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Spillovers from the ECB's non-standard monetary policies on non-euro area EU countries: evidence from an event-study analysis

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Spillovers from the ECB's non-standard monetary policies on non-euro area EU countries: evidence from an event-study analysis

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ABSTRACT

Using event-study techniques we investigate the presence and the magnitude of spillovers from the ECB's non-standard monetary policies on financial assets in selected non-euro area EU countries from Central and Eastern Europe (the Czech Republic, Hungary, Poland and Romania). Generally, we find strong evidence of spillover effects from the ECB's announcements on bond yields. We also find that the SMP announcements resulted in significant spillovers, while those from the OMT and the PSPP announcements were rather limited. Turning to the transmission channels, we argue that spillovers from the SMP announcements went through the portfolio rebalancing and the signalling channels. The transmission of the OMT operated via the confidence channel and for the PSPP we find evidence that both the confidence and the signalling channels were at play.

Keywords: monetary policy spillovers, ECB, Central and Eastern Europe, event-study

JEL Classification: C32, E52, E58

Non-technical summary

In this paper we examine the international transmission of ECB monetary policy. More specifically, we investigate whether the ECB's non-standard monetary policy measures spilled over to non-euro area EU countries in Central and Eastern Europe (CEE).

The existence of close economic and financial linkages between CEE countries and the euro area has been extensively studied and is well documented in the literature. In general, CEE countries are small and highly open economies for which euro area countries are the dominant trading partners and providers of capital. In addition, banks in CEE countries are to a large extent controlled by banking groups domiciled in the euro area, which has resulted in substantial cross-border banking flows. The very high degree of economic and financial integration between CEE countries and the euro area provides us with an interesting test case for studying potential monetary policy spillovers.

In this paper we investigate whether such monetary spillovers from the euro area to CEE countries following an inflation targeting monetary policy strategy (namely the Czech Republic, Hungary, Poland and Romania) occurred since 2007. By doing so, we seek to fill a gap in the literature on monetary policy spillovers, which is dominated by studies investigating the impact of the Federal Reserve's (Fed) monetary policy decisions and actions on emerging market economies.

We conduct a comprehensive event-study analysis to trace the impact of the ECB's non-standard monetary policy announcements on a wide range of financial assets from CEE countries. The event-study analysis is carried out over the period 2007-2015 using daily data and controlling for, among other things, domestic and foreign monetary policy decisions and news stemming from releases of macroeconomic data in respective CEE countries. This paper covers a complete range of non-standard monetary policy measures announced by the ECB since 2007, including the recently announced expanded Asset Purchase Programme. More than seventy events, including press conferences, press releases and speeches, related to ECB's non-standard monetary policy measures are identified and systematically classified.

We find evidence of strong spillovers from the ECB's non-standard monetary policy measures to all CEE countries, in particular, on sovereign bond yields. We find that spillovers from the Securities Markets Programme (SMP) announcements were the most pronounced, while spillovers from the Outright Monetary Transactions (OMT) and the Public Sector

Purchase Programme (PSPP) announcements were rather limited. Turning to the transmission channels of these spillovers, we argue that for the SMP announcements the portfolio rebalancing and the signalling channels played a key role. The OMT has impacted CEE countries indirectly, mainly through the confidence channel – by reducing the perceived redenomination risk within the euro area – without resulting in cross-border spillovers. Regarding the PSPP, we find evidence that it operated via both the confidence and the signalling channels.

“QE has several effects. [...] The portfolio rebalancing effect, namely if you buy euro-denominated assets, people who will get cash, will buy perhaps non-euro-denominated assets, and you have a portfolio rebalancing effect through that channel.”

(Mario Draghi, 4 December 2014)¹

1. Introduction

In recent years the European Central Bank (ECB) has announced and implemented a series of key policy rate changes and non-standard monetary policy measures. These actions were taken in response to a number of unusual economic and financial events, with the intention of addressing a range of risks including the risk of a too prolonged period of low inflation, fragmentation that would stem from a redenomination risk and disturbances to the liquidity of certain asset markets in the euro area (ECB, 2010; 2012; 2014a). While these actions were motivated and justified on the basis of events within the euro area, this paper suggests that they were likely to have had consequences for EU countries from Central and Eastern Europe (CEE) which, despite being outside the euro area, are closely integrated with it via real and financial linkages.

The existence of close economic and financial linkages between CEE countries and the euro area has been extensively studied and is well documented in the literature.² In general, CEE countries are small and highly open economies for which euro area countries are the dominant trading partners and providers of capital through foreign direct investments and portfolio investments. In addition, banks in CEE countries are to a large extent controlled by banking groups domiciled in the euro area, which has resulted in substantial cross-border banking flows particularly prior to the global crisis. The very high degree of economic and financial integration between CEE countries and the euro area provides us with an interesting test case for studying potential monetary policy spillovers. To the best of our knowledge, to date this region has received relatively little attention in the emergent monetary policy spillovers literature.

¹ Introductory Statement to the press conference, 4 December 2014.

² See, among others, Galesi and Sgherri (2009), Backé et al. (2013), and Sun et al. (2013).

The CEE region consists of a rather heterogeneous group of countries in terms of monetary policy regimes. Several countries follow an inflation targeting strategy with either freely or managed floating exchange rates. There are also countries, which target a bilateral exchange rate vis-à-vis the euro under a currency board arrangement (Bulgaria) or follow the exchange rate jointly with a definition of price stability (Croatia). There are also several CEE countries, which have already joined the euro area (Estonia, Latvia, Lithuania, Slovakia and Slovenia). Our paper focuses on the first group of CEE countries – the inflation targeters, specifically the Czech Republic, Hungary, Poland and Romania. In line with the Trilemma hypothesis,³ these countries could pursue an independent monetary policy under an open capital account and a flexible exchange rate regime.⁴ Rey (2013) recently argued that the global financial cycle has transformed the Trilemma hypothesis into a dilemma, suggesting that an independent monetary policy is possible “...if and only if the capital account is managed directly or indirectly”, as countries which are open to the free movement of capital are exposed to monetary policy spillovers from major developed economies.

Our paper investigates whether such monetary spillovers from the euro area to CEE countries following an inflation targeting monetary policy strategy occurred since 2007. This period covers two major shocks that hit European economies, namely the global financial and economic crisis and the euro area sovereign debt crisis. By doing so, we seek to fill a gap in the literature on monetary policy spillovers, which is dominated by studies investigating the impact of the Federal Reserve’s (Fed) monetary policy announcements and actions on emerging market economies. Our paper builds on the contributions of this literature, as the mechanisms and results outlined in those papers provide a useful benchmark for our analysis.

We conduct a comprehensive event-study analysis to trace the impact of the ECB’s monetary policy decision announcements on a wide range of financial assets from CEE countries. The event-study analysis is carried out over the period 2007-2015 using daily data and controlling, among other things, for domestic and foreign (i.e. Fed) monetary policy decisions

³ The *Impossible Trinity*, or the Trilemma hypothesis of international finance documented by Obstfeld et al. (2005), suggests that it is impossible to follow a fixed exchange rate, an independent monetary policy and allow the free movement of capital all at the same time.

⁴ It should be noted that the Czech National Bank intervened in the foreign exchange market in November 2013. According to the Czech National Bank (2014) “the policy objective of using the exchange rate as an additional monetary policy instrument – and therefore of using foreign exchange interventions to weaken the koruna – is the same as in the case of interest rates: to maintain price stability in the Czech economy in line with the CNB’s inflation target (which has been set at 2% since 2010).” This intervention is taken into account in the empirical analysis.

and news stemming from releases of macroeconomic data in CEE countries. In this paper we cover a complete range of non-standard monetary policy measures announced by the ECB since 2007, including the recently announced expanded Asset Purchase Programme (APP). More than seventy events, including press conferences, press releases and speeches, related to the ECB's non-standard monetary policy measures are identified and systematically classified.

We find evidence of strong spillovers from the ECB's monetary policy to all countries, in particular, on bond yields and the exchange rate. Among recent ECB monetary policy decisions, we find that spillovers from the Securities Markets Programme (SMP) announcements were the most pronounced, while spillovers from the Outright Monetary Transactions (OMT) and the Public Sector Purchase Programme (PSPP) announcements were rather limited. Turning to the channels of transmission of these spillovers, we argue that for the SMP announcements both the portfolio rebalancing and the signalling channels played a key role in the transmission to CEE countries. The OMT operated via the confidence channel, reducing the perceived redenomination risk within the euro area without resulting in cross-border spillovers to CEE economies. Regarding the PSPP we find that both the confidence and the signalling channels were important in its transmission across borders.

Although the primary focus of this paper is on spillovers from the ECB's monetary policy we also review the impact of the Fed's QE and tapering announcements. Our analysis reveals that CEE countries were subject to monetary policy spillovers not only from the euro area, but also from the US. When comparing the magnitude of spillovers from monetary policy announcements we conclude that spillovers to CEE countries from ECB policies were stronger and affected more asset classes than spillovers from Fed's policies. We also find that the average impact of announcements related to tapering was much higher than for the Fed's QE announcements, which may indicate non-linear or asymmetric spillovers during the life cycle of non-standard monetary policy measures.

The remainder of the paper is organized as follows. Section 2 provides a brief review of literature on monetary policy spillovers. Section 3 presents the non-standard measures announced and largely implemented by the ECB since 2007. Section 4 discusses the main channels through which monetary policy in advanced economies spills over internationally. Section 5 discusses the event-study methodology and reports our empirical results. Section 6 concludes.

2. Literature review

While the effectiveness of non-standard monetary policy measures on domestic variables has been studied extensively,⁵ the analysis of the spillover effects of such policies from advanced economies to emerging markets has only started to receive more attention in the empirical literature in recent years.

Many of the existing papers on the topic suggest that important global externalities arise from unconventional monetary policy decisions taken in advanced economies. Chinn (2013) provides evidence about their impact on exchange rates and asset prices in emerging market economies, concluding that these policies support global rebalancing by encouraging emerging market currency revaluation. Fic (2013) examines the financial market impact of unconventional monetary policy decisions adopted in major developed countries on the BRIC economies (i.e. Brazil, China, India and Russia), documenting their impact on long term bond yields, equity prices and exchange rates. Fratzscher et al. (2013) study the global spillovers of the Fed's unconventional monetary policy measures and conclude that such policies affected capital flows to emerging market economies in a pro-cyclical manner, have raised asset prices globally and weakened the US dollar. Lim et al. (2014) study the effects of quantitative easing (QE) policies in the US on gross financial inflows to developing countries, finding that QE have been transmitted internationally through liquidity, portfolio rebalancing, and confidence channels.

The analysis by Berge and Cao (2014) shows that a change in monetary policy at the zero-lower bound in the United States is associated with movements in a variety of asset prices abroad. Rogers et al. (2014) observe that there are important cross-country spillovers from unconventional monetary policies in the US, the UK, the euro area and Japan among these advanced economies. They find such monetary policy spillovers to be asymmetric, as the effects of the monetary policy shocks in the US economy on asset prices in the other three economies are larger than the spillovers from these countries' policies on the US. Tillmann (2014) finds that Fed's QE policies had strong effects on financial conditions in emerging markets and played an important role in explaining capital inflows, equity price and exchange rate movements in these economies.

⁵ See for example Angelini et al. (2011); Beirne et al. (2011); Gagnon et al. (2011); Joyce et al. (2011); Krishnamurthy and Vissing-Jorgensen (2011); Peersman (2011); Abbassi and Linzert (2012); Chen et al. (2012); D'Amico et al. (2012); Glick and Leduc (2012); Baumeister and Benati (2013); Krishnamurthy et al. (2014).

Aizenman et al. (2014) evaluate the impact of the Fed's tapering announcements from 2013 on financial markets in emerging economies and conclude that countries with stronger fundamentals face a larger depreciation of exchange rate, fall in stock prices and increase of CDS spreads than countries with weaker fundamentals.⁶ Eichengreen and Gupta (2014) show that countries with larger and deeper financial markets experienced more pressure on exchange rates, foreign reserves and equity prices following the Fed's tapering announcement from May 2013 as investors could better rebalancing their portfolios in a country with relatively large and liquid financial markets. In contrast with Aizenman et al. (2014) and Eichengreen and Gupta (2014), Mishra et al. (2014), find that countries with stronger macroeconomic fundamentals, deeper financial markets, and a tighter macroprudential policy stance in the run-up to the Fed's tapering announcements experienced smaller currency depreciations and smaller increases in government bond yields. Burns et al. (2014) find that a normalization of unconventional monetary policies and economic activity in high-income countries implies a significant slowdown in capital inflows (specifically portfolio investments) into emerging markets. Ahmed and Zlate (2014) report evidence of positive effects of unconventional U.S. monetary policy on portfolio inflows into emerging markets.

Two main points are apparent from the above review of the literature. Firstly, the vast majority of the papers in the literature conclude that advanced economy monetary policy does indeed have spillover effects on economic and financial variables in other countries. Secondly, a substantial proportion of the existing literature focuses on spillovers from the policies of the US Federal Reserve to emerging markets. This paper contributes to the existing literature by assessing the effects of ECB monetary policy announcements on four CEE countries, all of which feature an exceptional degree of trade and financial integration with the euro area and follow inflation targeting monetary policy regime with freely or managed floating exchange rate regimes.

3. The ECB's non-standard monetary policy measures

In response to the global financial crisis, the ECB, similarly to other central banks from major developed economies, reduced its key interest rate significantly and implemented a number of non-standard monetary policy measures which we briefly describe below.

⁶ An interpretation of these findings given by the authors is that countries with weaker fundamentals were less exposed to the inflows triggered by quantitative easing, in line with the conjecture that being closer to financial autarky provides better insulation from financial news.

Early on in the crisis and in order to support interbank money market in the euro area the ECB introduced the following measures:⁷ (i) an unlimited provision of liquidity through fixed rate tenders with full allotment (FRTPFA), allowing banks to get unlimited access to central bank liquidity at the main refinancing rate, subject to appropriate collateral; (ii) extension of the list of eligible collateral assets for refinancing operations (COLL); (iii) extension of the maturity of long-term refinancing operations (LTRO), in order to reduce uncertainty and improve liquidity conditions for banks; (iv) liquidity provision in foreign currencies through swap lines with other central banks to enhance banks' foreign currency funding (FOR).

In May 2009, the ECB modified the existing measures and added to them by adopting a new programme – the Enhanced Credit Support (ECS). The ECS included the four types of liquidity providing operations from the initial response outlined above and introduced a programme of outright purchases of covered bonds, the so-called Covered Bond Purchase Programme (CBPP1). A complementary program was announced in November 2011 (CBPP2). The goal of these programmes was to rekindle the functioning of the covered bond market in the euro area, which constitutes an important source of banks' refinancing in the euro area.

In May 2010, the ECB introduced an additional programme specially designed to restore an appropriate monetary policy transmission mechanism following tensions in the sovereign debt markets of some euro area countries. The Securities Markets Programme (SMP) involved purchases of euro area government bonds in the secondary markets, in order to ensure depth and liquidity in those market segments that were dysfunctional. Following the speech by the ECB President M. Draghi in London in July 2012, the ECB announced an Outright Monetary Transactions (OMT) programme in September 2012. The main aim of the OMT was to remove tail risk to overcome monetary and financial fragmentation of the euro area that would stem from a redenomination risk (ECB, 2012). The OMT, in contrast to all other ECB non-standard monetary policy measures implemented since the start of the global financial crisis, has never been applied.

In July 2013 the ECB changed its monetary policy communication strategy to include a form of forward guidance (FWG) as follows: “*The Governing Council expects the key ECB interest rates to remain at present or lower levels for an extended period of time.*” (ECB, 2013).

⁷ For more details, see de Haan et al. (2012).

In June 2014 the ECB announced measures, referred to as the Credit Easing package, to enhance the functioning of the monetary policy transmission mechanism by supporting lending to the real economy. In particular, the Governing Council decided to: i) conduct a series of targeted longer-term refinancing operations (TLTRO) aimed at improving bank lending to the euro area's non-financial private sector, excluding loans to households for house purchase, over a window of two years; ii) intensify preparatory work related to outright purchases of asset-backed securities (ABSPP), whose operations started in October 2014, in parallel with a new covered bond purchase programme (CBPP3).

In January 2015 the Governing Council announced the expanded Asset Purchase Programme (APP), which adds a purchase programme for public sector securities (PSPP) to the existing private sector asset purchase programmes (CBPP3 and ABSPP) to address the risks of a too prolonged period of low inflation. In particular, under the PSPP the ECB expanded its purchases to include bonds issued by euro area central governments, agencies and the European institutions. The combined monthly asset purchases amount to €60 billion until September 2016 or until the adjustment in the path of inflation is consistent with achieving inflation rates below, but close to, 2% over the medium term.

4. The international transmission of monetary policy

This section discusses the major transmission channels of international monetary policy spillovers, building on the contributions of the existing literature. More specifically, what follows is an overview of the transmission channels and a discussion of how monetary policy spillovers affect prices of the selected financial assets used in our event analysis. Our financial variables of interest include the following: (i) a bilateral nominal exchange rate vis-à-vis the euro,⁸ (ii) yields of sovereign bonds issued in local and foreign currencies, (iii) a money market interest rate, (iv) a benchmark stock market index and (v) credit-default swaps. This selection of variables is broadly comparable with Takáts and Vela (2014), who examine the impact of Fed's policies on a broader sample of emerging markets economies, including some CEE countries.

First, we elaborate on the *confidence channel*, through which monetary policy announcements, particularly those concerning non-standard measures, help to tackle market

⁸ The euro is a reference currency for all CEE countries' currencies and its weight in their respective nominal effective exchange rate ranges from 52% in Hungary to 57% in the Czech Republic and Poland.

uncertainty in the advanced economies and beyond their borders. In general, the confidence effect may influence financial assets in either direction. For instance, improved confidence in the euro area due to a monetary policy decision may induce, through expectations, capital flows reflecting both, carry trade strategies (in which higher-yield CEE assets are often targeted) and more lasting capital flows into CEE economies because of the tight trade linkages. However, the same return of confidence may also trigger reprising of risks and capital outflows from CEE countries, particularly if these are considered to be relatively safer investments during the periods of high uncertainty.⁹ Turning to the ECB programmes, we think that it is reasonable to assert that the international transmission of the OMT announcements operated via the confidence channel. As the OMT successfully reduced the perceived risk of sovereign bonds issued by stressed euro area countries thereby increasing capital inflows into those economies (ECB, 2014b),¹⁰ its announcements might have reduced the demand for CEE sovereign bonds.

Second, monetary policy spillovers may affect CEE countries through the *portfolio rebalancing channel*. Indeed, this channel may be particularly important in the case of non-standard monetary policies as these are generally designed to operate via changes in the prices and yields of domestic assets (Chinn, 2013). This may involve an international dimension, as substitute assets could also include comparable assets in other countries. More specifically, in the standard portfolio balance model, the ECB purchases of euro area short- and long-term government bonds would reduce their yields relative to comparable CEE bonds. Investors could turn to CEE assets for higher risk-adjusted returns, inducing lower bond yields and higher asset prices following the introduction of accommodative measures by the ECB (Fic, 2013; Mohanty, 2014).¹¹ We expect that the portfolio rebalancing channel could indeed be a prominent channel of transmission for the ECB announcements of non-

⁹ Whether CEE economies could be categorised as safe havens is debatable given that such a description was more typically applied to countries such as Switzerland, Sweden and Denmark during the crisis (Habib and Stracca, 2013; IMF, 2013).

¹⁰ Saka et al. (2014) show that the OMT restored confidence in the euro area sovereign markets, by signalling investors the ECB's intention to take up the function of lender of last resort.

¹¹ For comparison, Mohanty (2014) explains the spillover effect of the Fed's action on emerging markets' long-term interest rates as operating through the following channel. The US long-term rate affects both the global benchmark yield and risk appetite, which together determine the pricing of bonds issued by the emerging market economies in local and international markets. Thus, given the growing presence of foreign investors in emerging markets' local currency bond markets, the monetary policy of advanced economies is likely to have a larger effect on yield curves compared to the early 2000s. These phenomena are also likely to be relevant for CEE economies. Relatedly, Adam et al. (2014) highlight the substantial portfolio inflows to Poland and the increasing share of foreign investors as holders of sovereign debt in recent years.

standard monetary policies, especially those involving direct purchases of assets.¹² More specifically, when the ECB buys sovereign bonds issued by the governments of the stressed euro area economies, the sellers replace those bonds with securities of similar characteristics – say bank debt, resulting in increasing bank bond prices, declining yields, and thus generally more favourable refinancing conditions for banks. However, an alternative substitute asset may have been the sovereign bonds of CEE governments. As a result, purchases of stressed euro area sovereign bonds may have had an effect on the prices and yields of CEE sovereign bonds. Among other factors, the existence and magnitude of such an effect is dependent on the degree of substitutability between bonds issued by stressed euro area countries and CEE sovereign bonds.¹³

Third, the *signalling channel* is closely related to the portfolio rebalancing channel in that it also operates via changes in the prices and yields of assets. What is specific to the signalling channel, however, is that it changes expectations for future short-term policy rates. This could occur if a central bank makes a public commitment to maintain low interest rates into the future, often referred to as forward guidance. This could induce a reduction of long-term interest rates through the expectations hypothesis of the term structure (Chinn, 2013) and therefore results in changes in the interest rate differentials between countries across all maturities of bonds. In turn, this could then lead to spillovers in a similar fashion to that described above in the case of the portfolio rebalancing channel.

Fourth, within the CEE economies we see some evidence to support the assertion by Takáts and Vela (2014) that central banks in emerging markets directly respond to changes in advanced economy policy rates by changing their own policy rates.¹⁴ As domestic policy rate changes are an explanatory variable in our event study, it might raise an issue regarding endogeneity suggesting that our estimates of the spillover effects are biased downward.

¹² Eser and Schwaab (2013) provide a detailed assessment of the SMP. It should be noted that, in our analysis of the effect of the SMP, we analyse only the effects of announcements, not the effect of actual purchases.

¹³ Subject to a caveat, on which we elaborate below, we think that CEE sovereign bonds might have been considered by investors as more attractive than for instance banks' debt especially at the peak of euro area sovereign debt crisis, when the feedback loop between sovereigns and banks was particularly strong. The main reason why CEE bonds are not perfect substitutes for the euro area securities is FX risk which investor would need to carry, should they decide to purchase CEE bonds denominated in local currencies.

¹⁴ Takáts and Vela (2014) investigate whether the responsiveness of emerging market central banks to monetary policy actions in advanced economies varies between exchange rate and inflation targeting countries. Their results indicate that the correlation between US and emerging markets' policy rates is actually stronger for inflation targeting regimes than for all emerging markets taken together.

However, this is likely to relate more to conventional interest rate policy changes than to the non-standard monetary policy measures, in which case the policy response for a central bank from the CEE region seems to be less obvious. We partially address the issue of policy endogeneity through the inclusion of interaction terms controlling for occasions when the ECB and CEE central banks policies were implemented on the same day.

Fifth, in spite of the potentially endogenous response of policy rates, a major challenge facing central banks is the disruption of the conventionally understood monetary policy transmission mechanism arising from global financial integration (Hume and Sentance, 2009; Lane and Milesi-Ferretti, 2007). For instance, the opening up of financial systems and the rise in cross-border financial flows can influence domestic credit conditions through a number of channels, including via banks access to the inter-bank and money markets, as well as international bond and equity issuance (Lane and McQuade, 2014). Most notably, an increase in liquidity in the euro area following a policy action by the ECB may have relatively direct and straightforward consequences for CEE countries because of the large presence of foreign-owned banks in their local banking systems, which are controlled by parent banks domiciled almost exclusively in the euro area countries. In other words, a reduction in the interbank rate available to the parent bank is also likely to be associated with a similar reduction in the cost of funding for the subsidiary.¹⁵ Furthermore, this *international bank lending channel* is likely to be particularly important in CEE economies because of the dominance of banks in financial intermediation.

Bearing these transmission channels in mind, it is important to distinguish how monetary policy spillovers may vary depending on the specific design of the monetary policy instrument announced and/or implemented by the ECB.¹⁶ Much of the focus of this paper is on the effects of the SMP, the OMT and the PSPP announcements, primarily because of the similar nature of the three programmes (in principle they involve direct purchases of euro area sovereign bonds) and the contrasting impact that these programmes are found to have in

¹⁵ It should be noted, however, that the borrowing costs of parent banks and subsidiaries are not perfectly correlated. Furthermore, many euro area banks have sought to reduce their exposure to CEE countries by substituting domestic deposits for parent funding. To some extent, this might have been a consequence of tight funding conditions in the euro area.

¹⁶ The importance of distinguishing between different programmes is highlighted by Fratzscher et al. (2013), who find that the effect on emerging markets of US QE1 differed substantially from that of QE2. Similarly, Lim et al. (2014) illustrate that the effect of QE on emerging markets varied across asset classes with the most notable consequences observable for portfolio debt securities.

the event study, as outlined in Section 5. Conveniently these programmes are also relatively tractable in terms of identifying the channels through which they might operate.

It should also be noted that the degree of international transmission of ECB policies is likely determined by the underlying objective of these policies. The majority of non-standard monetary policy measures aimed to improve the transmission mechanism of the monetary policy in the euro area (e.g. SMP and OMT), while other measures directly addressed the risks of a too prolonged period of low inflation in the euro area at a time when the policy rate had reached its lower bound (e.g. forward guidance, PSPP). For instance, forward guidance attempted to address the latter via the signalling channel, whereby the ECB provided assurance to market participants that the central bank intends to keep the policy rate low for a longer period than initially expected by market participants. According to ECB (2014c), this policy was intended to influence investors' expectations regarding future short-term rates and, through the expectations hypothesis of the term structure of interest rates, put downward pressure on longer-term interest rates. Similarly the PSPP entails monthly purchases of euro-denominated investment-grade securities issued by euro area governments and agencies and European institutions with the expectation that such purchases will reduce euro area bond yields across instruments, maturities and issuers (ECB, 2015) with the final objective of addressing the risks of a too prolonged period of low inflation. What is important to note is that, despite the different motivation of these policies as compared to other non-standard monetary policy measures, the potential channels of their international spillovers remain the same.

5. Event-study analysis

5.1 The methodology

Our event-study analysis, through which we assess the spillovers from the ECB's monetary policy announcements on financial assets in CEE countries, uses the ordinary least squares estimation. We estimate the following country-specific equation using daily data over the period 01:01:2007 - 27:01:2015:

$$\begin{aligned} \Delta X_t = & \alpha + \beta_1 \Delta VIX_t + \beta_2 \Delta IR_t^{Dom} + \beta_3 \Delta IR_t^{ECB} + \beta_4 NSMP_t^{Dom} + \delta NSMP_t^{ECB} + \gamma NSMP_t^{US} + \\ & + \beta_5 IMF/EC_t + \lambda News_t + u_t \end{aligned} \quad (1)$$

where X_t is our dependent financial variable of interest (i.e. exchange rate vis-à-vis the euro, stock market index, 3-month interbank rate, medium- and long-term sovereign bond yields, yields of sovereign bonds denominated in foreign currency,¹⁷ 5- and 10-year CDS spread). The VIX_t is the volatility index for the euro area and we employ it to control for periods of heightened volatility in euro area financial markets, which could in turn affect financial markets in the region of our interest. The variables IR_t^{Dom} stands for the domestic central bank policy rate and IR_t^{ECB} for the ECB policy rate (see Appendix B; Table 1B). The variable $NSMP_t^{Dom}$ is a country specific event-dummy associated with announcements of non-standard monetary policy decisions by the domestic monetary policy authority (see Appendix B; Table 2B). The vector $NSMP_t^{ECB}$ contains the event-dummies related to ECB announcements of non-standard policy measures (see Appendix B; Table 3B for our classification of the ECB non-standard monetary policy measures). We use two specifications of the latter variable. First, we combine all ECB announcements regarding the various non-standard measures. Second, we build a policy-specific variable to separate the different ECB measures in line with our classification. By including the vector $NSMP_t^{US}$ we also control for spillovers from non-standard monetary policy announcements by the Fed (see Appendix B; Table 4B). As control variables we also introduce announcements related to the financial assistance programmes by the IMF and the European Commission (IMF/EC_t) in three out of four CEE countries (see Appendix B; Table 5B).¹⁸

Following the approach adopted by Altavilla and Giannone (2014), as additional control variables we introduce news stemming from releases of macroeconomic data, $News_t$, which could have affected our financial variables. A similar “controlled” event-study was recently conducted by Altavilla et al. (2014) to investigate the effects of the ECB’s OMT announcements on sovereign bond yields in euro area countries. Data on $News_t$ are collected via Bloomberg and consist of expectations of market participants about all available macroeconomic variables in the respective country. The expected values are median forecasts collected up to one day before the official data release. For each of the variables (see Appendix B; Table 6B), we compute the difference between the actual value on the day of release and its expected value. The series are standardised. They can be considered as a measure of the surprise content of the most relevant macroeconomic data releases in our

¹⁷ Appendix B; Table 7B reports the ISIN codes of the FX bonds used in our analysis.

¹⁸ These announcements concern Hungary, Poland and Romania.

countries. This procedure allows us to control for possible movements in our dependent variables that are due to unexpected changes in macroeconomic variables.

The financial variables (Appendix B, Figure 1B-9B) in equation (1) are transformed as follows. The VIX volatility index, the bilateral exchange rate vis-à-vis the euro, the stock market index, the interbank interest rate and the CDS spreads are expressed as daily percentage changes, whereas bond yields are expressed as daily basis point changes.¹⁹ For the monetary policy variables and the *IMF/EC_t* dummies we use a one-day event window.²⁰ In other words, around the event window we compute basis point changes of the policy rates, while the non-standard monetary policy dummy variables take the value one on the day of a particular announcement and zero elsewhere. Our motivation is to analyse international spillovers, which are likely to have longer transmission lag compared to policies implemented domestically. Therefore, in our view, this justifies the use of daily data rather than higher frequency (i.e. intra-day) data sometimes employed in event-studies.

5.2 The results

5.2.1 The aggregate measure of ECB's policies

When taking an aggregate view on ECB announcements by bundling together the various non-standard measures, we find spillover effects on sovereign bond yields (see Table 1).²¹ More specifically, the announcements of the ECB's non-standard monetary policy measures were associated with declining sovereign bond yields in the Czech Republic, Poland and Romania. Yields of sovereign bonds issued by Hungary are the only ones from the CEE region, which seem to be un-affected by the ECB's announcements. This may be attributable to the perceived higher riskiness of the country in comparison with its regional peers as is evident from the fact that Hungary has the lowest credit rating among CEE countries examined in this paper.

¹⁹ Specification and the data sources are reported in Appendix A.

²⁰ Alternatively we use 2-day and 3-day event windows to test for robustness of our baseline specification (see Section 5.3).

²¹ Regarding standard monetary policy, the announcements of negative changes of the key ECB policy rate in our sample coincide with a decline in sovereign bond yields denominated in local currency for Hungary and Poland. We interpret this as an evidence of carry trades, or yield-searching. We note that most of domestic and ECB monetary policy decisions on key interest rates announced during our sample period were in one direction (i.e. towards a more expansionary monetary policy stance, see Appendix B; Table 1B), which might complicate a generalisation of our results.

Table 1. Event-study analysis on ECB's monetary policy decisions (1-day window)

	ECB's non-standard policies				Domestic non-standard policies			
	CZ	HU	PL	RO	CZ	HU	PL	RO
Exchange rate	-0.05 (0.05)	0.07 (0.07)	-0.00 (0.07)	0.02 (0.04)	0.09 (0.12)	-0.31 (0.35)	-	-
Stock market index	-0.01 (0.16)	0.15 (0.23)	-0.13 (0.16)	-0.02 (0.17)	-0.25 (0.39)	0.95 (1.13)	-	-
Interbank rate (3M)	-0.12 (0.11)	0.17* (0.10)	-0.01 (0.05)	-0.45** (0.23)	0.06 (0.26)	-0.07 (0.48)	-	-
Benchmark bond yield (2/3Y; LC)	-1.84* (1.06)	0.52 (1.39)	0.10 (0.66)	-2.21 (4.90)	-1.84 (2.54)	-8.65 (6.72)	-	-
Benchmark bond yield (10Y; LC)	-1.03* (0.56)	1.13 (1.31)	-2.36*** (0.64)	-5.38*** (2.05)	-0.52 (1.35)	-12.14* (6.30)	-	-
Bond yield (FX)	-1.15*** (0.39)	-0.64 (0.87)	-0.01 (0.78)	0.81 (0.93)	-0.17 (0.93)	-11.69*** (4.21)	-	-
CDS 5-year (USD)	0.59 (0.53)	0.50 (0.38)	0.29 (0.45)	0.14 (0.32)	0.68 (1.27)	-1.89 (1.83)	-	-
CDS 10-year (USD)	0.28 (0.48)	0.38 (0.36)	-0.32 (0.40)	-0.23 (0.31)	-0.28 (1.16)	-1.87 (1.73)	-	-

Note: In addition to variables noted in the equation in Section 5.1, the regressions include two interaction terms: one for domestic and ECB key policy rate changes and the one for domestic and ECB non-standard monetary policy measures. In addition, we also include a dummy variable for the exchange rate regression for the Czech Republic in order to account for a regime change since 9 November 2013 (i.e. since when the CNB intervened and declared that the 27 CZK per EUR level is the preferred one). The δ - and β_4 coefficients from equation (1) are reported in this table jointly with standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

As all of the CEE countries included in our event analysis pursue an inflation targeting monetary policy strategy (and thus run their monetary policy independently), the ECB non-standard monetary policy should not impact the local 3-month money market rates directly, according to the policy trilemma outlined earlier. However, our aggregated control variable for ECB non-standard monetary policy announcements is statistically significant for Hungary and Romania. Interestingly, the announcements have a positive impact on the local interest rate in the former, while negative in the latter country.

As mentioned above, one spillover channel of non-standard monetary policy actions by the ECB could be through banks' liquidity (the so called international bank lending channel), as the majority of banks operating in CEE countries are owned by groups residing in the euro area. More specifically, all longer-term liquidity operations by the ECB vis-à-vis eligible counterparties in the euro area might spillover into the CEE region through the liquidity managed at the level of the banking groups. A bank operating in the CEE region could receive liquidity from its parent bank and use it to substitute for liquidity available in the local money market. This in turn would result in a lower demand for funds at the local money market and declining money market rates. Developments consistent with this channel are observed in the case of Romania, while the ECB's non-standard monetary policy announcements coincide with increasing 3-month interest rate in Hungary. In addition to the country's low credit rating, this may also reflect behaviour of parent banks domiciled in the

euro area toward their branches and subsidiaries in Hungary, particularly in response to policy measures targeting the banking sector that were introduced by Hungarian authorities during our sample period (e.g. bank levy, early repayment scheme for FX mortgages, etc.). Parent banks responded to these policies by withdrawing a significant amount of funding from their Hungarian operations.

We find that the exchange rates of CEE currencies vis-à-vis the euro seem to have been broadly insulated from the ECB announcements. Similarly, there seem to be no spillovers from the ECB's non-standard monetary policy announcements to CDS spreads. Similarly, benchmark stock market indices in CEE countries were not affected. When interpreting the latter result one should note the less developed state of equity markets compared to debt markets in CEE countries.

We also review the impact of the Fed's QE announcements, including those related to a tapering of bond purchases, on CEE countries' financial assets.²² The results are reported in Table 2. Starting with the Fed's QE announcements, we find that yields of sovereign bonds denominated in foreign currencies declined in all CEE countries, except Romania. Interestingly, yields of local currency sovereign bonds increased in Hungary and Poland. This contrasts with the spillovers from the ECB's announcements, which coincide with declining sovereign bond yields irrespective of their denomination. According to the BIS (2015), if investors treat bonds denominated in different currencies as close substitutes, purchases in one market also depress yields elsewhere. The results suggest that there may be a greater degree of substitutability between local currency denominated CEE sovereign debt and the euro area sovereign bonds as compared with dollar denominated US Treasury bonds.

Turning to the Fed's announcements related to tapering of bond purchases under its QE program, we find that almost all asset classes are impacted in at least one country, with the notable exception of the stock market index. Moreover the average impact of the Fed's tapering announcements was much higher than those of the Fed's QE, which suggests non-linear spillovers to CEE countries from the Fed's announcements.²³ These results contrast with Chen et al. (2014) because we find a larger impact for the Fed's tapering announcements

²² Due to different time zones and the timing of Fed's announcements, we investigate the behaviour of financial assets on the day following the day of announcement.

²³ Monetary policy spillovers may be non-linear in so far as larger shocks might result in disproportionately larger spillovers, or asymmetric in a sense that negative shocks have larger spillovers than positive shocks.

than for QE announcements even after controlling for uncertainty, for which we use the VIX as a proxy. Overall, we show that CEE countries were subject to monetary policy spillover effects from both the euro area and the US.

Table 2. Event-study analysis on Fed’s monetary policy decisions (1-day window)

	Fed’s QE				Fed’s tapering			
	CZ	HU	PL	RO	CZ	HU	PL	RO
Exchange rate	-0.01 (0.11)	0.14 (0.16)	0.02 (0.15)	-0.00 (0.10)	0.08 (0.18)	0.48* (0.27)	0.12 (0.25)	0.24 (0.16)
Stock market index	0.50 (0.36)	-0.46 (0.53)	0.05 (0.35)	0.16 (0.39)	-0.06 (0.60)	0.16 (0.88)	-0.14 (0.59)	-0.01 (0.64)
Interbank rate (3M)	0.00 (0.24)	0.04 (0.22)	-0.13 (0.10)	0.06 (0.52)	0.12 (0.40)	0.11 (0.37)	-0.08 (0.17)	6.46*** (0.85)
Benchmark bond yield (2/3Y; LC)	-3.03 (2.36)	-0.40 (3.15)	1.79 (1.48)	-4.01 (11.11)	-6.09 (3.95)	13.79*** (5.20)	6.25** (2.47)	0.60 (18.32)
Benchmark bond yield (10Y; LC)	0.50 (1.26)	5.10* (2.95)	2.39* (1.43)	-3.64 (4.64)	7.55*** (2.10)	10.59** (4.88)	11.09*** (2.39)	11.18 (7.65)
Bond yield (FX)	-4.52*** (0.87)	-3.46* (1.97)	-4.06** (1.76)	-0.63 (1.99)	4.34*** (1.45)	11.06*** (3.26)	2.27 (2.94)	10.24*** (3.28)
CDS 5-year (USD)	1.35 (1.18)	-0.27 (0.86)	0.19 (1.00)	-0.37 (0.72)	1.33 (1.97)	3.55** (1.41)	2.58 (1.67)	2.54** (1.18)
CDS 10-year (USD)	1.18 (1.08)	0.40 (0.81)	0.76 (0.89)	-0.36 (0.71)	1.41 (1.80)	3.72*** (1.34)	2.33 (1.49)	2.51** (1.17)

Note: In addition to variables noted in the equation in Section 5.1, the regressions include two interaction terms: one for domestic and ECB key policy rate changes and the one for domestic and ECB non-standard monetary policy measures. In addition, we also include a dummy variable for the exchange rate regression for the Czech Republic in order to account for a regime change since 9 November 2013 (i.e. since when the CNB intervened and declared that the 27 CZK per EUR level is the preferred one). The γ -coefficients from equation (1) are reported in this table jointly with standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Authors’ calculations.

In order to assess the relative size of spillovers from the ECB and Fed’s policies on financial assets in CEE countries we modify equation (1) by introducing each of the $NSMP_t^{ECB}$ and $NSMP_t^{US}$ events as a unique variable. We then compute the sum of changes on the announcement days and run an F-test for abnormal returns. For comparability, in the variable $NSMP_t^{ECB}$ we include only those programmes that involve purchases of sovereign assets, namely the SMP, the OMT and the PSPP.

When comparing the cumulative impact of spillovers, we conclude that spillovers from the Fed’s policy announcements on bond yields were of a similar magnitude to those associated with ECB announcements, but the former impacted yields of sovereign bonds denominated in foreign currencies, while the latter yields of sovereign bonds denominated in local CEE currencies.²⁴ On average, the spillovers from the Fed’s QE announcements are lower given

²⁴ We note that Fed’s QE announcements are associated with increasing yields of sovereign bonds denominated in local currencies in Hungary and Poland. We interpret this as an endogenous result of the investors’ shift towards bonds denominated in foreign currencies around Fed’s announcements. The results for the Czech Republic and Romania do not exhibit the same pattern. A further investigation of potential determinants of these responses is needed to support our intuition. We note however that Fratzscher et al. (2013) find a relatively muted impact of Fed’s QE2 on yields worldwide, reflecting a large portfolio rebalancing from the global bond markets into the emerging market equities.

the higher number of events as compared to the ECB's announcements. This result is in line with the greater degree of integration between the euro area and CEE economies noted above. At the same time, the magnitude of the cumulative effect of the tapering announcements is similar to that of the QE announcements despite the lower number of the former, with the largest impact is observed in the case of Hungarian bond yields. It is notable that spillovers from the Fed's tapering announcements affected more asset classes than those of Fed's QE.

5.2.2 The systematic measures of ECB's policies

In our baseline model a dummy variable tracking announcements of non-standard monetary policies by the ECB bundles together the various policies over our sample period. In order to account for the fact that the ECB had announced and implemented various non-standard measures with different objectives, which in turn could imply qualitatively and quantitatively different monetary policy spillovers to CEE countries, we run two additional exercises. In the first one we estimate our baseline model using rolling windows of one year over our sample period.²⁵ Figures 11B-14B in Appendix B plot our estimated coefficient for the $NSMP_t^{ECB}$ variable over such a rolling window for all financial assets separated by country. The following eight major ECB's announcements are highlighted in the charts to ease the interpretation: 1) the initial 6-month LTROs (28/03/2008); 2) Enhanced Credit Support (CBBB and the initial 1-year LTROs; 07/05/2009); 3) SMP (10/05/2010); 4) Announcement of the active implementation of the SMP (08/08/2011); 5) 3-year LTROs (08/12/2011); 6) Draghi's "London speech" (26/07/2012); 7) TLTROs (05/06/2014); 8) Draghi's speech at the European Parliament (17/11/2014). This simple exercise confirms our assertion that spillovers from ECB's announcements have varied across the different measures announced by the ECB. In particular, the announcement of the SMP (event labelled as #3) seems to have had a significant influence on most of our financial variables, especially bond yields and CDS spreads.

²⁵ Figure 10B in Appendix B plots the number of ECB announcements of non-standard monetary policies using our preferred one-year window for the rolling regression over our sample. In order to test how sensitive is our indicator to different length of rolling window we also show two additional lines corresponding to the number of events for both, the shorter and the longer window length for rolling regression (± 100 days). Results are broadly comparable with the baseline specification using one-year window.

Table 3. Cumulative effect of ECB's and Fed's monetary policy decisions (1-day window)

	ECB's sovereigns purchase measures (9 events)				Fed's QE measures (14 events)				Fed's tapering (4 events)			
	CZ	HU	PL	RO	CZ	HU	PL	RO	CZ	HU	PL	RO
Exchange rate	-2.92**	-2.43	-4.36**	0.44	-0.37	1.98	-0.22	-0.14	0.48	2.90**	0.76	0.95
Stock market index	-3.75	-4.03	-0.85	-5.78	7.50	-6.52	1.20	2.17	0.39	-0.33	-2.15	0.28
Interbank rate (3M)	-2.48	-0.64	0.38	-17.04***	0.10	0.64	-1.73	0.81	0.39	0.51	-0.38	30.17***
Benchmark bond yield (2/3Y; LC)	-20.55	-60.57*	-39.40**	-82.03	-44.42	-2.88	25.44	-75.92	5.23	73.23***	32.91***	0.41
Benchmark bond yield (10Y; LC)	15.04	-73.19**	-34.69**	-100.00*	8.02	82.59**	35.61*	-32.64	35.41***	58.35***	53.06***	55.65
Bond yield (FX)	-6.99	7.03	-20.18	-32.04	-64.37***	-52.45*	-58.80**	-13.90	18.38***	54.16***	14.15	49.98***
CDS 5-year (USD)	-33.58**	-20.66**	-26.02**	-24.86***	18.72	-4.11	1.56	-4.67	6.63	18.81***	10.95	12.71**
CDS 10-year (USD)	-33.71***	-21.62**	-23.85**	-25.23***	16.42	4.51	9.96	-4.43	6.22	19.59***	10.49	12.92**

Note: The table reports the sum of changes on the announcement days of ECB's and Fed's monetary policy decisions based on a 1-day event window. The ECB's sovereigns purchase measures include SMP, OMT and PSPP events. *, **, and *** denote significance of the F-test for abnormal return at 10%, 5%, and 1%, respectively. In addition to variables noted in the equation in Section 3.1, the regressions include two interaction terms: one for domestic and ECB key policy rate changes and the one for domestic and ECB non-standard monetary policy measures. In addition, we also include a dummy variable for the exchange rate regression for the Czech Republic in order to account for a regime change since 9 November 2013 (i.e. since when the CNB intervened and declared that the 27 CZK per EUR level is the preferred one).

Source: Authors' calculations.

In order to provide further evidence, we conduct a second exercise, which consists of estimating our baseline model over the whole sample with systemised $NSMP_t^{ECB}$ variables, including comparable non-standard monetary policy measures by the ECB. The results confirm that the spillovers from ECB announcements into CEE financial assets varied across different non-standard monetary policy measures (see Tables 8B-11B, Appendix B). The events relating to the provision of long-term refinancing operations (LTRO) and unlimited provision of liquidity through fixed rate tenders with full allotment (FRTPFA), resulted in decline of bond yields in the Czech Republic and Hungary. Similarly, the announcements on liquidity provisions in foreign currency (FOR) and forward guidance (FWG) spilled over to Czech and Polish 10-year bond yields. The announcements of the remaining measures resulted in some spillover effects on financial assets.

Among the ECB non-standard monetary policy measures which involve purchases of sovereign bonds (Table 4), the SMP announcements seem to have had the most pronounced spillovers on financial assets in CEE countries. Conversely, the OMT announcements seem to induce rather limited spillovers into CEE countries. Interestingly, no statistically significant coefficient is found for events related to the recently announced PSPP.

Table 5 shows the results in cumulative terms for ECB policies which involve purchases of sovereign securities. We show that the SMP announcements are associated with significant spillovers leading to appreciation of local currencies vis-à-vis the euro (in the Czech Republic, Hungary and Poland), declining stock market indices,²⁶ bond yields²⁷ and credit-default spreads (CDS). As regards the OMT announcements, we find only weak spillover effects on the Czech, the Polish and the Romanian sovereign bond yields, while the PSPP announcements seem to have had even more limited spillovers on financial assets across CEE countries. These results remain unchanged, when we focus on the key event for each ECB measure.

²⁶ While declining stock prices in response to the SMP announcements are somewhat counterintuitive, similar findings are reported in Fratzscher et al. (2014) and Georgiadis and Gräß (2015) for emerging market economies as a whole.

²⁷ Bond yields in the Czech Republic are however un-affected by the SMP announcements.

Table 4. Event-study analysis on ECB's monetary policy decisions (SMP, OMT and PSPP, 1-day window)

	SMP				OMT				PSPP			
	CZ	HU	PL	RO	CZ	HU	PL	RO	CZ	HU	PL	RO
Exchange rate	-1.10*** (0.29)	-0.73* (0.43)	-1.04*** (0.40)	0.09 (0.25)	-0.28 (0.24)	-0.30 (0.36)	-0.27 (0.33)	0.23 (0.21)	0.05 (0.21)	0.02 (0.31)	-0.34 (0.29)	-0.09 (0.18)
Stock market index	-2.58*** (0.97)	-4.16*** (1.41)	-2.02** (0.94)	-4.58*** (1.04)	-0.53 (0.79)	0.20 (1.16)	-0.11 (0.79)	0.72 (0.85)	0.78 (0.69)	0.87 (1.01)	0.78 (0.68)	0.38 (0.74)
Interbank rate (3M)	-1.04 (0.65)	-0.41 (0.60)	-0.23 (0.28)	-7.12*** (1.37)	-0.00 (0.53)	0.01 (0.49)	0.07 (0.23)	-0.13 (1.12)	-0.00 (0.47)	0.05 (0.43)	0.17 (0.20)	-0.52 (0.98)
Benchmark bond yield (2/3Y; LC)	-3.77 (6.38)	-28.15*** (8.40)	-12.35*** (3.97)	-36.85 (29.66)	-3.98 (5.22)	-0.05 (6.90)	-3.38 (3.33)	-1.11 (24.36)	-0.35 (4.56)	-0.75 (6.02)	-0.63 (2.85)	0.16 (21.24)
Benchmark bond yield (10Y; LC)	1.30 (3.40)	-31.50*** (7.86)	-3.91 (3.84)	-49.79*** (12.33)	2.57 (2.78)	-1.15 (6.45)	-5.23 (3.23)	1.40 (10.12)	0.75 (2.43)	-1.37 (5.63)	-2.26 (2.76)	0.50 (8.83)
Bond yield (FX)	0.19 (2.35)	-7.86 (5.27)	-8.24* (4.73)	-3.95 (5.32)	-3.82** (1.92)	-0.75 (4.33)	-1.45 (3.97)	-8.16* (4.35)	0.64 (1.68)	4.52 (3.77)	0.32 (3.39)	0.23 (3.79)
CDS 5-year (USD)	-13.53*** (3.19)	-10.95*** (2.27)	-12.00*** (2.68)	-10.27*** (1.90)	-2.21 (2.61)	-0.31 (1.87)	-0.81 (2.25)	0.01 (1.56)	0.76 (2.28)	0.76 (1.63)	0.71 (1.92)	-1.08 (1.36)
CDS 10-year (USD)	-13.06*** (2.91)	-11.17*** (2.14)	-11.55*** (2.39)	-10.47*** (1.87)	-2.62 (2.38)	-0.45 (1.76)	-0.21 (2.00)	-0.24 (1.54)	0.73 (2.08)	0.74 (1.54)	0.53 (1.71)	-0.82 (1.34)

Note: In addition to variables noted in the equation in Section 5.1, the regressions include two interaction terms: one for domestic and ECB key policy rate changes and the one for domestic and ECB non-standard monetary policy measures. In addition, we also include a dummy variable for the exchange rate regression for the Czech Republic in order to account for a regime change since 9 November 2013 (i.e. since when the CNB intervened and declared that the 27 CZK per EUR level is the preferred one). The δ -coefficients from equation (1) for the respective ECB non-standard monetary policy measure are reported in this table jointly with standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 **Source:** Authors' calculations.

Table 5. Cumulative effect of ECB's monetary policy decisions

	SMP (2 events)				OMT (3 events)				PSPP (4 events)			
	CZ	HU	PL	RO	CZ	HU	PL	RO	CZ	HU	PL	RO
Exchange rate	-2.29***	-1.48**	-2.16***	0.17	-0.90	-0.87	-0.83	0.68	0.24	-0.08	-1.39	-0.42
Stock market index	-5.16***	-8.56***	-4.09**	-9.20***	-1.92	0.50	-0.35	1.76	3.26	4.02	3.64	1.51
Interbank rate (3M)	-2.10	-0.87	-0.48	-15.24***	-0.42	0.05	0.20	-0.44	-0.08	0.18	0.65	-1.48
Benchmark bond yield (2/3Y; LC)	-8.27	-58.33***	-25.28***	-79.77	-11.13	-1.05	-10.66	-5.34	-1.07	-1.61	-3.70	1.67
Benchmark bond yield (10Y; LC)	2.77	-65.28***	-8.71	-105.12***	8.10	-3.94	-16.27*	0.49	4.47	-4.31	-9.85	2.69
Bond yield (FX)	0.37	-17.13	-17.49*	-8.61	-10.35*	-1.55	-4.50	-26.06**	3.35	26.57*	1.64	1.98
CDS 5-year (USD)	-28.74***	-22.96***	-25.20***	-21.49***	-7.46	-1.23	-3.51	-0.32	1.92	3.34	2.10	-3.20
CDS 10-year (USD)	-27.76***	-23.45***	-24.28***	-21.93***	-8.78	-1.65	-1.42	-1.11	2.16	3.29	1.41	-2.37
	SMP announcement (10 May 2010)				OMT (Draghi's speech, 26 July 2012)				PSPP announcement (22 January 2015)			
	CZ	HU	PL	RO	CZ	HU	PL	RO	CZ	HU	PL	RO
Exchange rate	-1.99***	-0.99	-1.80***	0.09	-0.30	-0.57	-0.33	-0.13	0.21	-0.46	-0.50	-0.29
Stock market index	-2.62*	-6.60***	-2.46*	-5.06***	0.14	0.36	-0.46	1.73	1.189	2.79	2.62*	0.30
Interbank rate (3M)	-1.16	-0.88	-0.48	-17.13***	0.06	-0.08	0.10	-0.27	-0.24	0.02	0.05	1.56
Benchmark bond yield (2/3Y; LC)	-11.07	-48.70***	-18.69***	-97.53**	-2.64	2.06	-6.61	-0.01	0.90	4.05	-4.79	3.81
Benchmark bond yield (10Y; LC)	3.03	-54.66***	-13.56**	-105.21***	-0.64	-1.54	-12.18**	1.40	5.86	2.76	-5.12	2.90
Bond yield (FX)	0.18	-22.13***	-19.16***	-9.45	-7.62**	-0.73	-0.52	-3.71	3.28	34.02***	1.63	3.99
CDS 5-year (USD)	-30.39***	-21.75***	-25.00***	-19.86***	-1.49	-2.06	-0.25	-1.21	-3.02	1.85	-1.83	2.83
CDS 10-year (USD)	-29.60***	-22.42***	-24.36***	-20.40***	-1.64	-2.18	-1.09	-1.30	-1.92	1.84	-1.91	2.29

Note: The upper part of the table reports the sum of changes on the announcement days of ECB's monetary policy decisions based on a 1-day event window. *, **, and *** denote significance of the F-test for abnormal return at 10%, 5%, and 1%, respectively. The lower part of the table reports the coefficient on the announcement day of ECB's monetary policy decisions based on a 1-day event window with *, **, and *** denoting significance of a *t*-test at 10%, 5%, and 1%, respectively. In addition to variables noted in the equation in Section 5.1, the regressions include two interaction terms: one for domestic and ECB key policy rate changes and the one for domestic and ECB non-standard monetary policy measures. In addition, we also include a dummy variable for the exchange rate regression for the Czech Republic in order to account for a regime change since 9 November 2013 (i.e. since when the CNB intervened and declared that the 27 CZK per EUR level is the preferred one). **Source:** Authors' calculations.

5.2.3 Channels of transmission

Focusing on the reaction of sovereign bond yields, we assume that the main channel of transmission of spillovers from ECB's announcements of non-standard monetary policy measures was the portfolio rebalancing channel.²⁸ This would imply that investors purchase CEE sovereign bonds in exchange for sovereign bonds of euro area countries targeted by the ECB's actions, which would result in lower yields of these bonds. One can also define the portfolio rebalancing channel more broadly. For instance, Klitgaard and Lucca (2015) emphasise the importance of the Lucas tree asset pricing model (Lucas, 1978) when discussing potential channels of monetary policy spillovers across borders. In such a model it is possible for asset prices to change in response to new information without any transaction taking place. This implies that spillovers can arise due to policy announcements and not only as a flow effect when the actual purchases are being made.

Of the ECB programmes involving direct purchases of sovereign assets, only the results for the SMP provide strong evidence of lower yields in response to the ECB announcements. The results for the OMT and the PSPP announcements show virtually no reaction. Although this suggests that spillovers to financial assets of the ECB announcements of the latter two programmes were limited, it cannot be excluded that CEE countries were affected via other channels (e.g. confidence, signalling channel).

We follow Fratzscher et al. (2014) when investigating the presence of the confidence channel of transmission, through which the impact of the ECB's announcements spills over into CEE countries. We conduct an event-study around the SMP, the OMT, and the PSPP events using the euro area volatility index (ΔVIX_t) as dependent variable. The results (Table 6), suggest that the OMT and the PSPP events are associated with declining volatility, which in turn could be interpreted as declining uncertainty and/or improving confidence in the euro area. In contrast, the SMP announcements show no impact. Given the lack of indices tracking volatility in CEE countries and building on the existent high degree of economic and financial integration of the region with the euro area and a relatively smaller size of CEE countries compared with the euro area, we believe that a general level of uncertainty in CEE

²⁸ In general, identifying channels of international transmission of monetary policy empirically is challenging, especially for countries with relatively limited availability of data. One option to test for the portfolio rebalancing channel more directly would be to employ high frequency data on capital flows. We use daily funds flows into bonds and stocks from the EPFR dataset. The results (not reported in this paper) are generally inconclusive.

countries and the euro area are highly and positively correlated. This leads us to conclude that the confidence channel is likely to have played a role in the transmission of spillovers from the OMT and the PSPP announcements.

Table 6. Testing for the confidence and the signalling channels (1-day window)

	Euro area VIX	Euro area inflation-linked swap rate		Euro area implied forward inflation-linked swap rates		
		5-year	10-year	1-year rate 4 years ahead	1-year rate 9 years ahead	5-year rate 5 years ahead
SMP (2 events)	-5.32 (-3.68)	0.02 (0.02)	0.02 (0.01)	0.05*** (0.02)	0.01 (0.02)	0.01 (0.01)
Announcement (10 May 2010)	-	0.10*** (0.02)	0.08*** (0.02)	0.11*** (0.03)	0.04 (0.03)	0.06*** (0.02)
OMT (3 events)	-10.04*** (-3.01)	0.00 (0.01)	-0.00 (0.01)	0.01 (0.01)	-0.01 (0.02)	-0.00 (0.01)
Draghi's speech (26 July 2012)	-	0.01 -0.02	0.01 -0.02	0.01 -0.03	0.03 -0.03	0.01 (0.02)
PSPP (4 events)	-5.44** (-2.61)	0.01 (0.01)	0.01 (0.01)	0.02 (0.01)	0.00 (0.01)	0.01 (0.01)
Announcement (22 January 2015)	-	0.07*** (0.02)	0.07*** (0.02)	0.11*** (0.03)	0.07** (0.03)	0.07*** (0.02)

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

Similarly, we use selected financial variables tracking inflation expectations in the euro area to directly test for the presence of the signalling channel.²⁹ Looking at all events by respective ECB programmes, we find only weak evidence as inflation expectations only reacted to the SMP announcements (Table 6). This evidence becomes stronger if we look at the key announcements per programme. We conclude that the SMP and the PSPP announcements by providing a signal of additional monetary policy stimulus helped increase inflation expectations in the euro area.

5.3 Robustness checks

A general limitation associated with event-study analyses is that it is necessary to assume that financial markets are (information) efficient, i.e. the majority of the impact of ECB monetary policy measures on financial assets of CEE countries does not occur when operations are actually implemented, but when market expectations about those measures are formed. Hence, the choice of the event window length is crucial, since it involves a trade-off between keeping the interval narrow to avoid the noise produced by extraneous information, and choosing a wider window to identify potential delayed reactions of market participants.

²⁹ A similar analysis, but using inflation-linked euro area government bonds, is conducted by Georgiadis and Gräß (2015).

Moreover, asset prices abroad may react more slowly to ECB monetary policy decisions compared to euro area asset prices. For these reasons, we test the robustness of the results obtained from our baseline model by extending our event window to two and three days respectively. Our main results remain the same, although we find some evidence of a delayed response of financial markets for particular asset classes, such as the exchange rate vis-à-vis the euro and bond yields.³⁰

It could be argued that only the surprise component of the ECB announcements should be expected to have contemporaneous asset-price effects, in either the euro area or CEE economies because, if the market already foresees announcement of new policies, this should already be reflected in asset prices prior to the announcement. Therefore, as a robustness test to our baseline specification using a binary dummy variable for the ECB announcements, we construct a variable which could capture the size of monetary policy surprise stemming from ECB announcements. Following Rogers et al. (2014), we use the daily change in the Italian-German 10-year sovereign bond yield spread on the day of the announcement. As most of ECB non-standard monetary policy measures were motivated by improving the transmission mechanism of monetary policy, if deemed successful, one should observe a compression of the Italian-German sovereign bond yield spread. The magnitude of this compression reflects the size of the surprise component stemming from the respective announcement. The estimates (see Appendix C) generally confirm our baseline results obtained using the binary dummy variable.

6 Concluding remarks

This paper studies the international transmission of the ECB monetary policy. More specifically, we investigate whether the ECB's announcements of non-standard monetary policy measures spilled over to non-euro area EU countries from Central and Eastern Europe. We focus on four CEE countries that follow an inflation targeting monetary policy strategy with either freely floating exchange rate, or managed floating, namely the Czech Republic, Hungary, Poland, and Romania.

We conduct a comprehensive event-study to investigate spillovers on a set of financial assets of the CEE economies. We find strong evidence of spillovers of the ECB monetary policy to CEE countries on sovereign bond yields. Turning to specific programmes we show that the

³⁰ These results are not reported here for the sake of brevity, but are available upon request.

SMP announcements had substantial spillover effects, while the OMT and the PSPP announcements seem to have had significantly more limited spillover effects on CEE countries. Turning to the transmission channels of these spillovers, we argue that for the SMP announcements the portfolio rebalancing and the signalling channels played a key role. The OMT has impacted CEE countries indirectly, mainly through the confidence channel – by reducing the perceived redenomination risk within the euro area – without resulting in cross-border spillovers. Regarding the PSPP, we find evidence that it operated via both the confidence and the signalling channels.

We see two avenues for future research. The first is to quantify the macroeconomic effects of spillovers from the ECB monetary policy on the CEE region. The second is to extend our event-study analysis to other European countries, including both emerging and developed economies.

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APPENDIX A: The data sources

- **Spot exchange rate vis-à-vis the euro:** expressed as the number of local currency units per euro. Source: Bloomberg.
- **Stock market indices.** Source: Bloomberg.
- **3-month interbank rate.** Source: Thomson Reuters – Datastream.
- **Benchmark bond yields (2/3- and 10-year maturity).** Source: Thomson Reuters – Datastream.
- **Yields of bonds denominated in foreign currency:** see Tables 7B in Appendix B for the bonds used in the analysis. For Hungary and Poland we use the first principal component of the yields of different bonds. Source: Bloomberg.
- **CDS spreads (5- and 10-year).** Source: Thomson Reuters – Datastream.
- **Euro VIX (volatility index).** Source: Thomson Reuters – Datastream.
- **Macroeconomic news,** as reported in Table 6B in Appendix B. Source: Bloomberg.

APPENDIX B: Other tables and figures

Table 1B. Number of changes in key central bank policy rates (January 2007 - January 2015)

	Negative changes	Positive changes	Total number of changes
ECB	14	6	20
CZ	11	5	16
HU	40	9	49
PL	15	13	28
RO	27	7	34

Table 2B. Domestic unconventional monetary policy measures

Date	Country	Description
27/09/2012	CZ	FX Interventions: Possible and Preferred non-standard instrument.
01/11/2012	CZ	Forward Guidance: Rates maintained until inflation pressures "rise significantly".
28/03/2013	CZ	FX Interventions: Possibility highlighted.
04/04/2013	HU	The Monetary Council launches the Funding for Growth Scheme (FGS) of the MNB.
30/04/2013	HU	Details of the FGS were approved by the Monetary Council.
01/08/2013	CZ	FX Interventions: Increased Likelihood.
07/11/2013	CZ	FX Intervention: Begin, target CZK 27/EUR.
17/12/2013	CZ	The Board decided to continue using the exchange rate as an additional instrument for easing the monetary conditions.
06/02/2014	CZ	The Board decided to continue using the exchange rate as an additional instrument for easing the monetary conditions.
27/03/2014	CZ	The Board decided to continue using the exchange rate as an additional instrument for easing the monetary conditions.
07/05/2014	CZ	The Board decided to continue using the exchange rate as an additional instrument for easing the monetary conditions.
26/06/2014	CZ	The Board decided to continue using the exchange rate as an additional instrument for easing the monetary conditions.
31/07/2014	CZ	The Board decided to continue using the exchange rate as an additional instrument for easing the monetary conditions.

Table 3B. ECB monetary policy measures (January 2007 - January 2015)

Date	Description	Policy rate change	Type
08/03/2007	GovC meeting	0.25	
06/06/2007	GovC meeting	0.25	
22/08/2007	Supplementary LTROs	0	LTRO
06/09/2007	GovC meeting, supplementary LTROs	0	LTRO
08/11/2007	GovC meeting, renewal of suppl. LTROs	0	LTRO
10/01/2008	GovC meeting, US dollar liquidity providing operations	0	FOR
07/02/2008	GovC meeting, renewal of two suppl. LTROs	0	LTRO
11/03/2008	The GovC decided to conduct US dollar liquidity providing operations	0	FOR
28/03/2008	The GovC decided to conduct supplementary 6-month LTROs	0	LTRO
02/05/2008	The GovC decided to enhance US dollar liquidity providing operations	0	FOR
03/07/2008	GovC meeting	0.25	
30/07/2008	The GovC decided to enhance US dollar liquidity providing operations	0.25	FOR
31/07/2008	The GovC decide to renew two LTROs	0	LTRO

04/09/2008	GovC meeting, renewal of two LTROs	0	LTRO
18/09/2008	The GovC decided to enhance US dollar liquidity providing operations	0	FOR
26/09/2008	The GovC decided to enhance US dollar liquidity providing operations	0	FOR
29/09/2008	The GovC decided to double the temporary swap lines with the Fed	0	FOR
07/10/2008	The GovC decided to enhance a LTROs and expand US dollar liquidity providing operations	0	FOR, LTRO
08/10/2008	The GovC decided to adopt a fixed rate tender procedure with full allotment	-0.5	FRTFPA
13/10/2008	The GovC decided to conduct US dollar liquidity providing operations	0	FOR
15/10/2008	The GovC decided to expand the list of assets eligible as collateral, enhance the provision of LTROs, and provide US dollar liquidity through forex swaps	0	COLL, FOR, LTRO
06/11/2008	GovC meeting	-0.5	
04/12/2008	GovC meeting	-0.75	
18/12/2008	The GovC decided that the MROs will continue to be carried out through FRTFA for as long as needed	0	FRTFPA
19/12/2008	The GovC decided to continue conducting US dollar liquidity providing operations	0	FOR
15/01/2009	GovC meeting	-0.5	
03/02/2009	The GovC decided to extend the temporary swap lines with the Fed	0	FOR
05/03/2009	GovC meeting, the GovC decided to continue the FRTFA for MROs and LTROs for as long as needed	-0.5	FRTFPA, LTRO
19/03/2009	The GovC decided to continue conducting US dollar liquidity providing operations	0	FOR
02/04/2009	GovC meeting	-0.25	
06/04/2009	The GovC decided to establish a temporary reciprocal currency arrangement with the Fed	0	FOR
07/05/2009	GovC meeting. The GovC decided to proceed with the ECS. In particular, the GovC decided to purchase euro-denominated covered bonds issued in the euro area, and to conduct liquidity providing LTROs with a maturity of one year	-0.25	CBPP, LTRO
04/06/2009	GovC meeting, The GovC decided upon the technical modalities of CBPP1	0	CBPP
25/06/2009	The GovC decided to extend the liquidity swap arrangements with the Fed	0	FOR
24/09/2009	The GovC decided to continue conducting US dollar liquidity providing operations	0	FOR
03/12/2009	GovC meeting. The GovC decided to continue conducting its MROs as FRTFA for as long as needed, and to enhance the provision of LTROs	0	FRTFPA, LTRO
04/03/2010	GovC meeting. The GovC decided to continue conducting its MROs as FRTFA for as long as needed, and to enhance the provision of LTROs	0	FRTFPA, LTRO
10/05/2010	The GovC decided to proceed with the SMP, to reactivate the temporary liquidity swap lines with the Fed, to adopt a FRTFPA in the regular 3-month LTROs, and to conduct new special LTROs	0	FOR, LTRO, SMP
10/06/2010	GovC meeting. The GovC decided to adopt a FRTFPA in the regular 3-month LTROs	0	LTRO
02/09/2010	GovC meeting. The GovC decided to continue to conduct its MROs as FRTFPA for as long as necessary, and to conduct 3-month LTROs as FRTFPA	0	FRTFPA, LTRO
02/12/2010	GovC meeting. The GovC decided to continue to conduct its MROs as FRTFPA for as long as necessary, and to conduct 3-month LTROs as FRTFPA	0	FRTFPA, LTRO
17/12/2010	The ECB announced a temporary swap facility with the Bank of England	0	FOR
21/12/2010	The GovC decided to extend the liquidity swap arrangements with the Fed	0	FOR
03/03/2011	GovC meeting. The GovC decided to continue to conduct its MROs as FRTFPA for as long as necessary, and to conduct 3-month LTROs as FRTFPA	0	FRTFPA, LTRO
07/04/2011	GovC meeting	0.25	
09/06/2011	GovC meeting. The GovC decided to continue to conduct its MROs as FRTFPA for as long as necessary, and to conduct 3-month LTROs as FRTFPA	0	FRTFPA, LTRO
29/06/2011	The GovC decided to extend the liquidity swap arrangements with the Fed	0	FOR
07/07/2011	GovC meeting	0.25	
04/08/2011	GovC meeting. The GovC decided to continue to conduct its MROs as FRTFPA for as long as necessary, to conduct 3-month LTROs as FRTFPA, and to conduct	0	FRTFPA, LTRO

	a liquidity providing supplementary LTRO with a maturity of 6 months as a FRTPFPA		
08/08/2011	The GovC decided to actively implement its SMP for Italy and Spain	0	SMP
25/08/2011	The GovC decided to extend the liquidity swap arrangements with the BoE	0	FOR
15/09/2011	The GovC decided to conduct 3 US dollar liquidity-providing operations in coordination with other central banks	0	FOR
06/10/2011	GovC meeting. The GovC decided to continue conducting its MROs as FRTFA for as long as needed, to conduct 3-month LTROs as FRTPFPA, to conduct 2 liquidity-providing supplementary LTROs with a maturity of 12 and 13 months as FRTPFPA, and to launch a new covered bond purchase program (CBPP2).	0	CBPP, FRTPFPA, LTRO
03/11/2011	GovC meeting. The GovC decided upon the technical modalities of CBPP2	-0.25	CBPP
30/11/2011	The GovC decided in cooperation with other central banks the establishment of a temporary network of reciprocal swap lines	0	FOR
08/12/2011	GovC meeting. The GovC decided to conduct 2 LTROs with a maturity of 3 years and to increase collateral availability	-0.25	COLL, LTRO
21/12/2011	Results of first 3-year LTRO	0	LTRO
09/02/2012	GovC meeting. The GovC approved specific national eligibility criteria and risk control measures for the temporary acceptance in a number of countries of additional credit claims as collateral in Eurosystem credit operations	0	COLL
28/02/2012	Results of second 3-year LTRO	0	LTRO
06/06/2012	GovC meeting. The GovC decided to continue to conduct its MROs as FRTPFPA for as long as necessary, and to conduct 3-month LTROs as FRTPFPA	0	FRTPFPA, LTRO
22/06/2012	The GovC took further measures to increase collateral availability for counterparties	0	COLL
05/07/2012	GovC meeting	-0.25	
26/07/2012	Draghi's London speech "... whatever it takes ..."	0	OMT
02/08/2012	GovC meeting. The GovC announced that it may undertake outright open market operations of a size adequate to reach its objective	0	OMT
06/09/2012	GovC meeting. The GovC announced the technical details of OMTs and decided on additional measures to preserve collateral availability	0	COLL, OMT
12/09/2012	The GovC decided to extend the liquidity swap arrangement with the BoE	0	FOR
06/12/2012	GovC meeting. The GovC decided to continue conducting its MROs as FRTPFPA for as long as necessary, and to conduct 3-month LTROs as FRTPFPA	0	FRTPFPA, LTRO
13/12/2012	The GovC decided to extend the liquidity swap arrangements with the Fed	0	FOR
21/02/2013	The GovC decided to publish the Eurosystem's holdings of securities acquired under the Securities Markets Programme (SMP)	0	SMP*
07/03/2013	GovC meeting	0	
22/03/2013	Collateral rule changed for some uncovered gov-guaranteed bank bonds	0	COLL
02/05/2013	GovC meeting. The GovC of the European Central Bank (ECB) has today decided to continue conducting its main refinancing operations (MROs) as fixed rate tender procedures with full allotment for as long as necessary, and at least until the end of the 6th maintenance period of 2014 on 8 July 2014. The GovC has decided to conduct the three-month longer-term refinancing operations (LTROs) as fixed rate tender procedures with full allotment.	-0.25	FRTPFPA, LTRO
16/09/2013	The GovC has decided, in agreement with the Bank of England, to extend the liquidity swap arrangement with the Bank of England	0	FOR
04/07/2013	The Governing Council expects the key ECB interest rates to remain at present or lower levels for an extended period of time. (Draghi's press conference)	0	FWG
31/10/2013	ECB establishes standing swap arrangements with other central banks	0	FOR
07/11/2013	GovC meeting. The GovC decided on 7 November 2013 to continue conducting its main refinancing operations (MROs) as fixed rate tender procedures with full allotment for as long as necessary, and at least until the end of the 6th maintenance period of 2015 on 7 July 2015. Furthermore, the GovC has decided to conduct the three-month longer-term refinancing operations (LTROs) as fixed rate tender procedures with full allotment.	-0.25	FRTPFPA, LTRO
09/01/2014	GovC meeting	0	
06/02/2014	GovC meeting	0	
06/03/2014	GovC meeting	0	

03/04/2014	GovC meeting	0	
08/05/2014	GovC meeting. “The Governing Council is comfortable with acting next time”* (Draghi’s press conference)	0	
05/06/2014	GovC meeting. The GovC furthermore decided to conduct a series of targeted longer-term refinancing operations (TLTROs) aimed at improving bank lending to the euro area non-financial private sector, excluding loans to households for house purchase. The GovC decided to continue conducting the Eurosystem’s main and three-month longer-term refinancing operations as fixed rate tender procedures with full allotment for as long as necessary. The GovC decided to extend the existing eligibility of additional assets as collateral, notably under the additional credit claims framework, at least until September 2018, and to intensify preparatory work related to outright purchases of asset-backed securities (ABS).	-0.10	LTRO, FRTPFA, COLL, TLTRO, ABSPP
17/06/2014	The GovC decided to continue offering seven-day US dollar liquidity-providing operations	0	FOR
03/07/2014	GovC meeting. The GovC decided on further technical details for the series of targeted longer-term refinancing operations (TLTROs)	0	TLTRO
29/07/2014	ECB publishes legal act relating to targeted longer-term refinancing operations	0	TLTRO
07/08/2014	GovC meeting	0	
04/09/2014	GovC meeting. The GovC decided to purchase a broad portfolio of simple and transparent asset-backed securities (ABSs) with underlying assets consisting of claims against the euro area non-financial private sector under an ABS purchase programme (ABSPP). The GovC also decided that the Eurosystem would purchase a broad portfolio of euro-denominated covered bonds issued by MFIs domiciled in the euro area under a new covered bond purchase programme (CBPP3). The interventions will start in October 2014.	0.10	CBPP, ABSPP
18/09/2014	The ECB allots €2.6 billion in first targeted longer-term refinancing operation	0	TLTRO*
02/10/2014	The ECB announces operational details of asset-backed securities and covered bond purchase programmes	0	CBPP, ABSPP
06/11/2014	GovC meeting	0	
17/11/2014	“The GovC is unanimous in its commitment to using additional unconventional instruments [...] Unconventional measures might entail the purchase of a variety of assets, one of which is sovereign bonds.” (M. Draghi, speech at the EP)	0	PSPP
26/11/2014	“[...] we will have to consider buying other assets, including sovereign bonds in the secondary market [...]” (V. Constâncio, London)	0	PSPP
04/12/2014	“Evidently we are convinced that a QE programme which could include sovereign bonds falls within our mandate.” (Draghi’s press conference)	0	PSPP
22/01/2015	GovC meeting. The GovC announced the expanded asset purchase programme. The GovC decided today that the interest rate for the remaining six TLTROs would be equal to the rate on the Eurosystem’s MROs prevailing at the time when each TLTRO is conducted.	0	PSPP, TLTRO

Notes: The list of events is constructed extending the one in Falagiarda and Reitz (2015). In particular, it includes events related to press conferences, press releases and speeches, and reported in the ECB media website (<https://www.ecb.europa.eu/press/html/index.en.html>). GovC stands for Governing Council. Events with * are omitted from the event study.

Table 4B. US unconventional monetary policy announcements

Date	Description	Type
25/11/2008	Fed Announces Purchases of MBS and Agency Bonds	QE
01/12/2008	Bernanke states Treasuries may be purchased	QE
16/12/2008	FOMC Meeting: FFTR decreased to 0–0.25%	QE
28/01/2009	FOMC Meeting, Large Scale Asset Purchase (LSAP) announcement	QE
18/03/2009	FOMC Meeting, LSAP	QE
10/08/2010	FOMC Meeting, LSAP	QE
27/08/2010	Bernanke Speech at Jackson Hole	QE
21/09/2010	FOMC Meeting, LSAP	QE
15/10/2010	Bernanke Speech at Boston Fed	QE

03/11/2010	FOMC Meeting, LSAP	QE
26/08/2011	Bernanke Speech at Jackson Hole	QE
21/09/2011	FOMC Meeting, LSAP	QE
20/06/2012	FOMC Meeting	QE
13/09/2012	FOMC Meeting, LSAP	QE
22/05/2013	Bernanke Testimony, Tapering Announcement	Tapering
19/06/2013	FOMC Meeting, Tapering	Tapering
18/12/2013	FOMC Meeting, Tapering	Tapering
29/01/2014	FOMC Meeting, Tapering	Tapering
11/02/2014	Yellen Testimony	Tapering

Notes: QE events are taken from Rogers et al. (2014). Due to time zone differences, all events are used in the regression as happening the day after the announcement.

Table 5B. IMF/EC programs events

Date	Country	Description
13/10/2008	HU	Statement by IMF Managing Director Strauss-Kahn on Hungary
22/10/2008	HU	IMF in Talks on Loans to Countries Hit by Financial Crisis + IMF and Hungary Agree on Policies to be Supported by International Community
28/10/2008	HU	IMF Announces Staff-Level Agreement with Hungary on 12.5 Billion Euro Loan (US\$15.7 billion); European Union, World Bank to Lend, Too
30/10/2008	HU	Commission proposes financial assistance to Hungary and an increase in overall BoP loans ceiling
04/11/2008	HU	The Council approves the grant of a loan to Hungary to support its medium term balance of payments
06/11/2008	HU	IMF Executive Board approves 12.3 Billion Euro Stand-By Arrangement for Hungary
17/11/2008	HU	Request for Stand-By Arrangement-Staff Report; Staff Supplement; and Press Release on the Executive Board Discussion
19/11/2008	HU	EU provides €5 billion Community financial assistance to Hungary.
21/11/2008	HU	Transcript of a Press Conference on the Executive Board approval of a Stand-by Arrangement for Hungary
15/12/2008	HU	Statement by an IMF Staff Mission to Hungary
09/01/2009	HU	IMF Managing Director Dominique Strauss-Kahn to Visit Hungary
23/01/2009	HU	IMF Stand-By Arrangement - Interim Review Under the Emergency Financing Mechanism
16/02/2009	HU	IMF Announces Staff-Level Agreement with Hungary on First Review of Stand-By Arrangement
11/03/2009	HU	Signature of the Supplemental MoU.
25/03/2009	RO	EU intends to provide medium-term financial assistance to Romania of up to €5 billion, IMF Outlines Plan to Lend \$17.5 Billion to Romania
26/03/2009	RO	IMF Financial Sector Coordination Meeting on Romania, Concluding Statement by Participating Banks
14/04/2009	PL	Poland seeks Flexible Credit Line
21/04/2009	RO	Commission asks Council to provide a medium-term loan to Romania as part of coordinated multilateral financial assistance
24/04/2009	RO	IMF Letter of Intent and Technical Memorandum of Understanding, April 24, 2009
04/05/2009	RO	IMF Executive Board approves €12.9 Billion Stand-By Arrangement for Romania
06/05/2009	PL	IMF grants Flexible Credit Line
18/05/2009	HU	IMF Mission to Hungary Reaches Staff-Level Agreement on Second Review of Stand-By Arrangement
20/05/2009	HU	Joint IMF, EC Press Release on the European Banking Group Coordination Meeting for Hungary.
20/05/2009	RO	Joint IMF, EC Press Release on the European Banking Group Coordination Meeting for Romania

10/06/2009	HU	Signature of the Second Supplemental MoU.
10/06/2009	RO	IMF Romania Request for Stand-By Arrangement - Staff Report; Staff Supplements; and Press Release on the Executive Board Discussion
23/06/2009	HU	IMF Completes Second Review Under Stand-By Arrangement with Hungary and approves €1.4 Billion Disbursement
23/06/2009	RO	Commission and Romania sign Memorandum of Understanding (MoU) on €5 billion balance-of-payments loan
30/06/2009	HU	Hungary: Second Review Under the Stand-By Arrangement, Request for Waiver of Non-observance of Performance Criterion, and Request for Modification of Performance Criteria
08/09/2009	RO	Letter of Intent and Technical Memorandum of Understanding
16/09/2009	HU	Hungary -- Letter of Intent and Technical Memorandum of Understanding, September 16, 2009
21/09/2009	RO	IMF Completes First Review Under Stand-By Arrangement with Romania and approves €1.85 Billion Disbursement
25/09/2009	HU	Press Release: IMF Executive Board Completes Third Review Under Hungary's Stand-By Arrangement, Extends the Arrangement, and approves €3.7 Million Disbursement
08/10/2009	RO	IMF Romania: First Review Under the Stand-By Arrangement, Request for Waiver of Non-observance of Performance Criterion, and Request for Modification and Establishment of Performance Criteria.
19/10/2009	HU	IMF Third Review Under the Stand-By Arrangement, Requests for Extension of the Arrangement.
06/11/2009	RO	IMF Statement by the IMF Mission in Romania
16/11/2009	HU	Commission concludes third review of the EU balance-of-payments assistance for Hungary.
18/11/2009	RO	European Banking Coordination Initiative Meeting for Romania, "Parent Banks Reaffirm Commitment to Romania". + IMF Statement at the Conclusion of a Staff Visit to Romania
19/11/2009	HU	European Commission and IMF Welcome Reaffirmed Commitments of the Largest Foreign Banks in Hungary
04/12/2009	HU	IMF Letter of Intent and Technical Memorandum of Understanding, December 04, 2009
22/12/2009	HU	Fourth Review Under the Stand-By Arrangement, and Request for Modification of Performance Criteria
15/01/2010	HU	Signature of the Third Supplemental MoU.
28/01/2010	RO	EU Balance of payments programme for Romania
05/02/2010	RO	Letter of Intent and Technical Memorandum of Understanding
15/02/2010	HU	European Commission concluded its fourth review of the EU medium-term financial assistance to Hungary.
19/02/2010	RO	IMF Completes Second and Third Review Under Stand-By Arrangement with Romania and approves US\$3.32 Billion Disbursement
25/02/2010	RO	Signature of Supplemental Memorandum of Understanding
26/02/2010	RO	Financial Sector Stability Assessment
26/03/2010	HU	IMF Fifth Review Under the Stand-By Arrangement, and Request for Modification of Performance Criterion
30/03/2010	RO	Statement by IMF Managing Director Dominique Strauss-Kahn at the Conclusion of his Visit to Romania
10/05/2010	RO	Statement after joint mission to Romania
10/06/2010	HU	IMF statement on Hungary + Commission visit to Hungary for informal discussions.
16/06/2010	RO	Letter of Intent, Supplementary Letter of Intent, and Technical Memorandum of Understanding
25/06/2010	RO	Statement by IMF Mission Chief for Romania on the Ruling of the Constitutional Court
02/07/2010	PL	IMF renews Poland's Flexible Credit Line
02/07/2010	RO	IMF Completes Fourth Review Under Stand-By Arrangement with Romania and approves US\$1.146 Billion Disbursement
17/07/2010	HU	Commission postpones conclusion of fifth review on the EU's balance of payments assistance to Hungary
22/07/2010	HU	European Commission and IMF meet with the banking community active in Hungary
22/07/2010	RO	Commission and IMF welcome the reaffirmed support of parent banks to their Romanian affiliates
04/08/2010	RO	Commission concludes that conditions for third disbursement of the EU BoP assistance of €1.2 bn have been met

09/09/2010	RO	IMF Letter of Intent, and Technical Memorandum of Understanding
24/09/2010	RO	IMF Completes Fifth Review Under Stand-By Arrangement with Romania and approves €84.0 Million Disbursement
30/09/2010	RO	IMF Fifth Review Under the Stand-By Arrangement, and Requests for Waiver of Non-observance of Performance Criterion, and Request for Modification and Establishment of Performance Criteria
03/11/2010	HU	European Commission BoP assistance agreement expiration.
03/11/2010	RO	European Commission Staff Statement after a joint mission with the IMF and the World Bank to Romania
22/12/2010	RO	Letter of Intent, and Technical Memorandum of Understanding
07/01/2011	RO	IMF Completes Sixth Review Under Stand-By Arrangement with Romania and approves €94.8 Million Disbursement
21/01/2011	PL	IMF renews Poland's Flexible Credit Line
03/02/2011	HU	IMF Staff Report for the 2010 Article IV Consultation and Proposal for Post-Program Monitoring
08/02/2011	RO	European Commission Staff Statement after a joint mission with the IMF and the World Bank to Romania.
10/03/2011	RO	IMF Announces Staff Level Agreement with Romania on New €3.6 billion Precautionary Stand-By Arrangement and on the Seventh and Final Review of the Current Stand-By Arrangement
17/03/2011	RO	€4.6 billion bond issued to assist Ireland and Romania Choose translations of the previous link
18/03/2011	RO	European Commission and IMF welcome the continued support by the parent banks of the largest foreign-owned banks for Romania
25/03/2011	RO	IMF Executive Board approves New €3.5 Billion Precautionary Stand-By Arrangement for Romania, Completes Seventh and Final Review Under the Current Stand-By Arrangement and approves €1 Billion Disbursement
01/04/2011	RO	Romania-Seventh Review Under the Stand-By Arrangement, Cancellation of Current Stand-By Arrangement, and Request for a New Stand-By Arrangement
08/04/2011	HU	Commission's mission to Hungary welcomes commitment to structural reform and calls for further details on deficit cuts
11/04/2011	HU	Hungary—Post-Program Monitoring Discussions
09/05/2011	RO	European Commission Staff Statement after a joint mission with the IMF and the World Bank to Romania
09/06/2011	RO	IMF Letter of Intent and Technical Memorandum of Understanding
15/06/2011	HU	IMF Executive Board Concludes First Post-Program Monitoring Discussions and the Ex-Post Evaluation of Exceptional Access under the 2008 Stand-By Arrangement with Hungary
27/06/2011	RO	IMF Completes First Review Under Precautionary Stand-By Arrangement with Romania and approves €481 Million Disbursement
29/06/2011	RO	The European Commission and Romania sign Memorandum of Understanding (MoU) on EUR 1.4 billion pre-cautionary balance-of-payments assistance
01/08/2011	RO	Statement by the EC and IMF on the Review Mission to Romania
14/09/2011	RO	IMF Letter of Intent, and Technical Memorandum of Understanding
29/09/2011	RO	IMF Completes Second Review Under Stand-By Arrangement with Romania
07/11/2011	RO	Statement by the EC and IMF on the Review of Romania's Economic Program
21/11/2011	HU	Statement of the European Commission on the request by Hungary of possible financial assistance
08/12/2011	HU	IMF statement on Hungary
22/12/2011	RO	The Balance of Payments Programme for Romania. First Review - Autumn 2011
23/01/2012	RO	IMF Third Review Under the Stand-By Arrangement
05/02/2012	RO	Statement by the WB, EC and IMF on the Review of Romania's Economic Programme
28/02/2012	RO	Letter of Intent/ Memorandum of Economic and Financial Policies/ technical Memorandum of Understanding
21/03/2012	RO	IMF Completes Fourth Review Under Stand-By Arrangement for Romania
25/04/2012	HU	IMF Executive Board Concludes Article IV Consultation and Second Post-Program Monitoring Discussions with Hungary + Commission decides to enter into negotiations on precautionary financial assistance with Hungary

27/04/2012	RO	Joint press release by the IMF and EC Missions in Romania
09/05/2012	RO	Statement by the WB, EC, and the IMF on the Review of Romania's Economic Program
08/06/2012	RO	Letter of Intent/ Memorandum of Economic and Financial Policies/ Technical Memorandum of Understanding
22/06/2012	RO	IMF Completes Fifth Review Under Stand-By Arrangement for Romania
29/06/2012	RO	Second Supplemental Memorandum of Understanding between the EU and Romania
17/07/2012	HU	17 - 25 July: Mission to Hungary starts the negotiations on financial assistance
14/08/2012	RO	Statement by the IMF, EC and WB on the Review of Romania's Economic Program
12/09/2012	RO	Letter of Intent/ Memorandum of Economic and Financial Policies/ Technical Memorandum of Understanding
10/10/2012	RO	The Balance of Payments Programme for Romania. Second Review - Spring 2012
14/11/2012	RO	Statement of the IMF and EC Staff Visit
18/01/2013	PL	IMF renews Poland's Flexible Credit Line
28/01/2013	HU	16 - 28 January: Commission's mission to Hungary encourages continued progress in fiscal consolidation while paying more attention to raising growth potential
29/01/2013	RO	Statement of the IMF and EC Review Missions
20/03/2013	RO	IMF approves Three-Month Extension of SBA for Romania
29/03/2013	HU	IMF Executive Board Concludes 2013 Article IV Consultation and Third Post-Program Monitoring Discussions
10/06/2013	RO	IMF Letter of Intent, Memorandum of Economic and Financial Policies, and Technical Memorandum of Understanding
26/06/2013	RO	IMF Completes Seventh and Eighth Reviews Under the SBA for Romania
16/07/2013	RO	Romania: Seventh and Eighth Reviews Under the Stand-By Arrangement and Request for Waiver of Non-observance of Performance Criteria
19/07/2013	RO	Christine Lagarde to Visit Romania and Lithuania + Overall assessment of the two balance-of-payments assistance programmes for Romania, 2009-2013
31/07/2013	RO	Statement by the IMF and the EC on Joint Discussions on a New Economic Programme for Romania
12/08/2013	HU	Hungary Repays Early Its Outstanding Obligations to the IMF
12/09/2013	RO	Letter of Intent, Memorandum of Economic and Financial Policies, and Technical Memorandum of Understanding
27/09/2013	RO	IMF Executive Board approves New €1.98 Billion Precautionary Stand-By Arrangement for Romania
04/10/2013	RO	IMF Romania Request for a Stand-By Arrangement
29/10/2013	RO	Council Decision 2013/531/EU of 22 October 2013 providing precautionary Union medium-term financial assistance to Romania
05/11/2013	RO	Statement of the European Commission and International Monetary Fund Staff Visit
06/11/2013	RO	Memorandum of Understanding
20/11/2013	RO	Romania: Balance-of-Payments Assistance Programme 2013-2015
11/12/2013	HU	Commission staff conclude fourth Post-Programme Surveillance mission to Hungary
04/02/2014	RO	Romania: Statement at the Conclusion of the IMF and EC Staff Visit
05/03/2014	RO	Letter of Intent, Memorandum of Economic and Financial Policies, and Technical Memorandum of Understanding
26/03/2014	RO	IMF Executive Board Completes First and Second Reviews Under the Stand-By Arrangement and Ex-Post Evaluation of Exceptional Access for Romania
01/04/2014	RO	IMF Romania: First and Second Reviews Under the Stand-By Arrangement and Request for Waiver of Non-observance of a Performance Criterion
04/04/2014	RO	IMF Balance-of-Payments Assistance Programme
12/06/2014	RO	Statement at the conclusion of the IMF-European Commission staff visit to Romania
01/07/2014	HU	Commission staff conclude the fifth Post-Programme Surveillance mission to Hungary

Table 6B. Macroeconomic releases included in the analysis

Czech Republic	Hungary	Poland	Romania
Av. Real Monthly Wage YoY	Av. Gross Wages YoY	Average Gross Wages MoM	CPI MoM
CPI MoM	Budget Balance YTD	Average Gross Wages YoY	CPI YoY
CPI YoY	CPI MoM	Budget Bal.: Performance YTD	GDP QoQ
Current Account (US\$)	CPI YoY	Budget Balance: Level YTD	GDP YoY
Current Account Balance	Current Account NSA	CPI Core MoM	
Current Account Monthly	GDP NSA YoY	CPI Core YoY	
GDP (constant prices) (YoY)	GDP SA QoQ	CPI MoM	
GDP QoQ	Ind. Production WDA YoY	CPI YoY	
GDP YoY	PPI MoM	Current Account Balance	
Industrial Output YoY	PPI YoY	Employment MoM	
Industrial Sales (YoY)	Retail Sales YoY	Employment YoY	
Manufacturing PMI	Trade Balance	Exports	
PPI Industrial MoM	Unemployment Rate	GDP Annual YoY	
PPI Industrial YoY		GDP QoQ	
Retail Sales YoY		GDP YoY	
Share of Unemployed 15-65		Imports	
Trade Balance		Manufacturing PMI	
Trade Balance NC		Money Supply M3 Level	
Unemployment Rate		Money Supply M3 MoM	
		Money Supply M3 YoY	
		NBP Inflation Expectations	
		Net Core Inflation (MoM)	
		Net Core Inflation (YoY)	
		PPI MoM	
		PPI YoY	
		Retail Sales MoM	
		Retail Sales YoY	
		Sold Industrial Output MoM	
		Sold Industrial Output YoY	
		Trade Balance	
		Unemployment Rate	

Table 7B. Sovereign bonds denominated in foreign currency

Czech Republic	Hungary	Poland	Romania
XS0215153296	XS0212993678	XS0210314299	XS0371163600
	XS0240732114	XS0242491230	
	US445545AC05	US731011AP73	
	XS0219107918	JP561600A5B9	
	XS0249458984	JP561600A6B7	
		JP561600B6B6	

Notes: ISIN codes are reported. For Hungary and Poland we use the first principal component of the yields of the different bonds.

Table 8B. Event-study analysis on ECB's monetary policy decisions (LTRO and FRTPF, 1-day window)

	LTRO				FRTPF			
	CZ	HU	PL	RO	CZ	HU	PL	RO
Exchange rate	-0.21** (0.10)	0.27* (0.15)	-0.13 (0.14)	0.23** (0.09)	0.01 (0.14)	-0.37* (0.21)	-0.11 (0.19)	-0.36*** (0.12)
Stock market index	0.30 (0.35)	-0.96* (0.50)	0.34 (0.34)	0.49 (0.37)	0.11 (0.47)	2.58*** (0.67)	0.02 (0.45)	-0.33 (0.49)
Interbank rate (3M)	0.62*** (0.23)	0.27 (0.21)	0.17* (0.10)	-0.61 (0.49)	-0.88*** (0.31)	-0.16 (0.28)	0.08 (0.13)	0.24 (0.65)
Benchmark bond yield (5Y; LC)	2.34 (2.27)	-0.80 (3.00)	0.92 (1.42)	6.11 (10.57)	-7.60** (3.06)	3.38 (3.97)	0.00 (1.88)	-10.10 (14.01)
Benchmark bond yield (10Y; LC)	-2.01* (1.21)	-4.33 (2.81)	-0.53 (1.37)	3.05 (4.39)	0.29 (1.63)	5.01 (3.72)	-0.84 (1.82)	-7.97 (5.82)
Bond yield (FX)	-2.08** (0.83)	-4.05** (1.88)	-1.01 (1.69)	-1.12 (2.31)	0.87 (1.13)	-2.34 (2.49)	-1.78 (2.24)	0.33 (2.74)
CDS 5-year (USD)	0.90 (1.14)	0.96 (0.81)	-0.29 (0.96)	0.15 (0.68)	-0.36 (1.53)	-0.18 (1.08)	0.27 (1.27)	-0.54 (0.90)
CDS 10-year (USD)	0.54 (1.04)	1.41* (0.77)	-0.68 (0.85)	0.34 (0.67)	0.28 (1.40)	-1.20 (1.02)	-0.08 (1.13)	-1.82** (0.88)

Note: In addition to variables noted in the equation in Section 5.1, the regressions include two interaction terms: one for domestic and ECB key policy rate changes and the one for domestic and ECB non-standard monetary policy measures. In addition, we also include a dummy variable for the exchange rate regression for the Czech Republic in order to account for a regime change since 9 November 2013 (i.e. since when the CNB intervened and declared that the 27 CZK per EUR level is the preferred one). The δ -coefficients from equation (1) for the respective ECB non-standard monetary policy measure are reported in this table jointly with standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

Table 9B. Event-study analysis on ECB's monetary policy decisions (FOR and COLL, 1-day window)

	FOR				COLL			
	CZ	HU	PL	RO	CZ	HU	PL	RO
Exchange rate	-0.04 (0.08)	-0.05 (0.12)	0.19* (0.11)	0.10 (0.07)	0.16 (0.17)	0.49** (0.25)	0.18 (0.23)	-0.22 (0.15)
Stock market index	-0.45* (0.26)	0.01 (0.38)	-0.47* (0.25)	-0.18 (0.28)	1.89*** (0.56)	0.71 (0.81)	0.61 (0.55)	1.23** (0.60)
Interbank rate (3M)	-0.16 (0.17)	0.25 (0.16)	-0.19** (0.07)	-0.62* (0.37)	-0.93** (0.37)	-0.08 (0.34)	-0.02 (0.16)	0.49 (0.79)
Benchmark bond yield (5Y; LC)	-0.77 (1.70)	-4.27* (2.25)	0.32 (1.07)	-4.97 (7.93)	1.86 (3.66)	8.65* (4.83)	5.28** (2.30)	8.19 (17.05)
Benchmark bond yield (10Y; LC)	-1.92** (0.90)	-0.73 (2.11)	-3.53*** (1.03)	-12.66*** (3.30)	2.02 (1.95)	13.26*** (4.52)	5.13** (2.23)	4.48 (7.09)
Bond yield (FX)	-1.65*** (0.62)	1.35 (1.41)	1.57 (1.27)	2.44 (1.50)	1.27 (1.35)	4.07 (3.03)	3.36 (2.74)	11.09*** (3.07)
CDS 5-year (USD)	0.51 (0.85)	0.16 (0.61)	0.82 (0.72)	0.14 (0.51)	4.79*** (1.83)	5.98*** (1.31)	5.06*** (1.55)	2.78** (1.09)
CDS 10-year (USD)	-0.15 (0.77)	-0.02 (0.58)	-0.22 (0.64)	-0.00 (0.50)	4.89*** (1.67)	5.76*** (1.23)	1.72 (1.38)	3.03*** (1.08)

Note: In addition to variables noted in the equation in Section 5.1, the regressions include two interaction terms: one for domestic and ECB key policy rate changes and the one for domestic and ECB non-standard monetary policy measures. In addition, we also include a dummy variable for the exchange rate regression for the Czech Republic in order to account for a regime change since 9 November 2013 (i.e. since when the CNB intervened and declared that the 27 CZK per EUR level is the preferred one). The δ -coefficients from equation (1) for the respective ECB non-standard monetary policy measure are reported in this table jointly with standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

Table 10B. Event-study analysis on ECB's monetary policy decisions (CBPP and FWG, 1-day window)

	CBPP				FWG			
	CZ	HU	PL	RO	CZ	HU	PL	RO
Exchange rate	0.01 (0.20)	0.48 (0.29)	0.03 (0.27)	-0.09 (0.17)	-0.02 (0.40)	0.26 (0.60)	-0.76 (0.55)	-0.32 (0.35)
Stock market index	1.14* (0.65)	-0.58 (0.94)	0.10 (0.63)	0.57 (0.69)	-1.53 (0.96)	0.94 (1.40)	0.13 (0.93)	-0.48 (1.02)
Interbank rate (3M)	-0.41 (0.44)	-0.00 (0.40)	0.01 (0.18)	-0.69 (0.91)	0.08 (0.90)	-0.18 (0.83)	-0.74* (0.38)	-0.11 (1.89)
Benchmark bond yield (2/3Y; LC)	-16.85*** (4.30)	8.47 (5.61)	0.68 (2.65)	-5.06 (19.78)	-3.55 (8.79)	-0.89 (11.59)	-8.26 (5.49)	-1.33 (40.92)
Benchmark bond yield (10Y; LC)	2.45 (2.29)	7.10 (5.25)	-1.45 (2.57)	4.06 (8.22)	-9.97** (4.69)	-1.49 (10.85)	-13.44** (5.31)	0.53 (17.01)
Bond yield (FX)	5.33*** (1.58)	6.11* (3.52)	3.68 (3.16)	2.76 (3.54)	-1.00 (3.23)	-0.48 (7.27)	0.03 (6.53)	0.72 (7.29)
CDS 5-year (USD)	0.60 (2.15)	-2.92* (1.52)	-1.02 (1.79)	-1.60 (1.27)	0.97 (4.40)	3.39 (3.14)	2.52 (3.71)	-0.39 (2.63)
CDS 10-year (USD)	0.63 (1.96)	-2.98** (1.43)	-1.26 (1.59)	-1.30 (1.25)	0.40 (4.01)	3.26 (2.96)	2.29 (3.30)	-0.48 (2.58)

Note: In addition to variables noted in the equation in Section 5.1, the regressions include two interaction terms: one for domestic and ECB key policy rate changes and the one for domestic and ECB non-standard monetary policy measures. In addition, we also include a dummy variable for the exchange rate regression for the Czech Republic in order to account for a regime change since 9 November 2013 (i.e. since when the CNB intervened and declared that the 27 CZK per EUR level is the preferred one). The δ -coefficients from equation (1) for the respective ECB non-standard monetary policy measure are reported in this table jointly with standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

Table 11B. Event-study analysis on ECB's monetary policy decisions (ABSPP and TLTRO, 1-day window)

	ABSPP				TLTRO			
	CZ	HU	PL	RO	CZ	HU	PL	RO
Exchange rate	-0.06 (0.29)	-0.84* (0.43)	-0.25 (0.39)	0.06 (0.25)	0.09 (0.22)	0.14 (0.33)	-0.18 (0.31)	-0.01 (0.20)
Stock market index	-1.53 (0.96)	0.94 (1.40)	0.13 (0.93)	-0.48 (1.02)	-0.63 (0.74)	-0.59 (1.09)	-0.08 (0.72)	-0.35 (0.80)
Interbank rate (3M)	0.76 (0.65)	-0.15 (0.59)	-0.43 (0.27)	0.76 (1.35)	0.20 (0.50)	0.05 (0.46)	-0.04 (0.21)	-0.77 (1.05)
Benchmark bond yield (2/3Y; LC)	12.64** (6.35)	-11.93 (8.29)	1.62 (3.93)	-5.66 (29.26)	0.67 (4.90)	6.69 (6.46)	-2.95 (3.05)	-6.48 (22.76)
Benchmark bond yield (10Y; LC)	-3.12 (3.39)	-19.31** (7.76)	1.85 (3.80)	-3.70 (12.16)	3.63 (2.61)	11.65* (6.05)	-2.87 (2.96)	-1.08 (9.46)
Bond yield (FX)	-4.98** (2.33)	-2.69 (5.20)	-3.03 (4.67)	-8.18 (5.23)	-0.54 (1.80)	7.58* (4.05)	1.35 (3.63)	-0.04 (4.06)
CDS 5-year (USD)	-2.00 (3.18)	-1.92 (2.24)	-1.70 (2.65)	-1.20 (1.88)	-0.83 (2.45)	-1.14 (1.75)	-0.75 (2.06)	0.88 (1.46)
CDS 10-year (USD)	-1.97 (2.89)	-1.26 (2.12)	-0.19 (2.36)	-0.82 (1.85)	-0.73 (2.23)	-0.95 (1.65)	0.04 (1.83)	0.93 (1.44)

Note: In addition to variables noted in the equation in Section 5.1, the regressions include two interaction terms: one for domestic and ECB key policy rate changes and the one for domestic and ECB non-standard monetary policy measures. In addition, we also include a dummy variable for the exchange rate regression for the Czech Republic in order to account for a regime change since 9 November 2013 (i.e. since when the CNB intervened and declared that the 27 CZK per EUR level is the preferred one). The δ -coefficients from equation (1) for the respective ECB non-standard monetary policy measure are reported in this table jointly with standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

Figure 1B. Spot exchange rate vs. the Euro
(index; 01/01/2007=100)

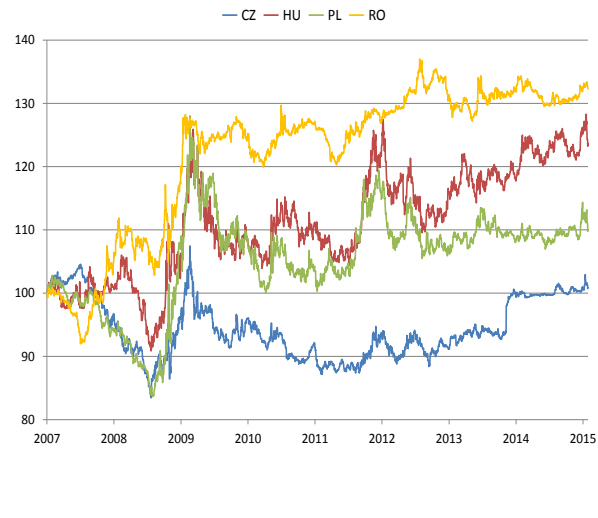


Figure 2B. Stock market index
(index; 01/01/2007=100)

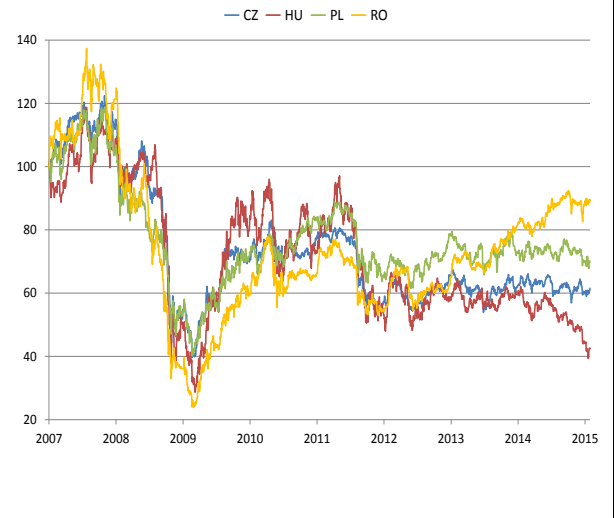


Figure 3B. 5-year CDS spread
(basis points)

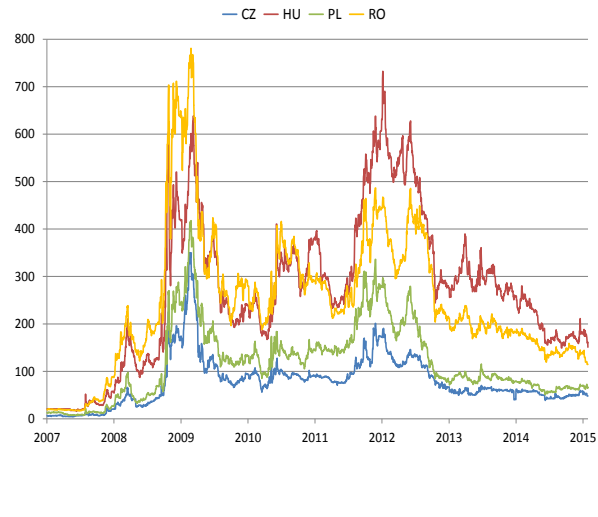


Figure 4B. 10-year CDS spread
(basis points)

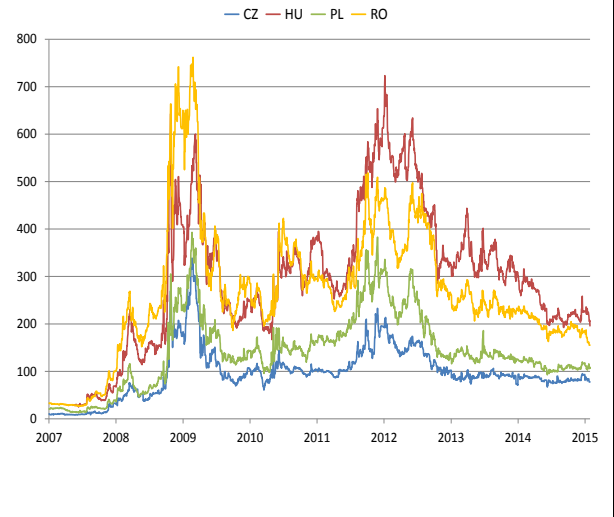


Figure 5B. 2-/3-year sovereign bond yields
(in %)

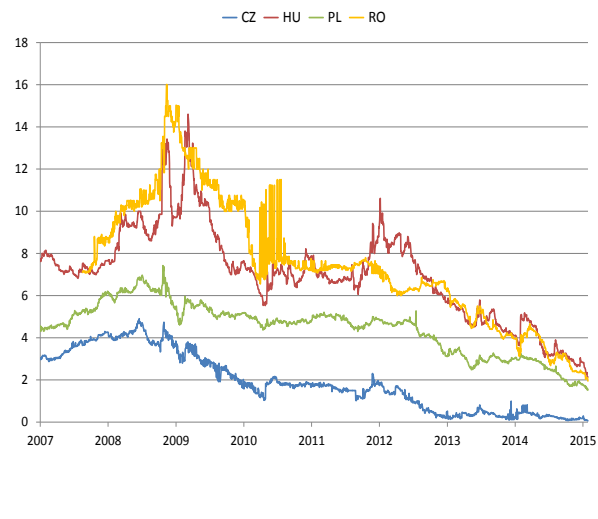


Figure 6B. 10-year sovereign bond yields
(in %)

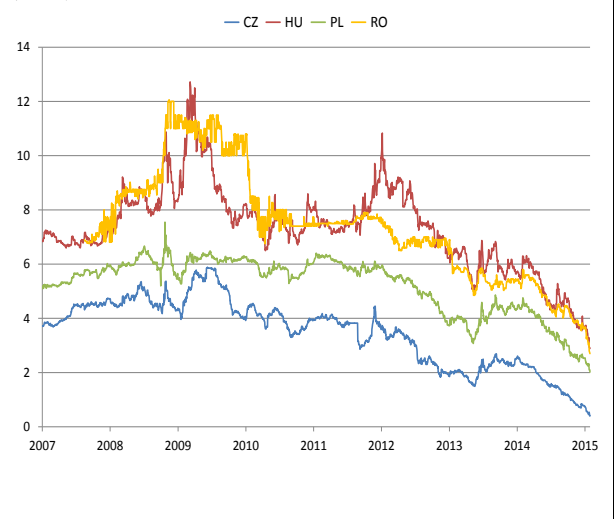


Figure 7B. 3-month interbank rate

(in %)

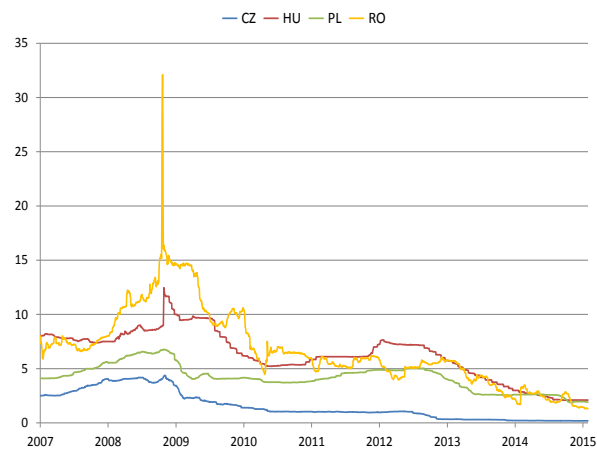


Figure 8B. FX sovereign bonds

(yield, 01/01/2009=100)

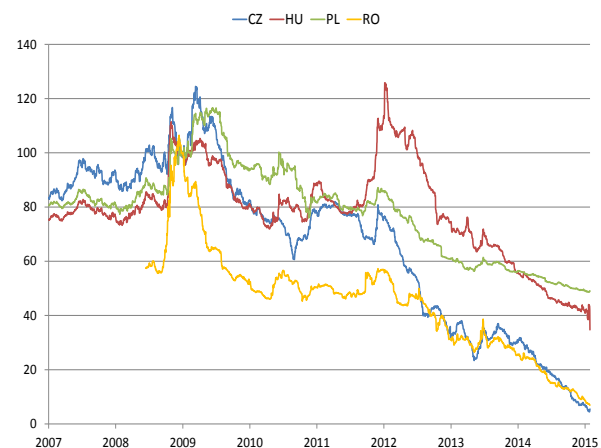


Figure 9B. “Euro-VIX” volatility index

(price index, euro)

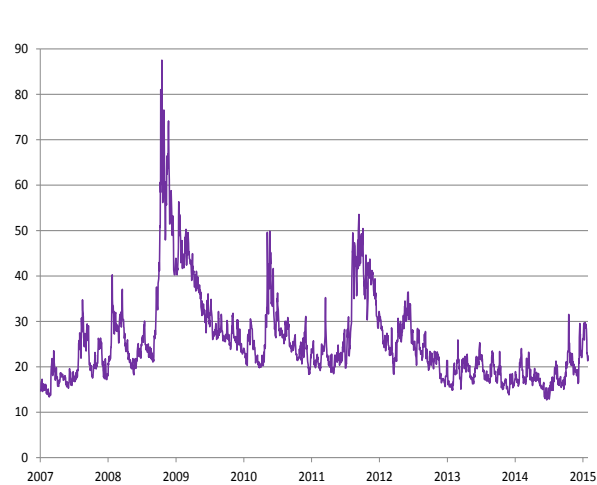
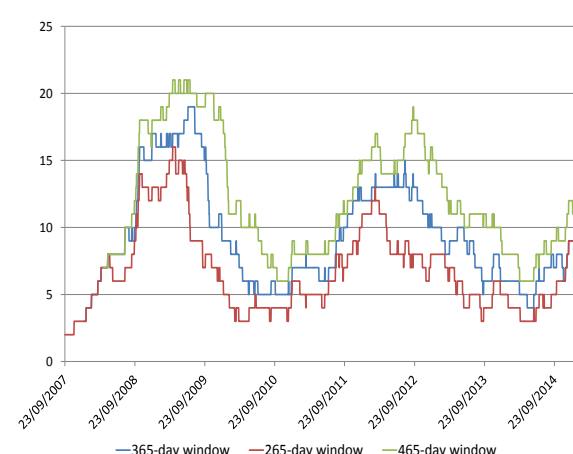


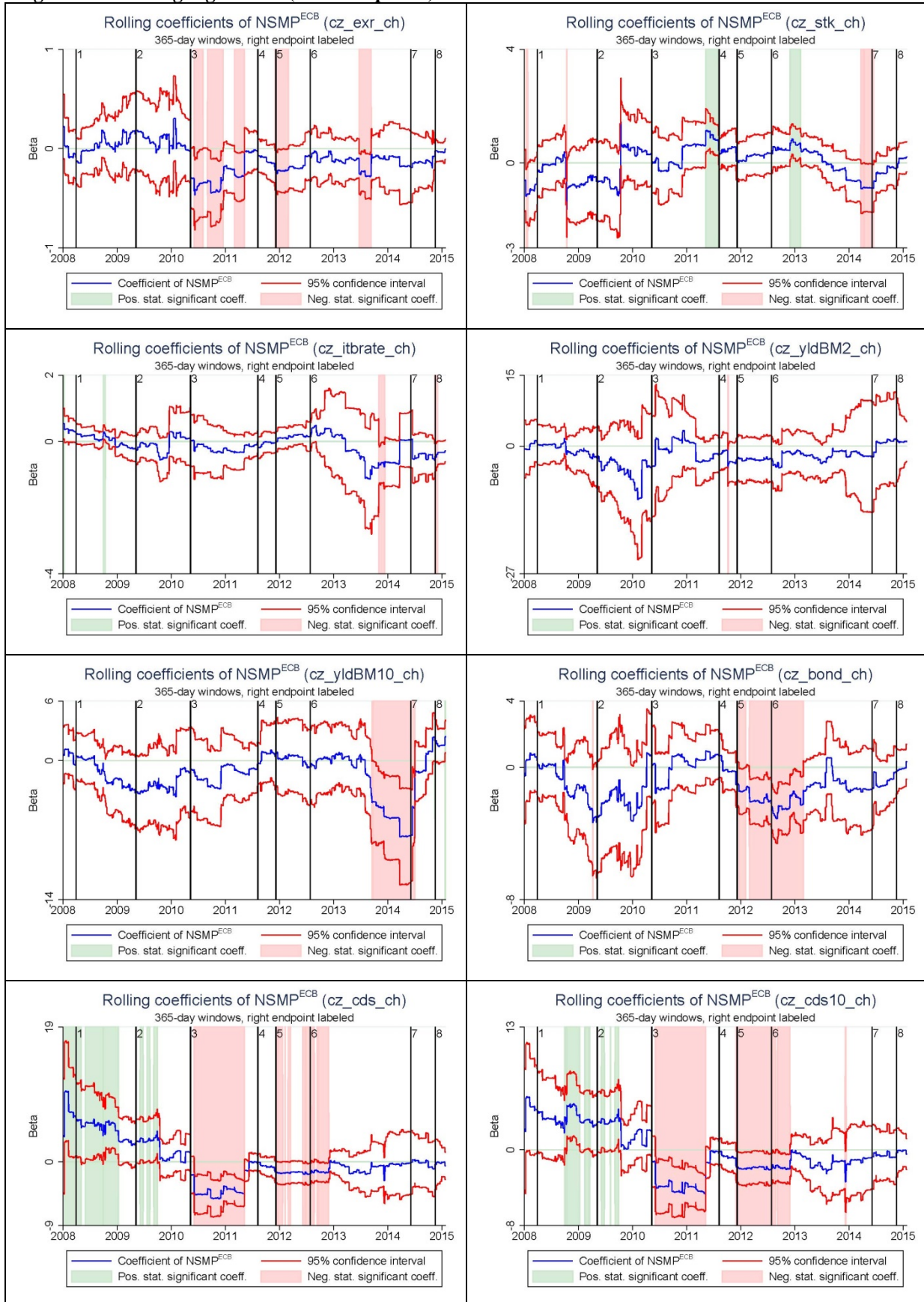
Figure 10B. ECB’s non-standard monetary policy announcements

(number of events)



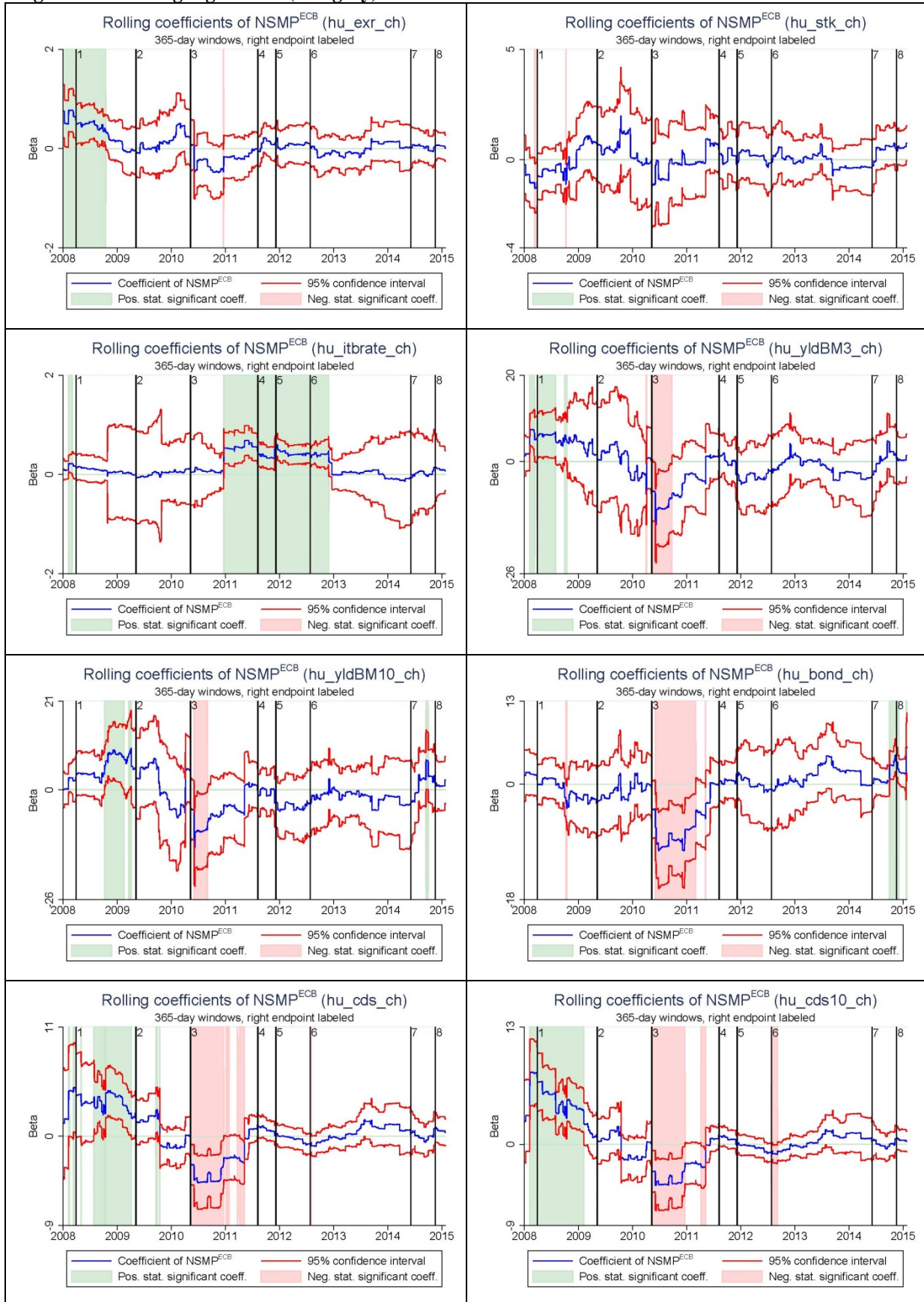
Source: see Appendix A for Figures 1B-9B. Authors’ calculations based on equation (1) for Figure 10B.

Figure 11B. Rolling regressions (Czech Republic)



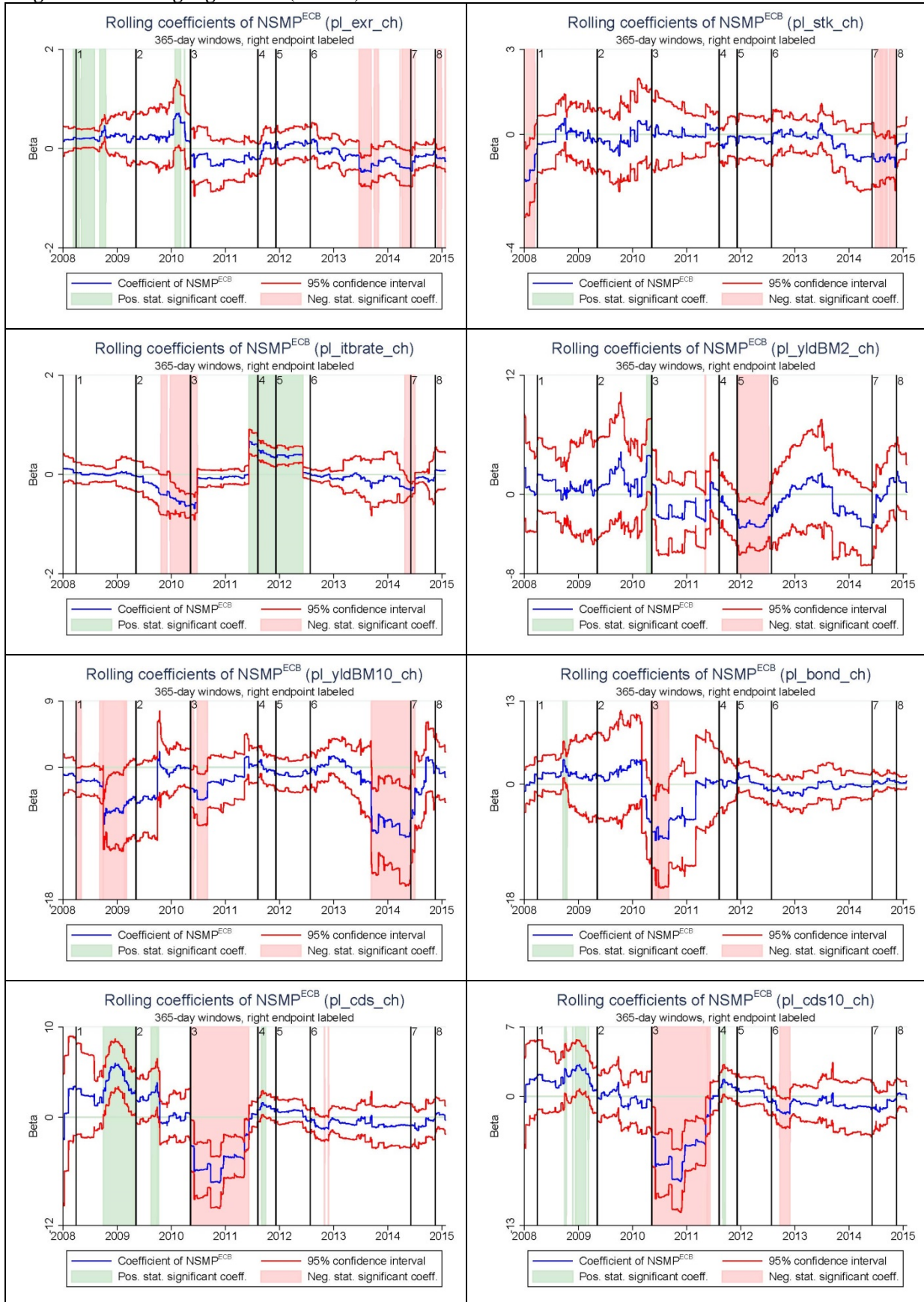
Notes: Eight major events are depicted. 1. First 6-month LTROs (28/03/2008); 2. Enhanced Credit Support (07/05/2009); 3. SMP (10/05/2010); 4. Active implementation of the SMP (08/08/2011); 5. 3-year LTROs (08/12/2011); 6. Draghi's London speech (26/07/2012); 7. TLTROs (05/06/2014); 8. Draghi's speech at the EP (17/11/2014). **Source:** Authors' calculations based on equation (1).

Figure 12B. Rolling regressions (Hungary)



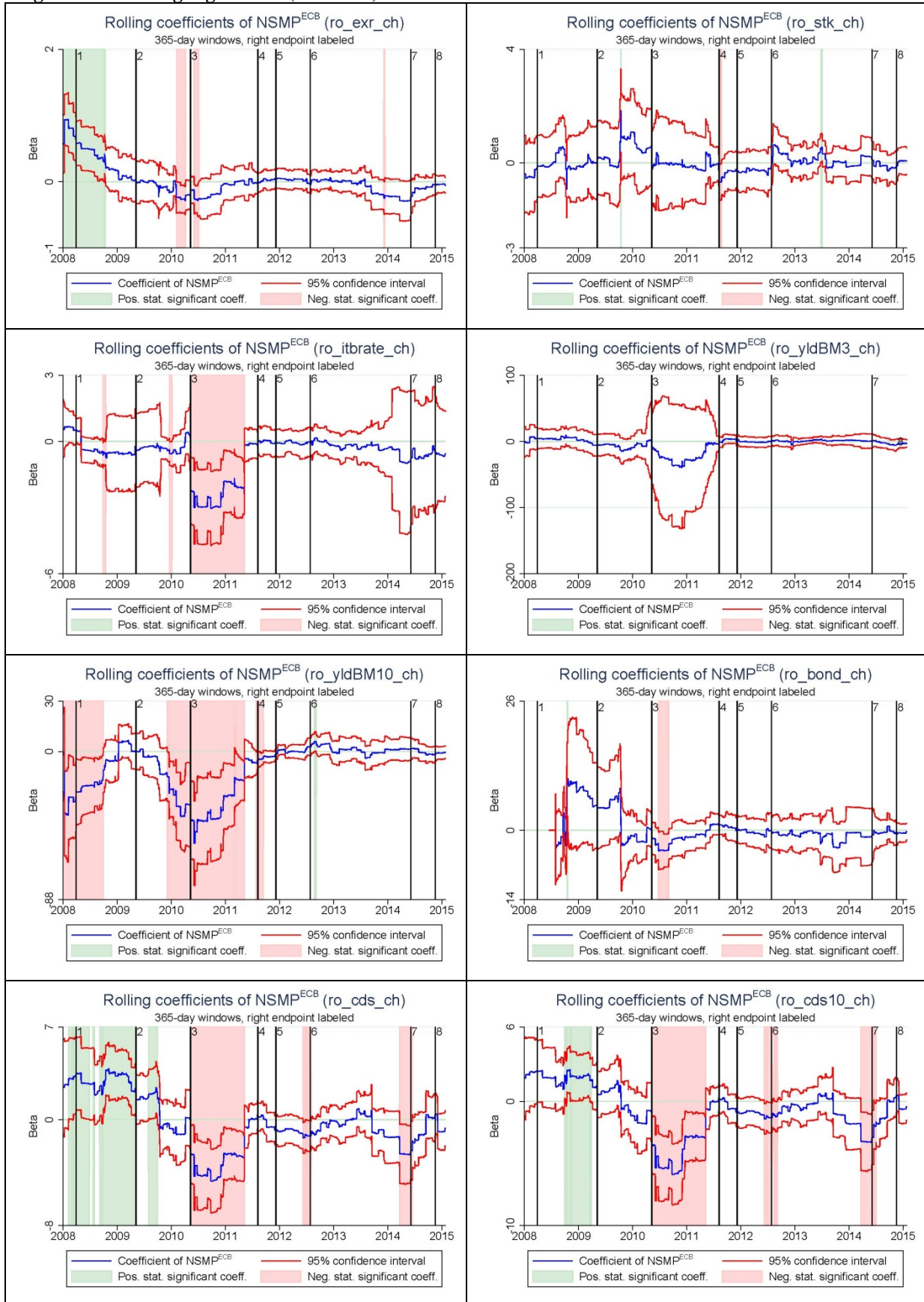
Notes: Eight major events are depicted. 1. First 6-month LTROs (28/03/2008); 2. Enhanced Credit Support (07/05/2009); 3. SMP (10/05/2010); 4. Active implementation of the SMP (08/08/2011); 5. 3-year LTROs (08/12/2011); 6. Draghi's London speech (26/07/2012); 7. TLTROs (05/06/2014); 8. Draghi's speech at the EP (17/11/2014). **Source:** Authors' calculations based on equation (1).

Figure 13B. Rolling regressions (Poland)



Notes: Eight major events are depicted. 1. First 6-month LTROs (28/03/2008); 2. Enhanced Credit Support (07/05/2009); 3. SMP (10/05/2010); 4. Active implementation of the SMP (08/08/2011); 5. 3-year LTROs (08/12/2011); 6. Draghi's London speech (26/07/2012); 7. TLTROs (05/06/2014); 8. Draghi's speech at the EP (17/11/2014). **Source:** Authors' calculations based on equation (1).

Figure 14B. Rolling regressions (Romania)



Notes: Eight major events are depicted. 1. First 6-month LTROs (28/03/2008); 2. Enhanced Credit Support (07/05/2009); 3. SMP (10/05/2010); 4. Active implementation of the SMP (08/08/2011); 5. 3-year LTROs (08/12/2011); 6. Draghi's London speech (26/07/2012); 7. TLTROs (05/06/2014); 8. Draghi's speech at the EP (17/11/2014). **Source:** Authors' calculations based on equation (1).

APPENDIX C: Weighted dummies

Following up on Rogers et al. (2014), we use the spread between the Italian and German 10-year sovereign bond yields in order to measure the size of monetary policy surprise stemming from the ECB announcements and we use it as an alternative explanatory variable $NSMP_t^{ECB}$ in our event-study analysis. We transform this measure so that its positive value indicates a positive surprise stemming from the ECB announcements, namely a compression of the 10-year sovereign bonds yield. The results are broadly consistent with those using the binary dummy variable albeit with some interesting divergences.

Most notably, the ECB announcements are associated with a statistically significant appreciation in local currencies vis-à-vis the euro, and a decline in CDS across all countries in our sample (see Table 1C). These spillovers are somewhat stronger compared with the ones obtained from our baseline specification using the binary dummy variable. In line with our earlier results, we find evidence of notable spillovers from ECB announcements on sovereign bond yields. Analysing the selected ECB announcements of non-standard monetary policy measures separately (see Table 2C), our baseline results – strong spillovers from the SMP and more muted ones from the OMT and the PSPP – are confirmed.

Table 1C. Event-study analysis on ECB’s monetary policy decisions (1-day window)

	ECB’s non-standard policies			
	CZ	CZ	HU	PL
Exchange rate	-0.01*** (0.00)	-1.10*** (0.29)	-0.73* (0.43)	-1.04*** (0.40)
Stock market index	-0.01 (0.01)	-2.58*** (0.97)	-4.16*** (1.41)	-2.02** (0.94)
Interbank rate (3M)	-0.02*** (0.01)	-1.04 (0.65)	-0.41 (0.60)	-0.23 (0.28)
Benchmark bond yield (2/3Y; LC)	-0.03 (0.07)	-3.77 (6.38)	-28.15*** (8.40)	-12.35*** (3.97)
Benchmark bond yield (10Y; LC)	-0.03 (0.04)	1.30 (3.40)	-31.50*** (7.86)	-3.91 (3.84)
Bond yield (FX)	0.01 (0.02)	0.19 (2.35)	-7.86 (5.27)	-8.24* (4.73)
CDS 5-year (USD)	-0.12*** (0.03)	-13.53*** (3.19)	-10.95*** (2.27)	-12.00*** (2.68)
CDS 10-year (USD)	-0.13*** (0.03)	-13.06*** (2.91)	-11.17*** (2.14)	-11.55*** (2.39)

Note: In addition to variables noted in the equation in Section 5.1, the regressions include two interaction terms: one for domestic and ECB key policy rate changes and the one for domestic and ECB non-standard monetary policy measures. In addition, we also include a dummy variable for the exchange rate regression for the Czech Republic in order to account for a regime change since 9 November 2013 (i.e. since when the CNB intervened and declared that the 27 CZK per EUR level is the preferred one). The δ -coefficients from equation (1) for the respective ECB non-standard monetary policy measure are reported in this table jointly with standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Authors’ calculations.

Table 2C. Event-study analysis on ECB's monetary policy decisions (1-day window)

	SMP				OMT				PSPP			
	CZ	HU	PL	RO	CZ	HU	PL	RO	CZ	HU	PL	RO
Exchange rate	-0.02*** (0.00)	-0.01 (0.01)	-0.01** (0.01)	0.00 (0.00)	-0.01 (0.01)	-0.00 (0.01)	-0.00 (0.01)	-0.01 (0.01)	0.03 (0.04)	-0.02 (0.06)	-0.03 (0.06)	-0.02 (0.04)
Stock market index	-0.04*** (0.02)	-0.06*** (0.02)	-0.03** (0.02)	-0.07*** (0.02)	-0.02 (0.02)	-0.00 (0.03)	-0.01 (0.02)	-0.01 (0.02)	0.03 (0.14)	0.10 (0.21)	0.23* (0.14)	0.01 (0.15)
Interbank rate (3M)	-0.02 (0.01)	-0.01 (0.01)	-0.00 (0.00)	-0.09*** (0.02)	-0.03** (0.01)	0.00 (0.01)	0.00 (0.01)	-0.01 (0.03)	-0.01 (0.10)	0.00 (0.09)	0.04 (0.04)	0.05 (0.20)
Benchmark bond yield (2/3Y; LC)	-0.04 (0.10)	-0.39*** (0.13)	-0.18*** (0.06)	-0.43 (0.48)	0.06 (0.13)	-0.03 (0.18)	-0.09 (0.09)	-0.15 (0.62)	0.06 (0.95)	0.08 (1.25)	0.01 (0.59)	0.26 (4.42)
Benchmark bond yield (10Y; LC)	0.02 (0.05)	-0.44*** (0.13)	-0.04 (0.06)	-0.64*** (0.20)	-0.02 (0.07)	-0.06 (0.17)	-0.15* (0.08)	-0.29 (0.26)	0.37 (0.50)	-0.15 (1.17)	-0.28 (0.57)	0.29 (1.84)
Bond yield (FX)	0.00 (0.04)	-0.09 (0.08)	-0.10 (0.08)	-0.05 (0.09)	-0.02 (0.05)	0.05 (0.11)	-0.01 (0.10)	-0.09 (0.11)	0.19 (0.35)	2.03*** (0.79)	0.12 (0.71)	0.03 (0.79)
CDS 5-year (USD)	-0.17*** (0.05)	-0.15*** (0.04)	-0.16*** (0.04)	-0.14*** (0.03)	-0.06 (0.07)	-0.06 (0.05)	-0.09 (0.06)	-0.05 (0.04)	-0.09 (0.47)	0.17 (0.34)	-0.13 (0.40)	0.31 (0.28)
CDS 10-year (USD)	-0.16*** (0.05)	-0.15*** (0.03)	-0.15*** (0.04)	-0.14*** (0.03)	-0.07 (0.06)	-0.06 (0.05)	-0.07 (0.05)	-0.05 (0.04)	-0.06 (0.43)	0.16 (0.32)	-0.13 (0.36)	0.24 (0.28)
	SMP announcement (10 May 2010)				OMT (Draghi's speech, 26 July 2012)				PSPP announcement (22 January 2015)			
	CZ	HU	PL	RO	CZ	HU	PL	RO	CZ	HU	PL	RO
Exchange rate	-0.04*** (0.01)	-0.02 (0.01)	-0.04*** (0.01)	0.00 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.00 (0.01)	0.03 (0.07)	-0.07 (0.10)	-0.07 (0.09)	-0.04 (0.06)
Stock market index	-0.05* (0.03)	-0.13*** (0.04)	-0.05* (0.03)	-0.10*** (0.03)	0.00 (0.03)	0.01 (0.04)	-0.01 (0.03)	0.04 (0.03)	0.18 (0.23)	0.40 (0.33)	0.37* (0.22)	0.05 (0.24)
Interbank rate (3M)	-0.02 (0.02)	-0.02 (0.02)	-0.01 (0.01)	-0.34*** (0.04)	0.00 (0.02)	-0.00 (0.02)	0.00 (0.01)	-0.01 (0.04)	-0.02 (0.15)	0.00 (0.14)	0.01 (0.06)	0.22 (0.32)
Benchmark bond yield (2/3Y; LC)	-0.22 (0.18)	-0.96*** (0.24)	-0.37*** (0.11)	-1.93** (0.86)	-0.06 (0.20)	0.05 (0.27)	-0.15 (0.13)	-0.00 (0.94)	0.11 (1.48)	0.60 (1.96)	-0.68 (0.93)	0.57 (6.91)
Benchmark bond yield (10Y; LC)	0.06 (0.10)	-1.08*** (0.23)	-0.27** (0.11)	-2.08*** (0.36)	-0.01 (0.11)	-0.04 (0.25)	-0.28** (0.13)	0.03 (0.39)	0.83 (0.79)	0.40 (1.83)	-0.74 (0.90)	0.49 (2.86)
Bond yield (FX)	0.00 (0.07)	-0.44*** (0.15)	-0.38*** (0.14)	-0.18 (0.16)	-0.17** (0.07)	-0.02 (0.17)	-0.01 (0.16)	-0.09 (0.17)	0.44 (0.54)	4.83*** (1.23)	0.23 (1.10)	0.61 (1.23)
CDS 5-year (USD)	-0.60*** (0.09)	-0.43*** (0.07)	-0.49*** (0.08)	-0.39*** (0.05)	-0.03 (0.10)	-0.05 (0.07)	-0.01 (0.09)	-0.03 (0.06)	-0.42 (0.74)	0.27 (0.53)	-0.24 (0.62)	0.41 (0.44)
CDS 10-year (USD)	-0.58*** (0.08)	-0.44*** (0.06)	-0.48*** (0.07)	-0.40*** (0.05)	-0.04 (0.09)	-0.05 (0.07)	-0.03 (0.08)	-0.03 (0.06)	-0.26 (0.67)	0.27 (0.50)	-0.26 (0.55)	0.33 (0.43)

Note: In addition to variables noted in the equation in Section 5.1, the regressions include two interaction terms: one for domestic and ECB key policy rate changes and the one for domestic and ECB non-standard monetary policy measures. In addition, we also include a dummy variable for the exchange rate regression for the Czech Republic in order to account for a regime change since 9 November 2013 (i.e. since when the CNB intervened and declared that the 27 CZK per EUR level is the preferred one). The δ -coefficients from equation (1) for the respective ECB non-standard monetary policy measure are reported in this table jointly with standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

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