sup>a</sup></b>	<b>Effect per Purchases of 1% GDP (in bp)</b>
This Paper	Italy SMP	Time Series	200 bp per €100bn	31
Ghysels et al. (2014)	Italy SMP	Time Series	100 bp per €100bn	16
Eser and Schwaab (2013)	Italy SMP	Time Series	190 bp per €100bn	30
Krishnamurthy and Vissing-Jorgensen (2011)	Post-War United States, LSAP1, and LSAP2	Time Series	15 bp per €600bn	4
Gagnon et al. (2011)	LSAP1	Event Study	30 bp per €600bn	8
Gagnon et al. (2011)	LSAP1	Time Series	18 bp per €600bn	5
D'Amico and King (2013)	LSAP1 Treasury Purchases	Security-Specific Event Study	100 bp per €600bn	27
Hamilton and Wu (2011)	United States, 1990–LSAP2	Affine No-Arbitrage Model	17 bp per €600bn	5
Christensen and Rudebusch (2012)	LSAP1, LSAP2, and UK LSAPs	Event Study, Affine No-Arbitrage Model	10 bp per €600bn	3

<sup>a</sup>Estimates for the United States are from the survey in Williams (2014).

**Figure 5. Yields on Italian BTP: Actual and Simulated Dynamics (daily data, percentage points)**



**Notes:** Dashed lines: simulations based on equation (1) under the assumption of no SMP interventions.

individual banks' access to the interbank market and lowered their funding costs. To this end, we take advantage of the possibility to merge bank-specific answers to the BLS with bank-level information on impaired loans and interbank market rates.

In our empirical approach, the BLS index of credit supply has a crucial role. In this respect we borrow from some existing literature (Ciccarelli, Maddaloni, and Peydró 2013 and Darracq-Paries and De Santis 2013) that exploits the information in the BLS to achieve identification, but we also go one step further to directly estimate the effects of the LTROs on credit availability conditions.

We construct an unbalanced panel at quarterly frequency that includes the degree of tightening of credit supply conditions as reported by each of the eleven Italian banks that have ever participated in the BLS. This variable consists of a qualitative index that admits five ordered answers, namely “tightened considerably,” “tightened somewhat,” “basically unchanged,” “eased somewhat,” and “eased considerably.” Following the literature, we assign values 1, 0.5, 0, -0.5, and -1, respectively, to those responses. We complement this qualitative information with bank-specific liquidity conditions, measured by the rates paid on the interbank market, and

with their credit risk, proxied by the flow of new impaired loans. We also consider aggregate information on interbank market tensions and economic prospects, such as the EURIBOR-EONIA swap spread, the spread between Italian and German government bond yields, and the Purchasing Managers' Index (PMI).

To assess the impact of the three-year LTROs on credit availability, we estimate several different regression equations linking the bank-level BLS index with the aforementioned set of aggregate and individual variables, which control for the main factors influencing credit supply conditions. We include an LTRO dummy to capture the "direct" impact of the measure on credit availability. Our baseline specification is

$$\begin{aligned}
 BLS_{i,t} = f(BLS_{i,t-1}, LTRO\_dummy_t, Euribor\_spread_t, \\
 overnight\_spread_{i,t}, BTP\_spread_t, \\
 \Delta impaired\_loans_{i,t}, y_t, \Delta y_t),
 \end{aligned}
 \tag{2}$$

where  $i$  denotes the bank,  $t$  indicates the quarter,  $BLS$  is the BLS supply index,  $LTRO\_dummy$  takes value 1 in 2012:Q1,  $Euribor\_spread$  is the difference between the three-month EURIBOR and the corresponding EONIA swap,  $overnight\_spread$  is the difference between the overnight rate paid on the Italian interbank market and EONIA,  $BTP\_spread$  is the spread between the ten-year Italian government bond yield and the corresponding German rate,  $\Delta impaired\_loans$  is the ratio of the flow of new impaired loans in the previous four quarters to total loans, and  $y$  and  $\Delta y$  correspond to the PMI index and its quarter-on-quarter growth.

We use a fixed-effect estimator that controls for unobserved bank-level effects. The baseline estimation results are reported in the first two columns of table 5.<sup>17</sup> The LTRO dummy has a significant "direct" impact on credit supply conditions, reducing the BLS index by around 0.2. Credit conditions respond significantly to changes in the availability of liquidity, tightening when the aggregate or the bank-specific interbank rate increases. The coefficients on the EURIBOR spread and the individual overnight spread are positive and

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<sup>17</sup>It has been shown that in panels with a limited number of periods, a fixed-effect estimator may result in downward-biased estimates, but we consider the time dimension of our panel (thirty-six quarters) to be long enough.

Table 5. Effects of LTROs on Credit Availability (quarterly data)

Dependent Variable	BLS <sub><i>i,t</i></sub> , Bank-Level Degree of Tightening of Credit Conditions <sup>a</sup>					
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged BLS <sub><i>i,t</i></sub>	0.37*** (0.08)	0.37*** (0.09)	0.37*** (0.08)	0.37*** (0.08)		0.32*** (0.10)
Dummy LTRO <sub><i>t</i></sub> (2012:Q1)	-0.15** (0.06)	-0.18*** (0.04)	-0.16** (0.04)	-0.18*** (0.04)	-0.58*** (0.20)	-0.15*** (0.04)
Dummy LTRO <sub><i>t</i></sub> (2012:Q2–2012:Q4)				-0.04 (0.07)		
EURIBOR-OIS Spread <sub><i>t</i></sub>	0.15*** (0.05)	0.13** (0.05)	0.08 (0.05)	0.13** (0.05)	0.82*** (0.30)	0.15*** (0.05)
Overnight (e-Mid)-EONIA Spread <sub><i>t</i></sub>	0.28** (0.11)	0.24*** (0.08)	0.11 (0.16)	0.25*** (0.09)	0.98*** (0.33)	0.20* (0.10)
BTP-Bund Ten-Year Spread <sub><i>t</i></sub>	-0.01 (0.02)					
ΔBanks' Impaired Loans <sub><i>i,t</i></sub> (one-quarter lead)	0.06 (0.04)	0.04 (0.03)	0.05* (0.03)	0.05 (0.03)	0.37** (0.18)	0.01 (0.03)
PMI <sub><i>t</i></sub>	0.00 (0.01)					

(continued)

Table 5. (Continued)

Dependent Variable	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\%PMI_t$ (quarter on quarter)	-0.74** (0.28)	-0.66** (0.27)	-0.70** (0.27)	-0.71** (0.04)	-5.19*** (2.14)	-0.59*** (0.19)
Dummy Lehman <sub>t</sub> (2008:Q3)			0.26*** (0.03)			
Dummy Sov. Crisis <sub>t</sub> (2011:Q4)			0.16* (0.06)			
Estimation Procedure	OLS <sup>a</sup>	OLS <sup>a</sup>	OLS <sup>a</sup>	OLS <sup>a</sup>	Ordered Probit	OLS <sup>a,b</sup>
Including Banks' Fixed Effects	Yes	Yes	Yes	Yes	No	Yes
Sample Start	2003:Q1	2003:Q1	2003:Q1	2003:Q1	2003:Q1	2003:Q1
Sample End	2012:Q4	2012:Q4	2012:Q4	2012:Q4	2012:Q4	2012:Q4
No. of Observations	275	275	275	275	285	264
Number of Banks	11	11	11	11	11	11
R <sup>2</sup>	0.39	0.39	0.42	0.39	0.13	0.39

**Notes:** Standard errors are in parentheses, clustered by date. \*\*\*, \*\*, and \* denote statistical significance at the 1 percent, 5 percent, and 10 percent level, respectively.

<sup>a</sup>In OLS regressions the dependent variable is an index taking values based on each bank's answers on credit conditions: "eased considerably" (-1), "eased somewhat" (-0.5), "basically unchanged" (0.0), "tightened somewhat" (0.5), and "tightened considerably" (1.0).

<sup>b</sup>Regression based on a slightly restricted sample that includes only "no change" and "tightened somewhat" answers.

significant. The BLS index is persistent over time, as shown by the lagged dependent variable's coefficient, which is around 0.4. Credit conditions also depend on the economic outlook, given that the coefficient on the quarterly growth of the PMI index is significant. By contrast, changes in impaired loans do not appear to be significant.

Columns 3–6 in table 5 present a series of robustness checks. Column 3 shows that our estimate of the impact of the LTROs is robust to the inclusion of dummies for the Lehman Brothers failure (2008:Q3) and the Italian sovereign crisis (2011:Q4).<sup>18</sup> Column 4 shows that the estimate is also robust to the inclusion of an additional LTRO dummy that takes value 1 from 2012:Q2 to 2012:Q4 and 0 in the rest of the time sample.

One further econometric issue is related to possible biases connected with the way in which we mapped the qualitative answers to the BLS survey onto numerical values. In order to control for this issue, we consider two additional econometric specifications, the outcomes of which are presented in columns 5 and 6 of table 5. In detail, column 5 presents the results of an ordered probit estimation, which is the most appropriate approach for ordered qualitative dependent variables. The magnitude of the ordered probit and fixed-effects linear regression estimates reported in the table is not directly comparable, but it can be shown that the results are substantially equivalent not only in terms of the statistical significance and signs of the coefficients but also in their quantitative implications.<sup>19</sup> Finally, column 6 shows that the estimates do not change even when very few extreme answers to the BLS (seven observations) are excluded so as to have a binary dependent variable and thus largely circumvent the problems connected with the ordinal nature of the BLS index.

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<sup>18</sup>The inclusion of the Lehman Brothers failure and the Italian sovereign crisis dummies reduces the impact of the interbank spreads. This result is hardly surprising, as the two events are very important for measuring the spreads' effect on credit conditions. Further regressions, not presented here, show that, as theory suggests, the Lehman event is more important for the assessment of the impact of EURIBOR-OIS spreads on credit conditions, and the Italian sovereign debt crisis is essential in gauging the effect of the bank-level Italian overnight spread.

<sup>19</sup>The quantitative implications, not shown here, can be easily derived by considering the effect of the LTROs on the marginal probabilities for each of the admissible answers, implied by columns 5 and 6 in table 5, and mapping them in the credit conditions indicators by the same metrics used to construct the BLS supply index.

All in all, the magnitude of the correlation coefficients indicates that the LTROs had a “direct” impact on credit supply and that interbank market spreads are an important determinant of lending conditions. The next section addresses the conjecture that the operations may have helped to normalize interbank market conditions and spreads and thus had a more persistent “indirect” effect on credit supply.

### *4.3 Event Study—Three-Year Longer-Term Refinancing Operations*

In order to estimate the impact of the three-year LTROs on financial market yields, we use a high-frequency event-study methodology, evaluating the statistical significance of the effects of an announcement on a financial asset, based on yield changes in a small temporal window surrounding the event.<sup>20</sup>

We identify three major events: the announcement of the three-year LTROs and the settlement of the first and second operations. For each we focus on the change in selected interest rates in the two days around the event and test the null hypothesis of no effect to determine whether the change is statistically significant. In particular, we consider two sets of interest rates. The first includes interbank interest rates, namely the spread between the overnight rate on the Italian interbank market (e-MID, “mercato interbancario dei depositi”) and EONIA, and the spread between the yield on three-month interbank loans collateralized by Italian sovereign securities and the average yield on those backed by French and German sovereigns. The second set includes yields on the sovereign bonds, namely medium- and long-term yields on Italian securities (secondary market Treasury-bond yield at the two-year and ten-year maturity). We also analyze the changes in the spread between those bond yields and the corresponding spread vis-à-vis the interest rate swap with the same maturity, which can be interpreted as a proxy for variations in risk and liquidity premia.

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<sup>20</sup>Event studies have been used widely to measure the impact of the unconventional measures adopted by the major central banks (see, for example, Gagnon et al. 2011 and Swanson 2011).

Table 6 reports the results. All in all, they indicate that the LTROs affected money-market rates substantially. The initial announcement of the LTROs on December 8 was not followed by any significant change in short-term rates, but both the first and the second auctions were followed by statistically and economically significant reductions in money-market spreads.<sup>21</sup> As a reference, the last two rows of the table report the cumulative change in each interest rate over the three events considered and over the entire period between the announcement of LTROs and the settlement of the second operation. These figures suggest that the changes that took place around the event dates were persistent, since they are close to the total change over the period considered. The interest rates paid by Italian banks on the interbank market dropped by 70 to 100 basis points.

Although the direct effects of the LTROs on long-term sovereign yields also played a prominent role in the public discussion, our event studies do not find any immediate reaction of government bond yields to the announcements. While this may at first seem surprising, our results do not necessarily contradict the widespread view that the LTROs, prompting a sovereign debt carry trade, contributed to the subsequent gradual but steady and significant fall in Italian long-term yields that took place in the three months following the LTROs. However, over the same period, the financial markets were also affected by other news; this raises a substantial identification problem and prevents attributing this particular decline in sovereign spreads to the monetary operations, which therefore we refrain from doing in this paper.<sup>22</sup>

The overall effect of the LTROs on credit supply conditions implied by both our regression analysis and our event study can be estimated by combining the two sets of results. Figure 3 reports

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<sup>21</sup>If anything, the effect of the announcement on the overnight rate and on ten-year yields had the wrong sign. An interpretation is that the market was disappointed by the announcement, because it was expecting an enhancement of the SMP.

<sup>22</sup>The decrease of the yields on Italian sovereign bonds started in the second half of January 2012, after a series of successful auctions on the primary market for Italian securities. In January and February, there was positive news on the conclusion of the Greek PSI, on the German contribution to the European Stability Mechanism, and on the new support program for Greece.

Table 6. Effects of LTROs Announcements on Italian Interest Rates<sup>a</sup> (basis points)

Event	Money-Market Interest Rates		Sovereign Bond Yields			
	Spread Italian Overnight <sup>b</sup>	Spread Italian Collat. Three-Month <sup>c</sup>	Two-Year BTPs	Two-Year BTPs over IRS	Two-Year BTPs over IRS	Spread Ten-Year BTPs over IRS
Announcement LTROs (Dec. 8, 2011)	23**	-2	31	37**	29	41*
Settlement First LTRO (Dec. 22, 2011)	-76***	-63***	1	19	3	21
Settlement Second LTRO (Mar. 1, 2012)	-37***	-5	-39	-28	-33	-27
Cumulated Change over the Above Events	-90	-70	-8	-28	0	35
Cumulated Change over the Period (Dec. 7, 2011–Mar. 2, 2012)	-103	-99	-391	-108	-356	-64

**Notes:** \*\*\*, \*\*, and \* denote statistical significance at the 1 percent, 5 percent, and 10 percent level, respectively; statistical significance is not provided for cumulative changes.  
<sup>a</sup>Cumulative two-day change around the announcement.  
<sup>b</sup>Spread between the overnight interest rates on e-MID and EONIA; overnight interest rate on e-MID computed as a weighted average (by volume of transactions) of the interest rates observed in the small-size and large-size segments of the market.  
<sup>c</sup>Spreads between the Italian collateralized three-month interest rates and the average collateralized three-month interest rates observed in France and in Germany.

the outcome of a dynamic simulation of equation (2) assuming no LTROs. That is, *LTRO\_dummy* is set to 0 and it is assumed that each bank faced an overnight rate 90 basis points higher beginning in 2012:Q1, consistently with the result of the event study. The EURIBOR spread is held constant at the level reached before the LTROs, which corresponds to a maximum of 60 basis points more at the end of 2012.<sup>23</sup> In this simulation the BLS credit conditions index would have been persistently higher by 0.4, mainly reflecting the permanent decrease in the interbank market rates paid by Italian banks. The effect is economically significant, considering that the range of variation of the BLS index is between  $-1$  and  $1$ .

#### 4.4 *Event Study—Outright Monetary Transactions*

We perform a second event study to determine the effect of the ECB's OMTs on interest rates. In this case, we consider three events: the speech by ECB President Draghi on July 26, 2012, announcing that the ECB would do "whatever it takes" to contrast yield movements due to redenomination risk, and the ECB Governing Council meetings of August 2 and September 6, 2012, first making public the broad guidelines of the OMTs and then communicating the complete operational details for the operations. For each event, we consider the same set of money-market rates and of sovereign yields as in the previous section.

The results, shown in table 7, are broadly symmetrical to those set out in the previous section. The estimates suggest that the impact of the OMTs on money-market rates was negligible but that on sovereign yields was sizable and almost entirely front-loaded.<sup>24</sup>

Concerning the yield on government bonds, a large and significant decrease took place around Draghi's speech (table 7, first row). The effect was concentrated on the shorter end of the term structure, where yields decreased by more than 100 basis points, but it also affected the longer end. After the August meeting of the Governing Council, long-term rates did not move, but short-term rates fell

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<sup>23</sup>Our assessment of the impact of the three-year LTROs on EURIBOR-OIS spreads is in line with the results of Dubecq et al. (2013) summarized in section 2.

<sup>24</sup>It is not surprising that money markets were not significantly affected, since the OMTs did not involve changes in excess liquidity (at any rate, liquidity was abundant at that time, as a consequence of the three-year LTROs).

Table 7. Effects of OMT Announcements on Italian Interest Rates<sup>a</sup> (basis points)

Event	Money-Market Interest Rates		Sovereign Bond Yields			
	Spread Italian Overnight <sup>b</sup>	Spread Italian Collat. Three-Month <sup>c</sup>	Two-Year BTPs	Two-Year BTPs	Spread Two-Year BTPs over IRS	Spread Ten-Year BTPs over IRS
Draghi's London Speech (Jul. 26, 2012)	-2	-1	-116***	-49***	-112***	-62***
ECB Governing Council (Aug. 2, 2012)	2	-2	-64**	12	-67**	6
ECB Governing Council (Sep. 6, 2012)	-3	-1	-21	-46**	-23	-55**
Cumulative Change over the Above Events	-3	-3	-201	-83	-202	-112
Cumulative Change over the Period (Jul. 25, 2012–Sep. 7, 2012)	-5	4	-270	-139	-255	-145

**Notes:** \*\*\*, \*\*, and \* denote statistical significance at the 1 percent, 5 percent, and 10 percent level, respectively; statistical significance is not provided for cumulative changes.

<sup>a</sup>Cumulative two-day change around the announcement.

<sup>b</sup>Spread between the overnight interest rates on e-MID and EONIA; overnight interest rate on e-MID computed as a weighted average (by volume of transactions) of the interest rates observed in the small-size and large-size segments of the market.

<sup>c</sup>Spreads between the Italian collateralized three-month interest rates and the average collateralized three-month interest rates observed in France and in Germany.

further (table 7, second row). This result is likely to be a consequence of the announcement that interventions were to be concentrated on bonds with short maturities. Long-term rates fell again around the Council's September meeting (table 7, third row). The last two rows of the table suggest that most of the movements in government bond yields and risk premia around event dates were persistent.

## 5. Macroeconomic Assessment

Using the Bank of Italy's quarterly econometric model, we combine all the estimates obtained in the previous section to assess the effect that the three measures considered had on the main Italian macroeconomic variables. Note that our purpose is not to construct a complete counterfactual macroeconomic scenario, which cannot be done by standard econometric methodologies in view of the powerful non-linear dynamics that would have marked the economic variables in an extreme scenario of complete market collapse, which the ECB's measures may well have averted.<sup>25</sup>

In order to derive the macroeconomic impact, we construct the time series of the overall effect of the unconventional measures on interbank rates, on the yields on one- and ten-year Treasury securities, and on the index of credit conditions over the period 2012–13. We then impose these “shocks” on the BIQM and run a simulation. By comparing the results with actual data, we derive a measure of the responses of the main Italian macroeconomic variables to the unconventional monetary measures.

The set of shocks imposed on the model is described in table 8. The Italian overnight unsecured rate and the three-month collateralized rate are 70 and 90 basis points higher, respectively, from the first quarter of 2012 on. Absent the impact of SMP, the one-year and ten-year yields are 120 basis points higher in third-quarter 2011

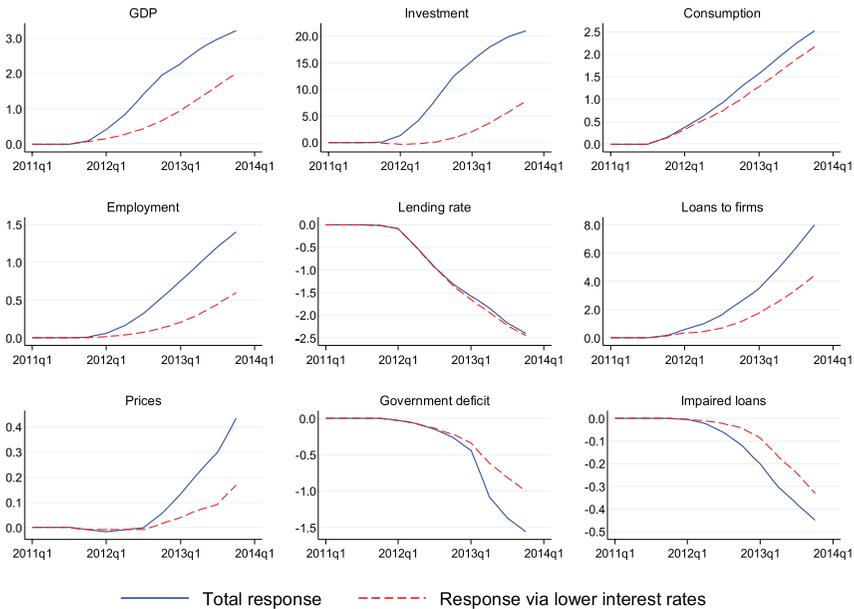
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<sup>25</sup>The possible counterfactual of a larger, non-linear market collapse would imply that our estimates of the effects of policy interventions may be significantly understated. However, it must also be considered the existence of a different alternate scenario, in which credit and financial markets would have gradually stabilized within the simulation horizon even without the adoption of unconventional monetary measures. In that case, the ECB actions would have had a temporary effect that dissipated over time and our estimates would be overstated, at least in terms of their permanent effect.

Table 8. Summing-Up of the Main Results

	Approach	Main Findings	Overall Estimated Effects
SMP	Time-Series Regressions	Interventions by the Eurosystem significantly affect the level of Italian government bond yields.	Ten-year and two-year BTP: Cumulative decrease by about 200 bp starting from 2011:Q3.
Three-Year LTROs	Time-Series Regressions	The Italian BLS credit supply index was significantly affected by the LTROs (both directly and through reduction of premia in interbank market).	BLS supply index: permanent decrease by about 0.4 beginning in 2012:Q1.
	Event Study	When the LTROs were implemented, premia on the Italian interbank market fell (while bond yield did not react).	Premia on Italian interbank market: permanent decrease by 70–100 bp starting from 2012:Q1.
OMTs	Event Study	At dates of OMTs announcements, premia on Italian medium- and long-term BTPs fell (while interbank interest rates did not react).	Ten-year BTP yields: cumulative decrease by 95 bp starting from 2012:Q3. Two-year BTP yields: cumulative decrease by 180 bp starting from 2012:Q3.

**Figure 6. Response of Selected Variables to the Unconventional Monetary Measures**



**Notes:** The difference between the solid line and the dashed line represents the response via improvement in credit availability.

and 200 points higher starting the next quarter. When excluding the effect of the OMTs, the short-term and the long-term rates on sovereign bonds increase by an additional 180 and 95 basis points starting from the fourth quarter of 2012. Finally, we consider a permanent upward shift of the BLS credit supply index (by 0.4), starting from the first quarter of 2012.

Figure 6 reports the responses of output, investment, consumption, employment, loan rates, credit supply, prices, the government budget deficit, and banks' new non-performing loans to the unconventional monetary measures. For each variable, the solid line shows the response over the period 2011–13, which is the percent deviation from the “no-policy” scenario.<sup>26</sup> The dashed line corresponds to the

<sup>26</sup>The responses of interest rates, the deficit-to-GDP ratio, and the ratio of bad loans are in terms of absolute differences.

portion of the response due to the interest rate component of the unconventional instruments.<sup>27</sup> The distance between the solid and the dashed lines represents the portion of the effect on each variable that is due to the improved credit availability.

Four considerations stand out. First, the effects of the unconventional measures on the real economy are certainly substantial. At the end of 2013, GDP is higher by around 3 percent. Most of the positive impact results from an increase in investment, which is 21 percent higher, due to its large sensitivity to credit conditions. Consumption reacts comparatively less, being about 2.5 percent higher at the end of 2013. The more subdued response of consumption to changes in interest rates and credit availability reflects, among other factors, the relatively low indebtedness of Italian households. Moreover, a relatively large share of Italian household wealth consists in housing and is thus associated with a low propensity to consume out of capital gains. Overall, the effect on the labor market is substantial, with employment almost 1.5 percent higher at the end of the simulation horizon. Given these results, we conclude that while the considered unconventional measures were unable to prevent recession, they avoided a much deeper depression for the Italian economy. The average yearly effect of the unconventional policy measures, summarized in table 9, indicates that the Italian GDP growth rate would have been lower by 1.1 percentage points in 2012 and 1.6 points in 2013.<sup>28</sup>

Second, the cost and quantity of bank loans respond strongly, indicating the relevance of the credit channel. Lending rates are almost 2.5 percentage points lower than in the “no-policy” scenario at the end of 2013, while lending to firms is 8 percent higher, due to the loosening of credit constraints and the decrease in rates. Once again, the credit responses indicate that the unconventional operations may have averted an even worse situation. Although bank lending continued to decrease in Italy in 2012, the direct effect on supply conditions measured by the BLS and the transmission of lower sovereign yields to bank lending rates via the interest rate structure greatly attenuated the decline in lending to firms, both in

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<sup>27</sup>This is calculated as the response obtained keeping credit availability in line with actual data.

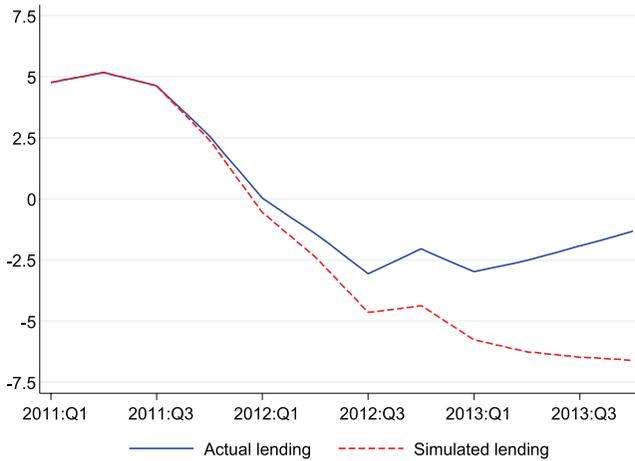
<sup>28</sup>Italian GDP shrank by 2.4 percent in 2012 and 1.9 percent in 2013.

**Table 9. Macroeconomic Effects of the Unconventional Shocks (growth rates, differences with respect to the “no-policy” scenario; percentage points)**

	Total		Via Interest Rates		Via Credit Availability	
	2012	2013	2012	2013	2012	2013
	GDP	1.1	1.6	0.4	1.1	0.7
Exports	0.1	0.0	0.0	0.0	0.1	0.0
Imports	2.6	3.1	0.5	1.8	2.2	1.6
Household Consumption	0.7	1.2	0.6	1.0	0.1	0.2
Investment	5.4	10.3	0.1	4.3	5.4	6.5
– In Machinery	12.5	21.7	0.0	6.3	12.7	16.5
– In Construction	0.4	3.8	0.3	3.0	0.1	0.8
– Residential	0.4	3.7	0.4	3.3	0.0	0.4
Lending to Firms	1.4	4.0	0.6	2.3	1.0	1.8
Consumer Credit	0.8	3.0	0.8	2.9	0.0	0.2
Mortgages	1.5	6.5	1.4	6.1	0.0	0.4
Consumption Deflator	0.0	0.2	0.0	0.1	0.0	0.1
Unemployment Rate	-0.2	-1.5	-0.2	-0.9	0.0	-0.5
Government Deficit (%GDP)	-1.1	-1.6	-0.4	-1.1	-0.7	-0.6

**Source:** Bank of Italy quarterly model simulation.  
**Notes:** The effects via interest rates and credit availability may not add up to the total effect reported in the table due to rounding and non-linearities in the BIQM.

**Figure 7. Lending to Firms: Actual and Simulated Dynamics (twelve-month percent growth)**



**Notes:** The simulated profile posits the absence of unconventional policy measures.

2012 and in 2013 (see figure 7).<sup>29</sup> The former effect is consistent with recent work by Del Giovane, Nobili, and Signoretti (2013) who, using micro data on bank loans and information from the BLS survey, estimate the effect of the tightening of credit conditions triggered by the sovereign debt crisis on credit growth. The latter is consistent with the findings of Albertazzi et al. (2012) that sovereign spreads were largely transmitted to bank lending rates.

Third, the improvement in credit availability is an important channel for the transmission of unconventional measures to the economy. As shown in figure 6, the loosening of constraints on credit availability, measured by the difference between the solid and the dashed lines, accounts for two-thirds of the GDP response at the end of 2012 and for almost half at the end of 2013. For investment in machinery, the contribution is greater still. The effects of lower interest rates build up more slowly, but they are economically significant at the end of the simulation horizon.

<sup>29</sup>Lending to Italian firms fell by 2.0 percent year on year in 2012.

Fourth, unconventional operations also had major effects on other variables. For instance, the ratio of the government budget deficit-to-GDP ratio decreases by 1.6 percentage points at the end of the simulation horizon, and the improvement is due not only to the effect of lower yields on interest outlays but also to higher growth. The flow of new impaired bank loans, as a ratio to outstanding credit, also decreases substantially, a decline estimated at almost 0.4 percentage point at the end of 2013. The amelioration in credit quality reflects the effect of lower interest rates and higher growth on firms' profits and cash flow.

## 6. Conclusions

In order to estimate the impact of the non-standard measures adopted by the ECB in 2011 and 2012 (SMP, three-year LTROs, OMTs) on the Italian economy, we first adopted specific estimation approaches to measure the impact on money-market interest rates, government bond yields, and credit availability and then mapped the estimated effects onto their macroeconomic implications, taking advantage of the Bank of Italy quarterly model of the Italian economy.

The first conclusion is that the SMP has been effective in contrasting undue increases in government bond yields. This conclusion is based on a set of regressions linking daily changes in bond yields with SMP purchases and a series of control variables. The estimates indicate that the effect of the SMP on Italian government bond yields is around 2 basis points per billion euros purchased. Once standardized for the different size of the economy, the impact on yields was much larger than the range of those reported for U.S. large-scale asset purchases. This finding is consistent with the view that asset purchases are more effective when addressing market disruptions than when aimed at addressing a zero-lower-bound problem.

Second, the LTROs had a significant impact on credit supply, mainly through a sizable reduction in money-market spreads, associated with the revival of the interbank market. Although bank lending continued to decrease in Italy in 2012, this result suggests that the unconventional operations may have avoided a much more severe credit restriction and helped to counteract the decline in lending to firms in both 2012 and 2013.

Third, the announcement and the design of the OMTs had very large front-loaded effects on the sovereign bond market. Yields on Italian government bonds decreased sharply after President Draghi's speech at the end of July 2012, and the improvement was reinforced by the ECB Governing Council announcements in early August and September.

From a macroeconomic perspective, our simulations indicate that the unconventional measures have had a powerful effect on the Italian economy through several channels. Based on the standard elasticities included in the BIQM, the cumulative GDP growth response comes to 2.7 percentage points over the period 2012–13. One of the main channels of transmission is the improvement in credit availability—in particular, through its impact on investment.

The simulations also show that the set of unconventional operations had a favorable effect on relevant macroeconomic variables that are usually not emphasized in discussions on the effectiveness of monetary policy. We find that the deficit-to-GDP ratio improves greatly thanks to the combination of lower interest expenses and higher growth. The flow of new impaired bank loans decreases, as lower interest rates and higher growth support businesses' profits and cash flow. There accordingly appears to be good reason to believe that the unconventional policies helped avoid a further worsening of the adverse spiral between sovereigns, banks, and growth.

The Securities Markets Programme, the three-year longer-term refinancing operations, and the Outright Monetary Transactions, however, did not prevent the Italian economy from falling into recession. Over the time horizon considered in this paper, interest rates did not completely regain their pre-crisis levels, credit conditions remained relatively tight, and business lending continued to contract, although less sharply than would otherwise have been the case. Partly, this reflects the incomplete institutional framework of the monetary union that prevented a more intensive use of other tools, like fiscal policy.<sup>30</sup> It may also suggest, however, that more aggressive monetary policy could have been beneficial for countries under stress, and ultimately for the whole euro area.<sup>31</sup>

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<sup>30</sup>See Draghi (2014).

<sup>31</sup>See Rossi (2014).

All in all, however, the evidence presented in this paper strongly supports the argument that the unconventional monetary measures implemented by the ECB were far from ineffective; they significantly supported economic activity by avoiding a further downward spiral of the crisis of confidence and a much more severe credit crunch.

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