Monetary Policy Transmission to Russia & Eastern Europe

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Abstract: In this paper, we argue that the ECB's unconventional monetary policy announcements have generated significant spillover effects in Russia and Eastern Europe. The hypothesis is tested using OLS estimations of event-based regressions on monetary policy event dummies and seven financial variables in eleven East European countries including Russia. Overall, the empirical results associate the ECB's unconventional policy announcements with the appreciation of East European currencies, rising stock market indices as well as falling long-term government bond yields and lower sovereign CDS spreads in Eastern Europe and Russia. Notably, bilateral integration with the eurozone is a key determinant of the strength of spillovers, with spillovers strongest in non-euro EU countries and weakest in non-EU East European countries. Interestingly, we find differentiated strength of spillovers to Russia compared to other non-EU East European countries, which we attribute to its fixed exchange rate regime. Lastly, we test for the presence of the portfolio rebalancing and confidence transmission channels.

Keywords: monetary policy transmission, spillovers, European Central Bank, transmission channels, Eastern Europe, Russia

JEL Codes: E52, E58, F34, F37, F42, P51

I. Introduction

Since the Global Financial Crisis and the development of non-standard monetary measures, spillover effects from monetary policies in large advanced economies to emerging market economies (EME) have become the subject of considerable debate and a focal point of criticism from policy makers in EMEs (Chen, Mancini-Griffoli and Sahay 2014, p. 3; Fratzscher, Lo Duca and Straub 2018: 330). It is pertinent to ask how domestic monetary policies are transmitted abroad and what consequences they have on foreign economies. The existing literature focuses heavily on spillovers emanating from the Federal Reserve's policies. This paper contributes to the debate by investigating the international transmission of the European Central Bank's (ECB) non-standard monetary policies and their spillover effects to Eastern Europe and Russia, which hitherto have been overlooked in the literature.

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Although the ECB's price stability mandate, assigned by the Treaty on the Functioning of the European Union, only formally encompasses the 19 euro area member states, this paper suggests the body's monetary policies also have serious macroeconomic implications for Eastern Europe and Russia, which through extensive economic integration with the euro area in terms of economic and financial linkages provides the ideal testing ground for monetary policy spillover effects.[3] This paper expects countries with the strongest linkages to the euro area to experience the most significant spillover effects, whereas countries with weaker linkages should experience fewer. Thus, REE countries (Russia and Eastern Europe) within the EU such as Bulgaria, Czechia, Hungary, Poland and Romania are expected to experience the greatest spillover effects, while non-EU countries such as Russia, Serbia and Ukraine are expected to experience fewer spillovers. Furthermore, the magnitude of spillover effects likely also depends on the exchange rate regime of each country. Countries with currency pegs or fixed currency regimes are more exposed to changes in euro area financial conditions than countries with free floating regimes. Similarly, the monetary policy framework of a country also influences spillover effects. Countries pursuing exchange rate anchor frameworks are suspected to be more vulnerable than inflation targeting countries because they have less space to counter spillover effects with domestic monetary policy.

Furthermore, this paper hypothesizes time-varying spillover effects. The ECB's initial programs, both unprecedented in nature and lacking forward guidance, likely generated greater announcement-related spillover effects than their later counterparts. The announcement of Outright Monetary Transactions (OMT) is proposed as an inflection point, at which announcements take on different characteristics, leading to changed spillover effects. Many empirical methods are available to test spillover effects. However, given the role monetary policy announcements play in influencing market expectations and thus prices, this paper employs an event-based empirical approach to study spillover effects specifically related to the ECB's non-standard monetary policy announcements to the following REE economies: Bulgaria, Croatia, Czechia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Serbia, and Ukraine. In total, 76 separate ECB policy announcements are tested for spillover effects on a range of financial variables including exchange rates, stock market indices, interbank lending rates, short and long-term sovereign bond yields, as well as 5- and 10-year credit default swap spreads.

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[3] See Keppel and Prettner (2015), Backé et al. (2013), Hájek and Horváth (2016) and Maćkowiak (2007) for evidence of economic linkages between the eurozone and Eastern Europe.

Additionally, this paper conducts several tests on the channels of international monetary policy transmission.

In this paper, we find that the ECB's unconventional monetary policy has produced significant spillovers to Eastern Europe and Russia. More specifically, asset prices, particularly sovereign yields and CDS spreads, have reacted strongly to the ECB's non-standard monetary policy announcements; the latter have been associated with declining sovereign yields, falling CDS spreads and appreciating exchange rates. A key, yet unsurprising, finding is that a country's bilateral integration with the eurozone is an important determinant of the strength of spillover effects. Similarly, the hypothesis that the depth and openness of domestic financial markets exacerbate spillover effects is also confirmed. Specifically, non-euro EU countries experienced many more significant spillover effects than non-EU countries. Among the sample countries, Bulgaria, Hungary, Poland and Romania experienced the most spillover effects, while Russia, Serbia and Ukraine experienced the fewest. For example, the Securities Markets Programme (SMP) led to between 36 and 98 bps tightening of mid-term sovereign bond yields in Bulgaria, Hungary, Poland and Romania, while no significant impact was detected in Russia, Serbia or Ukraine. While Serbia and Ukraine were largely insulated from spillover effects related to ECB policy announcements, spillovers to Russia were noticeably stronger, albeit weaker than those to non-euro EU countries. Two factors drive this very interesting and surprising result. First, according to the IMF's exchange rate regime classification of 2008, Russia pursues a fixed currency peg regime, whereas Ukraine and Serbia both follow managed floats. Second, financial markets in Russia, although politically shielded, are deeper and more mature than those in Serbia or Ukraine. Constrained by its fixed exchange rate regime, domestic monetary policy in Russia had less policy space to counter spillover effects than the managed floats in either Serbia or Ukraine, a factor contributing to Russia's greater vulnerability to spillover effects. For example, spillovers related to LTRO and FRFA announcements significantly impacted Russian 5- and 10-year CDS spreads, while only affecting 10-year spreads in Serbia and neither in Ukraine. Similarly, SMP announcements affected Russian 5- and 10-year CDS spreads, while only impacting Ukrainian 10-year CDS spreads and neither maturity in Serbia. These results underscore the finding that the depth and maturity of financial markets as well as the exchange rate regime are key determinants of spillover effects.

The remainder of the paper is structured as follows. Section 2 reviews the literature on monetary spillover effects. Section 3 provides an historical account of the

ECB's non-standard monetary policy measures and analyzes the international monetary policy transmission mechanism. In Section 4, we introduce the event study methodology, present the data used and outline the empirical strategy. Section 5 presents the results and empirically tests the transmission channels. Section 6 concludes.

II. Unconventional Monetary Policy & Emerging Markets

While the domestic effect of non-standard monetary policies has been studied extensively, spillover effects from unconventional monetary policies from advanced economies to emerging market economies (EMEs) have only recently gained traction. A strong consensus exists in the literature that monetary policy decisions made in advanced economies have important implications for EMEs. In an event study analysis, Fic (2013) examines both the domestic and international impact of quantitative easing by the Fed, BoE, ECB and BoJ on a series of developing economies (Brazil, China, India and Russia), and finds evidence that unconventional monetary policy had significant consequences for long-term yields and equity prices in developing economies. Similar to the findings of this paper, Fic (2013) finds only a limited impact of non-standard monetary policy on exchange rates. Chinn (2013) concludes that the expansion of central bank balance sheets led to a global portfolio rebalancing and a repricing of emerging market currencies. Takáts and Vela (2014) provide evidence that both EME policy rates as well as long-term interest rates are at least partially driven by US monetary policy.

Economic integration as well as the depth and liquidity of domestic financial markets are important determinants of the strength of spillover effects. Ehrmann and Fratzscher (2006) as well as Berge and Cao (2014) emphasize the important role of a country's bilateral integration with the United States in determining the strength of monetary policy transmission abroad. Fic (2013) notes that the impact of quantitative easing policies varies significantly across countries and reflects the degree of a country's exposure to developed economies in terms of trade and financial linkages, a finding also confirmed in this paper. Ehrmann and Fratzscher (2006) and Eichengreen and Gupta (2015) find that transmission correlates with the degree of financial openness and the liquidity of financial markets. This paper also finds that countries more closely integrated with the Eurozone and with more developed and liquid financial markets experienced greater spillover effects from the ECB's non-standard monetary policy announcements.

The magnitude and global reach of US monetary policy have been well researched and documented by Ahmed and Zlate (2014), Berge and Cao (2014), Bauer and Neely

(2014), Bowman, Londono and Sapriza (2015), Dedola, Rivolta and Stracca (2017), Ehrmann and Fratzscher (2006), Fratzscher et al. (2018) as well as Georgiadis (2016). Berge and Cao (2014) use an event study analysis to show that changes in monetary policy in the United States are associated with movements in asset prices both in the United States and abroad. Fratzscher et al. (2018) analyze the effects of the Fed's unconventional monetary policy on global portfolio flows and concludes that the Fed's asset purchases led to a rebalancing towards non-US assets and, in particular, towards emerging market equities. Similarly, Ahmed and Zlate (2014) provide evidence that unconventional monetary policy in the United States led to portfolio inflows into emerging markets. Using a portfolio choice model, Neely (2015) also provides evidence that the Federal Reserve's unconventional monetary policies substantially reduced international long-term bond yields. Like Fic (2013), Fratzscher et al. (2018) find time-varying effects dependent on both the individual country's financial linkages to the US as well as on economic conditions in the US. In periods of lower macroeconomic uncertainty and a positive outlook, monetary policy announcements are transmitted with greater intensity outside the US. Meinusch and Tillmann (2016) use a Qual VAR model to show that shocks from the Fed's Large Scale Asset Purchases (LSAP) led to lower interest rates, appreciations in equities and a rise in inflation. Also analyzing LSAP, Gagnon et al. (2010) show that by reducing the net supply of long-term assets available to markets, LSAPs led to a reduction in long-term interest rates on many securities, including those not directly purchased by the Fed. Krishnamurthy and Vissing-Jorgensen (2011) also use an event-study-based methodology to examine the effects of the Fed's purchase programs, and find that purchases had varying impacts on different securities, but generally led to lower yields, especially for Treasuries.

Using intraday data to study spillover effects between advanced economies, Rogers, Scotti and Wright (2014) provide evidence of significant cross-country spillover effects from monetary policy announcements between the Fed, BoE, ECB and BoJ. However, Rogers et al. (2014) note that while shocks in one currency area impact bond yields in other currency areas, spillovers are asymmetric: monetary policy surprises in the US lead to larger spillovers in other jurisdictions than the other way around.

Although the overwhelming majority of the spillovers literature focuses on the Federal Reserve's policies, a growing large body of literature examines the impact of the ECB's non-standard monetary policies on the eurozone. Using a VAR model, Peersman (2011) shows that the ECB was able to stimulate the economy, not only through the use of

its policy rate, but also through the expansion of its balance sheet and the monetary base. Beirne et al. (2011) provide an overview of the ECB's first Covered Bond Purchase Programme (CBPP) and employ event-based regressions to evaluate its impact on covered bond spreads, concluding that the CBPP was effective in tightening spreads and easing funding conditions. Importantly, Beirne et al. (2011) do not find any significant impact on prices from the asset purchases themselves, but rather attribute the effects of the CBPP to their announcements, a result consistent with the expectations hypothesis. Markmann and Zietz (2017) extend Beirne et al. (2011) to include CBPP2 and CBPP3. Their paper confirms the analysis of Beirne et al. (2011) but finds less conclusive evidence for spillovers from the subsequent CBPP2 and CBPP3 programs, a result also found in this paper.

Turning to sovereign bond purchase programs, De Pooter, Martin and Pruitt (2018), Eser and Schwaab (2013), Ghysels, Idier, Manganelli and Vergote (2014), Jäger and Grigoriadis (2017), Krishnamurthy, Nagel and Vissing-Jorgensen (2018), Rivolta (2014) as well as Szczerbowicz (2015) show that the ECB's Securities Markets Programme (SMP) effectively reduced sovereign bond spreads across the euro area. Using high frequency intraday data paired with SMP purchases, Ghysels et al. (2014) provide evidence that SMP purchases themselves, not just announcements, reduced eurozone sovereign bond spreads. De Pooter et al. (2018) estimate a pooled panel regression model on Ireland, Portugal, Italy, and Spain (four countries for which the ECB purchased sovereign bonds) to evaluate the correlation between sovereign bond purchases and a country's probability of default, measured by credit default swap spreads.

In contrast to the analysis of actual purchase volumes, a sizable portion of the literature focuses on event study analysis. Szczerbowicz (2015) implements event-based regressions to evaluate the impact of the ECB's unconventional monetary policy announcements on borrowing costs across the eurozone. She provides evidence that the ECB's liquidity-providing program announcements led to a decline in market borrowing costs. Additionally, she shows that asset purchase program announcements effectively lowered both covered bond and sovereign bond spreads, while she finds with respect to covered bond markets that CBPP1 and CBPP2 were both effective in lowering covered bond spreads. In a similar event study analysis, Falagiarda and Reitz (2015) examine changes in sovereign bond yields in Greece, Ireland, Italy, Portugal and Spain around the ECB's unconventional monetary policy announcements, and conclude that announcements led to a reduction in sovereign risk. Although Falagiarda and Reitz (2015) find evidence that liquidity-providing programs such as LTROs reduced sovereign

spreads in stressed euro area countries, the researchers note that the SMP and OMT were more effective in reducing sovereign spreads. Furthermore, Falagiarda and Reitz (2015) provide a useful analysis of the channels of unconventional monetary policy transmission, which are addressed in greater detail in Section 4.

Jäger and Grigoriadis (2017) blend event study analysis with an analysis of purchase volumes to estimate a pooled OLS model on two datasets: monetary policy event dummies and SMP purchase volumes. Both approaches yielded significantly negative effects on sovereign bond yield spreads across the eurozone. Jäger and Grigoriadis (2017) provide evidence that LTROs were most effective in non-crisis countries, while OMT and SMP announcements had more significant effects on crisis countries, a result in line with that of Falagiarda and Reitz (2015). Interestingly, the researchers find differentiated effects of non-monetary policies for each group. The researchers attribute this difference to the fact that non-crisis countries are likely to carry a disproportionate amount of risk from the ECB's balance sheet expansion.

In a novel approach, Krishnamurthy et al. (2018) utilize a Kalman filter to decompose the country-specific components of changes in yields (default risk premium, redenomination risk premium, and sovereign bond market segmentation), which are not directly observable. After extracting the country-specific default risk premium, the redenomination risk premium and the sovereign bond market segmentation components, Krishnamurthy et al. (2018) conduct an event study analysis on each of the components with respect to the ECB's sovereign bond purchase programs, concluding that SMP and OMT announcements worked primarily through the default risk premium and sovereign bond segmentation channels.

Falagiarda, McQuade and Tirpak (2015) conduct a comprehensive event study analysis of the spillovers of the ECB's non-standard monetary policy announcements to non-euro EU countries in East-Central Europe (ECE) countries (Czechia, Hungary, Poland, Romania). They find evidence of strong spillovers from the ECB's non-standard monetary policy to all ECE countries, with the largest impact on sovereign bond yields. Using an aggregated view of announcements, Falagiarda et al. (2015) provide evidence that ECB policy announcements were associated with declining sovereign bond yields across the ECE region. Interestingly, the researchers find that exchange rates and stock market indices were largely insulated from ECB policy announcements. Of all ECB programs, Falagiarda et al. (2015) find that SMP announcements had the largest impact on financial assets in CEE countries, with statistically significant coefficients indicative of an

appreciation of exchange rates, declining stock market indices, bond yields and credit default spreads across the ECE region. In contrast to strong spillovers from the SMP, they find almost no significant spillovers from OMT announcements. Likewise, the researchers found no statistically significant PSPP-related announcements. Falagiarda et al. (2015) also examine the impact of the Fed's policy announcements under its QE program, and find, unsurprisingly, that the ECE region is much more sensitive to ECB policy announcements than Fed announcements.

The strong economic and financial linkages between the eurozone and East-Central Europe provide an interesting testing ground for spillover effects. The following literature provides evidence of these linkages, which are also analyzed in Section 3.1. Jimenez-Rodriguez et al. (2010) use a structural near-VAR analysis of ten CEE countries and show that a positive shock in the euro area interest rate causes a weak but contractionary response of industrial production and a fall in prices in a majority of countries in their sample. Benkovskis et al. (2011) use a FAVAR model to investigate monetary policy spillovers from the euro area to Czechia, Poland and Hungary. The authors find a negative and significant response in output to policy tightening in the eurozone. Babecka-Kucharcukova et al. (2014) study the macroeconomic impact of both the ECB's conventional and unconventional monetary policy measures on the euro area and six non-euro EU countries. By the use of a synthetic index of overall eurozone monetary conditions (MCI) within the standard VAR framework, they find the transmission of unconventional monetary policy has an immediate effect on prices but no effect on real activity.

The literature reviewed above supports three general claims. First, non-standard monetary policies in advanced economies had large impacts on asset prices, interest rates and yields in the eurozone (Beirne et al. 2011, De Pooter et al. 2018, Eser and Schwaab 2016, Falagiarda and Reitz 2015, Ghysels et al. 2014, Jäger and Grigoriadis 2017, Krishnamurthy et al. 2018, Markmann and Zietz 2017, Meinusch and Tillmann 2016 as well as Szczerbowicz 2015). This result is a fundamental prerequisite for the transmission of spillover effects. Second, non-standard monetary policy programs in developed economies led to significant international spillover effects (Ahmed and Zlate 2014, Bauer and Neely 2014, Berge and Cao 2014, Bowman et al. 2015, Dedola et al. 2017, Falagiarda et al. 2015, Fic 2013, Fratzscher et al. 2018, Georgiadis and Gräb 2016, Neely 2015 as well as Rogers et al. 2014). Last, the ECE region and the eurozone have close economic and financial ties, which provide the underlying mechanism for the international transmission

of ECB monetary policy decisions (Backé, Feldkircher and Slačík 2013, Benkovskis 2011, Hájek and Horváth 2016, Jimenez-Rodriguez et al. 2010 as well as Maćkowiak, 2007). In the research involving Eastern Europe, the focus is limited to those in the EU (Falagiarda et al. 2015). We contribute to the existing literature by examining both EU and non-EU REE countries. The sample period, country sample and sample of ECB non-standard monetary policies included in this paper exceed the scope of any other paper on spillover effects to Russia and Eastern Europe.

III. ECB & International Monetary Policy Transmission

The ECB's non-standard liquidity-providing measures are grouped into four pillars: the provision of central bank liquidity through a fixed-rate full-allotment (FRFA) procedure, the extension of collateral eligible for refinancing operations (COLL), provision of foreign currency liquidity through swap lines (FOR) and the extension of the maturity of long-term refinancing operations (LTRO). Extending maturities even further, the ECB introduced 48-month targeted longer-term refinancing operations (TLTROs) in mid-2014 and on the same day introduced a negative deposit facility interest rate (ECB 2014b).

With respect to asset purchases, after Lehman Brothers collapsed in September of 2008, the covered bond market came under significant pressure. To prevent a credit crunch, the ECB announced the first of three covered bond purchase programs (CBPP) on May 7, 2009 (ECB PR 07.05.2009). By purchasing covered bonds, the ECB accepted liquidity and default risk private investors were unwilling to accept and replaced it with risk-free reserves (Szczerbowicz 2015, p. 99). Under its Securities Markets Programme (SMP) on May 10, 2010, the ECB would directly purchase sovereign bonds of distressed countries, primarily Greece, Ireland, Portugal, Spain and Italy. The objective of the SMP was to re-equalize borrowing costs across the euro area by lowering sovereign bond spreads in severely afflicted markets and thereby restore the proper transmission of monetary policy. In 2012, the ECB introduced its Outright Monetary Transactions (OMT) program. Under OMT, the ECB would consider outright purchases of sovereign bonds with a maturity of between one and three years in secondary markets, conditional on the applying country's acceptance of specific domestic measures set forth by the European Financial Stability Facility (EFSF) or European Stability Mechanism (ESM) (ECB PR 2.08.12). However, in contrast to other non-standard measures, OMT was never implemented. Nevertheless, its mere announcement had a significant impact on sovereign bond yield spreads in crisis countries such as Italy and Spain (Altavilla, Giannone and

Lenza 2016, p. 6, and Jäger and Grigoriadis 2017, p. 40 as well as Szczerbowicz 2015, p. 120).

In January 2015, the ECB introduced the expanded Asset Purchase Programme (APP), which added a public-sector purchase program (PSPP) to the existing purchase programs (CBPP3 & ABSPP) (ECB 2015b). Soon after, the Corporate Sector Purchase Programme (CSPP) was added to APP (ECB 2016a). Through the PSPP, bonds issued by eurozone governments, agencies and European institutions were purchased, while the CSPP purchased securities issued by non-bank corporations (ECB 2016b). Although the PSPP was not the first program to purchase public sector debt (the SMP was the first), the scale of the PSPP was unparalleled, compared to both previous and contemporaneous programs.

Monetary policy transmission mechanisms

But how are domestic monetary policy decisions transmitted abroad? The primary transmission channels are the *portfolio-rebalancing channel*, the *signaling channel*, the *confidence channel*, the *central bank response channel* and the *international bank lending channel*. Through these channels, domestic monetary policy motivates capital flows and changes in expectations, which through exchange rates and trade linkages affect foreign economies. The literature proposes a wide variety of possible transmission channels for non-standard policies including a confidence, credit, bank lending, liquidity premia, portfolio rebalancing and signaling channel. Beirne et al. (2011), ECB (2015), Falagiarda and Reitz (2015), Fratzscher et al. (2018) as well as Krishnamurthy and Vissing-Jorgensen (2011) provide useful reviews of the various transmission channels of non-standard monetary policies. It is important to note that these transmission channels are not mutually exclusive and that non-standard policies likely work through several channels simultaneously (Fratzscher et al. 2018, p. 337). Bauer and Neely (2014), Falagiarda et al. (2015), Fratzscher et al. (2018), Georgiadis (2016) and Neely (2015) extend these channels to explain international spillover effects from both the ECB's and the Fed's non-standard monetary policies. Examining spillover effects, Chinn (2013), Fic (2013) and Mohanty (2014) emphasize the role of capital flows, exchange rate and trade channels. Indeed, these channels serve as the infrastructure for the previously mentioned channels to propagate spillovers effects internationally.

The *portfolio-rebalancing channel* functions through private agents' response to changes in the price and yield of assets (Chinn 2013, p. 8). Through purchase programs, central banks limit the supply of specific assets, thereby increasing their price and

lowering yields. Because investors have downward sloping demand curves, a reduction in the supply of a specific asset also reduces the asset's expected return and induces substitution towards other assets, which are then implicitly underpriced (Bauer and Neely 2014, p. 31). Furthermore, as monetary policy alters domestic interest rates relative to those abroad, relative demand dictates that investors will reallocate their funds accordingly (Berge and Cao 2014, p. 76). Naturally, the search for substitutable assets includes an international component. As central bank asset purchases drive domestic prices higher and yields fall, international yield spreads for comparable assets emerge. Relative price changes motivate international capital flows, the engine of international spillover effects.

Dahlhaus and Vasishtha (2014) and Hamilton and Wu (2012) highlight this channel as the central transmission channel through which asset purchases affect cross-border capital flows and transmit domestic monetary policy abroad. At the height of the European financial crisis, when the negative feedback loop between countries and their banking sectors was at its peak, investors likely considered REE bonds as an attractive substitute for eurozone bonds from crisis countries. The substitution of REE bonds for those purchased by the ECB implies international capital flows which place upward pressure on the exchange rate. Furthermore, substitution towards REE bonds raises their prices and lowers their yields. Thus, spillovers from portfolio rebalancing manifest themselves through the exchange rate and bond yields. Falagiarda et al. (2015) argue that ECB bond purchases under the CBPP, SMP and PSPP reduced their yields relative to similar REE bonds, to which investors may have turned to for higher risk-adjusted returns.

To the extent that monetary policy announcements can influence agents' expectations of future economic conditions and the path of short-term policy interest rates, the monetary authority can also affect long-term rates via the so-called *signaling channel*. However, this requires that the central bank make an open and credible commitment to maintain low interest rates into the future, i.e. forward guidance.[4] Clouse, Henderson, Orphanides, Small and Tinsley (2003) argue that long-duration asset purchases can represent a credible commitment to keep interest rates low, because by raising rates at a later date, the central bank would make a loss on the purchased assets. Fratzscher et al. (2018) note the additional negative impact on yields if monetary policy announcements are perceived to lower the risk-neutral component of interest rates.

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[4] See ECB (2014) for a comprehensive review of forward guidance.

Through the *signaling channel*, domestic monetary policy announcements can negatively impact yields abroad.

Similarly, through the *confidence channel,* monetary policy announcements may impact market uncertainty by contributing new information about the state of the economy. For example, Saka, Fuertes and Kalotychou (2015) present evidence that the OMT announcement curbed self-fulfilling default dynamics and successfully returned confidence to the sovereign bond markets of crisis countries. Falagiarda et al. (2015) suggest increased confidence resulting from a monetary policy decision may, on the one hand, trigger capital flows reflective of tight linkages and economic synergies into CEE economies; on the other hand, renewed confidence may trigger a repricing of risk and result in outflows from CEE countries, particularly if earlier inflows were triggered by periods of high uncertainty in the euro area. The *confidence channel* seems to have played a decisive role in driving spillovers to countries closest to the euro area and in part explains why countries such as Bulgaria, Croatia, Czechia, Poland and Romania generally experienced greater spillovers than the Russia, Serbia or Ukraine.

In times of crisis, markets are often characterized by thin liquidity and high liquidity risk premia. Via the *liquidity risk premia channel*, central bank actions taken to improve market functioning can reduce liquidity risk and encourage private investors to return to markets (Falagiarda and Reitz 2015, p. 285). The ECB's CBPPs and ABSPP are perfect examples of the liquidity risk premia channel in action. These programs provided markets with an ongoing source of demand by giving agents the option to sell to the monetary authority if necessary, in the process reducing spreads for the traded assets and rejuvenating market activity (Gagnon et al. 2010, pp. 5–6). Falling yields in the euro area imply relatively higher yields for comparable assets in the REE region, which may attract investors. Search for yield theories indicate that in the presence of a liquidity glut, capital flows should tend towards REE assets. Thus, extraordinary liquidity-providing operations such as the ECB's LTROs or asset purchases such as CBPP1/2 and the SMP may negatively impact yields in the REE region.

Through the *credit channel* or *international bank lending channel*, local liquidity conditions also have international implications (Falagiarda et al. 2015, p. 17). Under abundant liquidity, banks have improved access to funding via the interbank and money markets, thus encouraging lending and investment activity (Lane and Mcquade 2014, p. 232). Given the large presence of EU domiciled banks operating in the REE region (Backé et al. 2013, p. 56 as well as Sun, Heinz and Ho 2013, p. 7), the *international credit channel*

may have direct consequences for REE countries.

IV. Data & Empirical Strategy

Data

Using ECB press releases and guided by the selection of events dummies in the relevant literature, a database of 76 unconventional monetary policy announcements over the period 1 January 2009 to 31 December 2017 has been created.[5] A full list of the ECB policy announcements and other announcements can be found in tables A.1-A.2. Furthermore, figures 1-3 below offer an overview of the ECB asset purchase programs related to the European financial crisis. In this paper, we investigate the impact of the complete set of ECB non-standard monetary policy announcements, i.e. 12 separate programs, implemented between 2009 and 2017 (see tables A.1-A-2) on a wide set of financial variables in eleven REE countries: Bulgaria, Croatia, Czechia, Hungary, Poland, Latvia, Lithuania, Romania, Russia, Serbia and Ukraine. The data sample spans January 2009 to December 2017. The seven financial variables of interest include the exchange rate vis-à-vis the euro, stock market index as measured by the country's MSCI index, the 3-month interbank lending rate, 3- and 10-year sovereign bond yields as well as 5- and 10-year credit default swap spreads for all eleven REE countries.[6] Additionally, the ECB marginal lending facility rate and the European volatility benchmark, VSTOXX, are chosen as control variables. All financial data was obtained from Reuters' Datastream. The codes used to access the time series as well as summary statistics for the financial variables of interest are available in the appendix (tables A.3-A.5).

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[5] Liquidity providing measures include the fixed-rate full-allotment procedure (FRFA), extension of eligible collateral assets for refinancing operations (COLL), maturity extension of long-term refinancing operations (LTRO/TLTRO) and foreign currency liquidity provision (FOR). Asset purchases include covered bond purchases (CBPP1, CBPP2, CBPP3) along with long-term sovereign bond purchase programs (SMP, PSPP), the short-term sovereign bond purchase program (OMT), asset-backed securities purchases (ABSPP) and corporate sector purchases (CSPP).

[6] Except for Latvia, for which the OMX Riga all-share index was used due to data availability. No 3-year sovereign bond yield was available for Serbia or Ukraine. Instead, a 5-year and a 2-year bond yield were taken for Serbia and Ukraine, respectively. No 10-year sovereign bond yield was available for Ukraine.
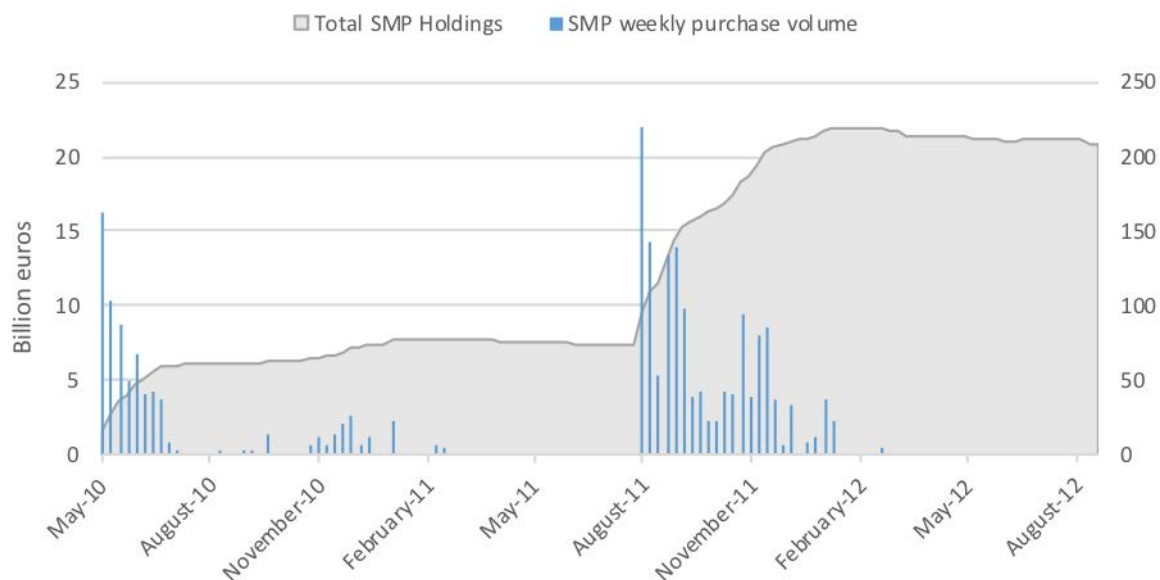
Figure 1: Weekly SMP asset purchase volume (left axis) and total SMP holdings (right axis)
Source: Own representation of SMP asset purchases and total holdings (data: ECB).
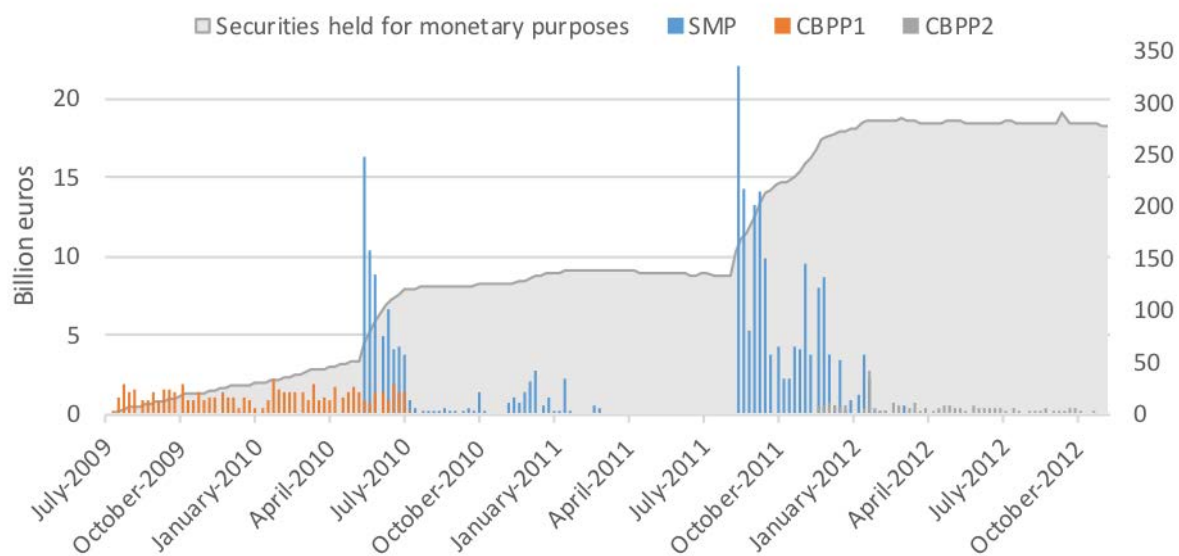
Figure 2: Weekly asset purchases under CBBP1, CBBP2 and SMP (left axis) and total securities held for monetary purposes (right axis)
Source: Own representation of weekly ECB asset purchase volumes and total holdings (data: ECB).
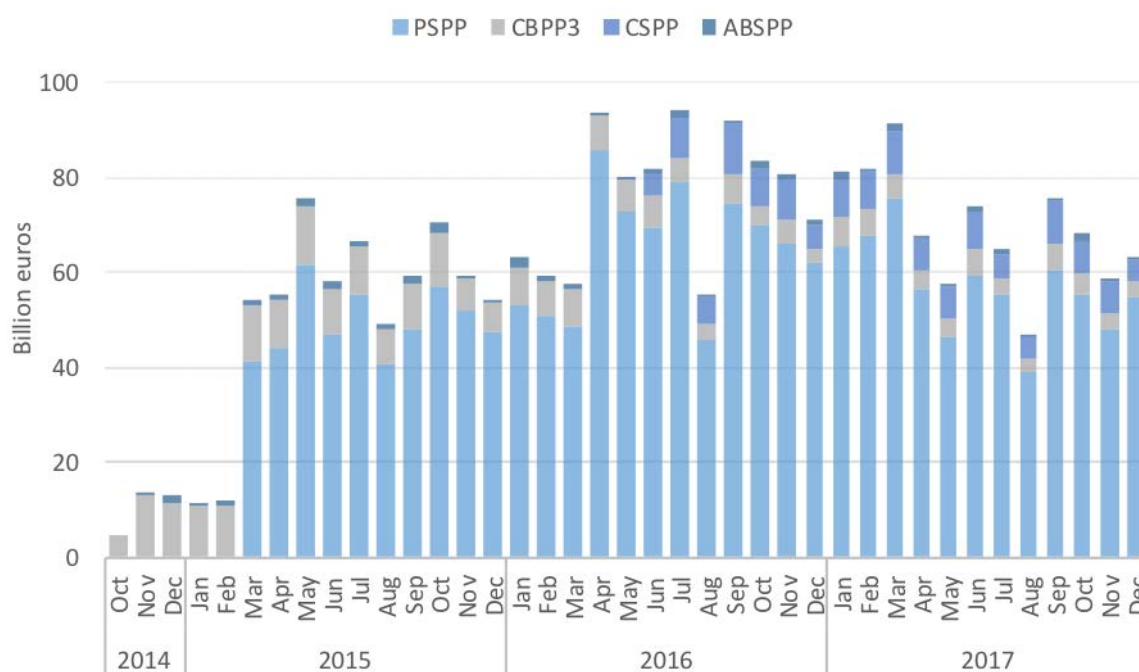
Figure 3: Monthly asset purchases under the ECB's Asset Purchase Programme
Source: Own representation of monthly asset purchases (data: ECB).

Empirical strategy

The main hypothesis of this paper is that there have been strong spillovers of the ECB's unconventional monetary policy to the REE region. We expect exchange rate appreciation vis-à-vis the euro, a rise in stock market indices and a decline in sovereign bond yields. Furthermore, REE CDS spreads should generally decline in response to ECB non-standard monetary policy announcements. Due to country-specific differences, countries with the strongest trade and financial linkages to the euro area are expected to experience more significant spillovers than REE countries that are not linked to the euro area. This is mainly the case for Bulgaria, Croatia, Czechia, Poland and Romania.

Spillover effects from the ECB's non-standard monetary policy announcements on financial variables are assessed through an ordinary least squares estimation of event-based regressions. The methodology developed is inspired by Falagiarda et al. (2015), but adapted to the data and scope of this paper.

This paper expands the sample of the four non-euro area EU countries (Czechia, Hungary, Poland Romania) developed by Falagiarda et al. (2015) to include seven additional REE economies (Bulgaria, Croatia, Latvia, Lithuania, Russia, Serbia and Ukraine), offering a truly comprehensive evaluation of spillovers to the REE region. This paper's sample period also extends that of Falagiarda et al. (2015) by two years to

encompass 2009 to 2017. Extending the sample period by two full years enabled us to include two additional ECB programs (CSPP and ABSPP) and consider additional policy announcements. Overall, the breadth of this study exceeds any known paper on monetary spillover effects to Eastern Europe. The choice of event window is of critical importance: the trade-off is between a precise and narrow window to avoid the noise from superfluous information and a wider window which allows for lagged reactions (Falagiarda et al., 2015). While the standard event window in the literature comprises 1 day (see Berge and Cao, 2014, Falagiarda et al., 2015, Falagiarda and Reitz, 2015 as well as Jäger and Grigoriadis, 2017), other researchers also consider 2-day event windows (see Altavilla et al., 2016, Bowman et al., 2015, Rivolta, 2014 and Szczerbowicz, 2015). This paper uses a 1-day event window as a benchmark, while also conducting robustness checks using 2- and 3-day event windows. These robustness checks allow for REE asset prices to react more slowly to ECB policy announcements than prices in the euro area (Falagiarda et al., 2015), but also risk allowing other non-relevant events to affect prices.

The following country-specific regression was estimated using daily data over the period 02.01.2009 – 31.12.2017:

$$\Delta FX_{i,t} = \alpha + \beta_1 \Delta EuroVIX_t + \beta_2 IR_t^{ECB} + \beta_3 \Delta Y_{t-1} + \gamma MP_t^{ECB} + \delta MP_t^{US} + \theta EC_t + \varepsilon_t,$$

where Y_t takes on the values of the dependent financial variables of interest (i.e. the exchange rate vis-à-vis the euro, stock market index, 3-month interbank lending rate, 3- and 10-year sovereign bond yields as well as 5- and 10-year credit default swap spreads). The euro area volatility index is included as $EuroVIX_t$ to control for periods of high volatility which may have impacted financial markets in REE economies. The vector IR_t^{ECB} represents the interest rate on the ECB's marginal lending facility. Additionally, a lagged dependent variable is included to account for autocorrelation in the residuals and improve model fit. Similarly, Jäger and Grigoriadis (2017) included lagged dependent variables in their event studies to correct for this problem. For simplicity and in order to maintain a consistent modelling framework, a first order lag is included in all estimations. The vectors MP_t^{ECB}, MP_t^{US} and EC_t contain the event-dummy variables related to non-standard monetary policy announcements. MP_t^{ECB} contains the dummy related to the ECB's unconventional monetary policy announcements. The vector MP_t^{US} is included to control spillovers related to monetary policy announcements made by the Federal Reserve, given the numerous studies that have shown the global impact of the Fed's

policies: Dedola et al. (2017), Fic (2013), Fratzscher et al. (2018), Georgiadis (2016), Glick and Leduc (2012). The event-dummy variable EC_t is used to control for announcements related to financial relief programs provided by the European Commission (EFSF and ESM), a step also taken by Falagiarda et al. (2015), Jäger and Grigoriadis (2017) and Szczerbowicz (2015). The exchange rate, stock market index, volatility index and CDS spreads are all expressed as daily percent changes, whereas bond yields, interbank lending rates and the ECB's policy rate are expressed as daily changes in basis points.

V. Results

Tables 1 and 2 report results on the effects of liquidity-providing and asset purchase measures. The results confirm the hypothesis of non-monotonic spillovers before and after Mario Draghi's famous London speech of July 2012. More significant spillovers from both liquidity operations and outright purchases were found between 2009 and 2012 than between 2012 and 2017. The lack of significant announcement-related spillovers from both liquidity and outright purchase related announcements on the 2012-2017 sample is indicative of the ECB's carefully managed forward guidance later in the crisis. With forward guidance, markets' expectations became anchored and spillovers related specifically to policy announcements faded. While this result does not indicate that no spillover effects took place, it does show that announcement-related spillovers did not occur, a finding that affirms that forward guidance is an effective monetary policy tool.

Table 1 reports negative spillovers to interbank rates in Romania and Russia. Given that many of the banks active in REE countries are owned by euro area groups, spillovers from liquidity operations are likely due to the *credit channel*. Throughout the crisis, the ECB provided a variety of programs to alleviate liquidity conditions in the euro area. Programs such as LTRO extended the maturity of the ECB's main refinancing operations, while the FRFA policy ensured that any banks in need of liquidity received the needed funds. The ECB broadened the pool of collateral eligible assets through its COLL announcements, allowing banks access to greater liquidity. FOR ensured liquidity provision in foreign currencies. Together these measures significantly alleviated liquidity shortages in the euro area. Table 2 reports the pooled effects of all purchase-related announcements from CBBP1, CBPP2, CBPP3, SMP, PSPP, OMT, ABSPP and CSPPP. CDS spreads in Bulgaria Croatia, Czechia, Hungary, Poland, Russia and Ukraine were reduced between 0.3% and 1.6% in response to purchase program-related announcements. The narrowing of CDS spreads indicates a lower relative default risk, a key component of

yield determination. Negative spillovers to sovereign yields were also identified in Lithuania and Poland. These spillover effects likely passed through the *liquidity risk premia channel*. Falling yields in the euro area imply relatively higher yields for comparable assets in the REE region. Offering higher risk-adjusted returns, REE assets would attract capital flows. This is particularly true for REE countries that are EU member states, where capital is easily transferable. Increased demand through capital flows to REE assets would decrease yields while increasing prices, an effect detected on both sovereign bonds and stock market prices.

However, pooling all program announcements into one event-dummy variable may have blurred spillover effects and therefore makes them impossible to observe at this level of analysis. Tables 3 and 4 report program-specific spillover effects on Russia and Eastern Europe. Events relating to the ECB's long-term refinancing operations (LTRO and TLTRO), 21 separate announcements, resulted in spillovers to sovereign bonds and CDS spreads (Table 3 left-hand side). Sovereign bond yields in Czechia, Lithuania, Poland and Romania declined between 2.1 bps and 17.9 bps on 3- and 10-year maturities, indicating that these countries' bonds served as close substitutes for euro area sovereign bonds; the lack of spillovers to other sample countries indicates higher country specific risk and lower substitutability. Spillovers related to LTRO announcements also led to a narrowing of credit risk premia as measured by CDS spreads on both 5- and 10-year maturities in Bulgaria, Croatia, Czechia, Poland, Romania, and Russia of about 1.5% to 2%, with a small widening of 0.6% in Serbia.

As bond yields decline, the cost of debt for sovereigns also declines, leading to a lower probability of default and thereby lower CDS spreads. Notably, spreads did not decline in Hungary, Latvia or Lithuania. This may be indicative of elevated country-specific risk as compared to those countries' peers. Falagiarda et al. (2015) also found limited spillovers to Hungary, in part due to the country's lower credit rating relative to its peers. LTRO announcements also impacted exchange rates in Czechia, Hungary, Poland and Romania. Similarly, the implementation of a fixed-rate full-allotment (FRFA) procedure resulted in significant spillovers to sovereign CDS spreads (Table 43 right-hand side). Under FRFA, market demand wholly determined central bank liquidity provision. The policy effectively capped interest rates at the MRO rate, providing banks with significantly higher liquidity. As yields fell in the euro area, yields in REE countries also declined with similar effects on the default risk of sovereigns, as reflected by the spillovers to CDS spreads. The broader impact of FRFA to CDS spreads than LTRO

announcements is likely because a greater portion of banks were eligible to engage in MROs than LTROs, which were restricted to limited auctions and tighter collateral requirements.

Table 1: Spillover effects of liquidity-providing announcements on REE financial variables

	Sample Period: 2009 - 2012								Sample Period: 2012 - 2017						
	Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)		Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)
Bulgaria	0.0**	0.06	-0.20	4.88	0.52	-0.37	-0.62		0.00	-0.04	-0.08	2.79	0.00	-0.27	-0.17
	(0.0)	(0.24)	(0.38)	(5.36)	(2.64)	(0.45)	(0.45)		(0.0)	(0.3)	(0.19)	(2.44)	(1.6)	(0.44)	(0.34)
Croatia	-0.02	0.11	-0.31	0.75	-0.47	-0.99**	-1.16**		-0.05**	-0.07	0.18	1.09	0.43	-0.28	-0.30
	(0.02)	(0.15)	(2.18)	(2.92)	(1.22)	(0.44)	(0.46)		(0.02)	(0.15)	(1.06)	(3.39)	(2.41)	(0.34)	(0.29)
Czechia	-0.08	0.38*	-0.30	-1.01	-1.37	-0.83	-0.91		-0.06	0.04	-0.21*	1.03	0.51	-0.41	0.04
	(0.07)	(0.19)	(0.24)	(1.48)	(0.97)	(0.79)	(0.69)		(0.05)	(0.23)	(0.11)	(1.23)	(0.94)	(0.31)	(0.24)
Hungary	-0.21*	-0.06	1.07	-4.14*	-3.41	-0.29	-0.35		-0.07	-0.12	0.19	-0.79	-1.28	0.17	0.19
	(0.12)	(0.29)	(0.75)	(2.45)	(2.43)	(0.51)	(0.51)		(0.09)	(0.27)	(0.58)	(1.47)	(1.87)	(0.42)	(0.33)
Latvia	-0.01	-0.01	-0.64	-0.01	0.39	-0.42	-0.35		-0.19**	0.18	-0.21	0.16	-0.02	-0.73	-0.43
	(0.01)	(0.24)	(4.46)	(0.24)	(6.02)	(0.51)	(0.54)		(0.08)	(0.22)	(0.26)	(1.32)	(1.31)	(0.48)	(0.3)
Lithuania	0.00	0.00	2.32**	-20.74	0.30	-0.52	-0.26		0.01***	-0.06	-0.03	-0.06	-0.59	-0.73**	-0.54**
	(0.0)	(0.24)	(1.02)	(199.46)	(8.98)	(0.46)	(0.48)		(0.0)	(0.22)	(0.06)	(0.22)	(1)	(0.34)	(0.26)
Poland	-0.16	0.22	-0.26	-2.31***	-0.98	-1.12**	-1.04*		0.00	-0.03	0.01	1.80	2.75**	-0.35	-0.31
	(0.12)	(0.22)	(0.26)	(0.88)	(0.76)	(0.56)	(0.55)		(0.0)	(0.15)	(0.39)	(1.41)	(1.29)	(0.34)	(0.28)
Romania	-0.1**	0.59*	-4.44***	-15.3*	-13.42***	-0.62	-0.83		-0.02	-0.31	-0.62	0.19	-1.92	-0.10	-0.15
	(0.05)	(0.33)	(1.67)	(9.21)	(3.27)	(0.46)	(1.16)		(0.05)	(0.21)	(1.06)	(1.72)	(1.64)	(0.3)	(0.24)
Russia	-0.01	0.04	-13.74***	-7.86	4.29	-1.59**	-1.56***		0.03	0.00	4.17	-0.37	0.64	-0.62	-0.88
	(0.1)	(0.28)	(5.11)	(5.86)	(6.62)	(0.66)	(0.59)		(0.3)	(0.26)	(4.35)	(4.78)	(3.85)	(0.88)	(0.72)
Serbia	-0.09	(0.17)	2.85	-3.17	-3.17	-0.06	0.27		-0.01	(0.47)	-2.42	5.28	5.28	-1.55***	-1.46***
	(0.07)	(0.31)	(2.49)	(2.16)	(2.16)	(0.36)	(0.24)		(0.05)	(0.22)	(2.23)	(5.97)	(5.97)	(0.43)	(0.34)
Ukraine	-0.06	0.22	-11.35	n/a	n/a	-1.11**	-1.23**		-0.33	-0.22	-7.74	-0.16	n/a	-0.62	-0.86
	(0.17)	(0.31)	(12.14)	n/a	n/a	(0.49)	(0.49)		(0.47)	(0.46)	(11.72)	(50.69)	n/a	(1.48)	(1.65)

Source: own calculations based on data from Reuters' Datastream and ECB policy announcements

Note: Observed policy announcements – FRFA, COLL, LTRO, FOR, *** p<0.01, **p<0.05, *p<0.1. Standard errors are reported in parentheses.

Table 2: Spillover effects of asset-purchasing announcements on REE financial variables

	Sample Period: 2009-2012							Sample Period: 2012-2017						
	Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)	Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)
Bulgaria	0.00	1.16*	0.51	-20.63	3.53	-3.1***	-3.7***	0.00	-0.03	-0.13	-0.15	-0.57	0.11	-0.03
	(0)	(0.61)	(0.97)	(14.1)	(6.81)	(1.16)	(1.16)	(0)	(0.29)	(0.19)	(2.38)	(1.56)	(0.43)	(0.33)
Croatia	-0.01	0.72*	-3.39	5.16	-2.07	-4.26***	-4.58***	0.01	0.11	0.96	-1.95	-4.11*	0.22	0.08
	(0.05)	(0.39)	(5.64)	(7.66)	(3.15)	(1.14)	(1.18)	(0.02)	(0.15)	(1.03)	(3.31)	(2.34)	(0.34)	(0.29)
Czechia	-0.41**	1.8***	-0.30	-2.66	0.39	-4.36**	-3.8**	-0.01	-0.10	0.00	-0.85	1.03	0.02	-0.09
	(0.19)	(0.49)	(0.61)	(3.82)	(2.52)	(2.05)	(1.78)	(0.05)	(0.23)	(0.11)	(1.2)	(0.91)	(0.31)	(0.23)
Hungary	-0.58*	0.97	0.02	-4.95	-6.65	-3.62***	-3.52***	0.02	-0.20	-1.19**	0.14	1.18	0.28	0.21
	(0.31)	(0.74)	(1.95)	(6.32)	(6.27)	(1.3)	(1.31)	(0.09)	(0.26)	(0.57)	(1.43)	(1.82)	(0.41)	(0.32)
Latvia	-0.02	0.49	13.71	0.49	5.21	-0.05	0.07	-0.12	-0.26	0.14	0.41	0.60	-0.17	0.04
	(0.04)	(0.61)	(11.47)	(0.61)	(15.56)	(1.31)	(1.4)	(0.08)	(0.22)	(0.25)	(1.28)	(1.27)	(0.46)	(0.3)
Lithuania	0.00	0.15	11.71***	-42.17	-47.75**	-1.44	-0.28	0.00	-0.05	-0.03	-0.05	-0.35	-0.01	0.05
	(0)	(0.61)	(2.62)	(515.37)	(23.14)	(1.19)	(1.23)	(0)	(0.21)	(0.06)	(0.21)	(0.98)	(0.33)	(0.26)
Poland	-0.9***	0.77	-0.52	-6.91***	-4.77**	-4.19***	-3.84***	0.00	0.13	0.02	1.14	0.70	0.12	0.05
	(0.31)	(0.58)	(0.67)	(2.27)	(1.96)	(1.45)	(1.42)	(0)	(0.15)	(0.38)	(1.37)	(1.26)	(0.33)	(0.28)
Romania	-0.07	2.3***	-22.94***	-15.65	-7.07	-5.55***	-5.28*	0.01	-0.14	-0.50	-0.43	0.41	-0.33	-0.28
	(0.13)	(0.86)	(4.29)	(23.83)	(8.51)	(1.18)	(2.99)	(0.05)	(0.2)	(1.03)	(1.67)	(1.59)	(0.29)	(0.23)
Russia	0.39	0.74	-7.23	0.82	-0.43	-6.51***	-5.77***	0.64**	-0.21	2.67	4.73	3.88	0.21	-0.02
	(0.25)	(0.73)	(13.24)	(15.14)	(17.05)	(1.69)	(1.52)	(0.29)	(0.25)	(4.25)	(4.66)	(3.75)	(0.86)	(0.7)
Serbia	0.01	(0.44)	0.36	-4.14	-4.14	0.72	0.45	0.05	(0.46)	-0.49	0.13	0.13	0.14	0.09
	(0.18)	(0.8)	(6.42)	(5.58)	(5.58)	(0.93)	(0.62)	(0.05)	(0.22)	(2.17)	(5.77)	(5.77)	(0.42)	(0.33)
Ukraine	0.38	2.11***	-81.23***	n/a	n/a	-1.95	-2.81**	-0.82*	-0.07	-1.07	1.17	n/a	0.26	0.18
	(0.44)	(0.79)	(31.24)	n/a	n/a	(1.28)	(1.26)	(0.46)	(0.45)	(11.43)	(49.41)	n/a	(1.45)	(1.62)

Source: own calculations based on data from Reuters' Datastream and ECB policy announcements

Note: Observed policy announcements – FRFA, COLL, LTRO, FOR, *** p<0.01, **p<0.05, *p<0.1. Standard errors are reported in parentheses

Table 3: Spillover effects of LTRO and FRFA announcements on REE financial variables (2009-2017)

	LTRO program announcements								FRFA program announcements						
	Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)	Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)
Bulgaria	0.00	-0.14	-0.15	4.03	-0.96	-1.24**	-1.49***	0.00	-0.53	-0.35	2.05	-0.53	-1.32**	-1.51**
	(0.00)	(0.3)	(0.37)	(4.84)	(2.62)	(0.53)	(0.49)	(0)	(0.36)	(0.44)	(5.7)	(3.14)	(0.63)	(0.59)
Croatia	-0.01	0.09	2.07	-0.24	0.04	-1.31***	-1.64***	0.02	-0.04	4.10	-1.62	0.65	-1.41**	-1.78***
	(0.02)	(0.17)	(2.1)	(3.78)	(2.07)	(0.48)	(0.48)	(0.03)	(0.21)	(2.5)	(4.22)	(2.48)	(0.58)	(0.57)
Czechia	-0.18**	0.49**	-0.10	-0.88	-2.08*	-1.71**	-1.49**	-0.19**	0.49*	-0.24	-1.55	-2.04	-2.19**	-2.12***
	(0.08)	(0.24)	(0.23)	(1.59)	(1.1)	(0.75)	(0.65)	(0.09)	(0.29)	(0.27)	(1.9)	(1.32)	(0.9)	(0.78)
Hungary	-0.38***	-0.26	0.18	-1.82	-3.26	-0.11	-0.32	-0.55***	-0.16	0.28	-4.24	-6.15**	0.12	-0.22
	(0.13)	(0.33)	(0.79)	(2.44)	(2.56)	(0.56)	(0.53)	(0.15)	(0.39)	(0.95)	(2.91)	(3.06)	(0.67)	(0.63)
Latvia	-0.02	-0.04	1.97	-0.04	1.72	-0.49	-0.41	-0.02	-0.08	-2.89	-0.08	2.43	-1.69***	-1.61**
	(0.01)	(0.26)	(3.92)	(0.26)	(5.38)	(0.52)	(0.53)	(0.02)	(0.31)	(4.69)	(0.31)	(6.43)	(0.62)	(0.63)
Lithuania	0.00**	0.07	3.79***	-16.71	-17.9**	-0.79	-0.31	0**	0.07	0.25	-22.30	-1.30	-1.88***	-1.66***
	(0.00)	(0.24)	(0.95)	(175.49)	(8.01)	(0.49)	(0.48)	(0)	(0.28)	(1.14)	(209.81)	(9.58)	(0.58)	(0.57)
Poland	-0.42***	0.10	0.62**	-2.36*	-1.73	-1.47**	-1.48***	-0.55***	0.21	0.89**	-2.27	-1.97	-1.73**	-1.77***
	(0.12)	(0.26)	(0.3)	(1.24)	(1.17)	(0.63)	(0.56)	(0.15)	(0.31)	(0.36)	(1.48)	(1.4)	(0.75)	(0.67)
Romania	-0.14**	0.62*	-7.67***	-5.58	-8.52***	-1.44***	-1.97*	-0.17**	0.48	-9.11***	-10.22	-16.57***	-0.66	-1.58
	(0.06)	(0.34)	(1.69)	(8.27)	(3.16)	(0.48)	(1.06)	(0.07)	(0.4)	(2.02)	(9.89)	(3.77)	(0.58)	(1.26)
Russia	-0.12	0.23	-5.21	-6.24	-5.31	-2.12**	-2.15***	-0.12	-0.06	-7.31	-7.49	-8.97	-2.32**	-2.63***
	(0.24)	(0.32)	(5.8)	(6.26)	(6.51)	(0.88)	(0.76)	(0.28)	(0.39)	(6.94)	(7.49)	(7.78)	(1.05)	(0.90)
Serbia	-0.11	(0.38)	2.01	-2.80	-2.80	0.50	0.63*	-0.13	(0.46)	0.51	-3.93	-3.93	0.70	0.88**
	(0.07)	(0.32)	(2.75)	(4.76)	(4.76)	(0.45)	(0.33)	(0.09)	(0.38)	(3.29)	(5.69)	(5.69)	(0.54)	(0.39)
Ukraine	-0.14	0.44	n/a	-16.43	n/a	-1.24	-1.75	-0.23	-0.03	10.46	-8.54	n/a	-0.75	-1.34
	(0.38)	(0.44)	n/a	(78.09)	n/a	(1.17)	(1.29)	(0.46)	(0.52)	(16.45)	(92.49)	n/a	(1.4)	(1.54)

Source: own calculations based on data from Reuters' Datastream and ECB policy announcements

Note: *** p<0.01, **p<0.05, *p<0.1. Standard errors are reported in parentheses.

Table 4: Spillover effects of COLL and FOR announcements on REE financial variables (2009-2017)

	COLL program announcements								FOR program announcements						
	Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond Yield (10Y)	CDS (5Y)	CDS (10Y)		Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)
Bulgaria	0***	-0.21	-0.47	-0.07	0.37	0.86	0.65		0.00	0.21	-0.08	5.17	2.78	-1.06**	-1.21***
	(0)	(0.33)	(0.4)	(4.97)	(2.84)	(0.57)	(0.53)		(0)	(0.28)	(0.34)	(4.71)	(2.45)	(0.49)	(0.46)
Croatia	0.00	-0.06	-1.70	1.71	-0.55	-0.01	-0.19		-0.06**	0.14	-1.28	-0.03	0.49	-1.74***	-1.62***
	(0.03)	(0.19)	(2.26)	(3.64)	(2.24)	(0.52)	(0.52)		(0.02)	(0.16)	(1.96)	(3.66)	(1.94)	(0.45)	(0.45)
Czechia	0.08	-0.11	-0.24	1.38	0.81	1.06	0.55		-0.2***	0.41*	-0.52**	-1.37	-1.35	-1.9***	-1.39**
	(0.08)	(0.26)	(0.24)	(1.72)	(1.2)	(0.81)	(0.7)		(0.07)	(0.23)	(0.21)	(1.49)	(1.03)	(0.7)	(0.61)
Hungary	0.11	-0.57	0.04	2.30	2.49	0.71	0.57		-0.34***	0.72**	1.7**	-10.77***	-9.17***	-1.64***	-1.4***
	(0.14)	(0.35)	(0.86)	(2.63)	(2.77)	(0.6)	(0.57)		(0.12)	(0.3)	(0.74)	(2.27)	(2.39)	(0.52)	(0.49)
Latvia	0.01	0.13	-0.07	0.13	-0.74	-0.17	0.00		-0.01	-0.07	-3.50	-0.07	1.09	-1.42***	-1.28***
	(0.01)	(0.28)	(4.24)	(0.28)	(5.82)	(0.56)	(0.57)		(0.01)	(0.25)	(3.69)	(0.25)	(5.03)	(0.49)	(0.49)
Lithuania	0.00	-0.21	-0.23	8.48	22.23**	0.15	0.20		0.00	0.08	0.37	-49.67	-0.78	-1.37***	-1.27***
	(0)	(0.26)	(1.03)	(189.74)	(8.65)	(0.53)	(0.52)		(0)	(0.22)	(0.89)	(163.91)	(7.48)	(0.45)	(0.45)
Poland	-0.08	0.08	-0.02	-0.71	0.94	-0.43	-0.22		-0.2*	0.52**	-1.15***	-2.86**	-1.73	-1.94***	-1.54***
	(0.13)	(0.28)	(0.33)	(1.34)	(1.27)	(0.68)	(0.61)		(0.12)	(0.24)	(0.28)	(1.16)	(1.1)	(0.59)	(0.53)
Romania	0.06	-0.26	-0.36	-22.73**	-8.96***	0.66	0.48		-0.13**	0.8**	-6.55***	-8.80	-15.7***	-1.22***	-0.97
	(0.06)	(0.37)	(1.84)	(8.93)	(3.42)	(0.52)	(1.14)		(0.06)	(0.32)	(1.58)	(7.72)	(2.94)	(0.45)	(0.99)
Russia	-0.02	-0.18	0.89	1.26	4.80	-0.24	-0.13		0.17	0.03	-21.15***	-7.95	8.70	-2.27***	-2.31***
	(0.25)	(0.35)	(6.27)	(6.77)	(7.03)	(0.95)	(0.82)		(0.22)	(0.3)	(5.4)	(5.85)	(6.08)	(0.82)	(0.71)
Serbia	-0.10	(0.41)	1.81	7.10	7.10	-0.51	0.02		0.00	(0.36)	-0.03	-4.67	-4.67	-1.44***	-1.28***
	(0.08)	(0.35)	(2.97)	(5.19)	(5.19)	(0.49)	(0.36)		(0.07)	(0.3)	(2.57)	(4.44)	(4.44)	(0.42)	(0.31)
Ukraine	-0.18	-0.28	0.28	11.63	n/a	-0.57	-0.54		-0.03	-0.01	-21.64*	-18.50	n/a	-1.59	-1.65
	(0.41)	(0.47)	(14.88)	(57.39)	n/a	(1.27)	(1.39)		(0.36)	(0.41)	(12.84)	(68.94)	n/a	(1.1)	(1.2)

Source: own calculations based on data from Reuters' Datastream and ECB policy announcements. Note: *** p<0.01, **p<0.05, *p<0.1. Standard errors are reported in parentheses.

Spillovers related to the extension collateral eligible for MROs only impacted sovereign bonds in Lithuania and Romania, with effects in opposite directions (Table 4). Nevertheless, the ECB's provision of liquidity in foreign currencies through swap agreements with other central banks (23 announcements) led to widespread spillover effects, as Table 5 also indicates. Spillovers to sovereign CDS spreads were detected in every country except the Ukraine, with spreads falling between 1 % and 2%. FOR announcements also placed downward pressure on yields in Hungary, Poland, and Romania. Interbank rates declined between 1bps and 21 bps in Czechia, Poland, Romania, Russia and Ukraine, with a slight but significant increase of 1.7 bps in Hungary. Some positive effects to stock market indices are also observed in Czechia, Hungary, Poland and Romania, while an appreciation of local currency against the euro was detected in Croatia, Czechia, Hungary, Poland and Romania.

As Table 5 shows, the SMP generated the most prominent spillover effects of any ECB unconventional program. In response to the SMP, REE sovereign CDS spreads declined between 9% and 24% in all sample countries except Serbia. Sovereign bond yields on both the mid- and long-term horizons fell between 17 and 98 bps around announcements in Bulgaria, Hungary Poland and Romania, with the highest declines in Hungary and Romania of 63 and 98 bps, respectively. Stock market indices rose in seven out of eleven sample countries, while currencies in Czechia, Hungary and Poland appreciated with the Euro exchange rates falling 1.1, 2.5 and 3.9 local currency units respectively. As with other programs, these results support the hypothesis that the degree of bilateral integration with the euro area is a strong determinant of spillover effects. Spillover effects were strongest in countries more closely integrated with the euro area, such as Bulgaria, Hungary, Poland and Romania, and weaker in non-EU countries, such as Russia, Serbia and Ukraine. Similarly, the ECB's largest purchase program by volume, the PSPP, generated no spillover effects other than weak stock market appreciation in Lithuania and small currency appreciation in Russia (Table 6). Two factors drive this result. First, the PSPP was implemented after OMT, which signaled to markets the ECB's willingness to intervene significantly in markets, thereby changing future expectations and leading to smaller effects attributable to announcements. Second, PSPP-driven spillovers may be more correlated with the purchases than the policy announcements themselves.

Table 5: Spillover effects of SMP and OMT announcements on REE financial variables (2009-2017)

	SMP program announcements							OMT program announcements						
	Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)	Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)
Bulgaria	0.00	-0.57	1.25	-36.35*	34.77***	-13.87***	-17.84***	0.00	-0.06	0.25	-10.12	-1.90	0.08	0.00
	(0)	(1.41)	(1.71)	(21.42)	(12.22)	(2.45)	(2.27)	(0)	(0.6)	(0.73)	(9.17)	(5.22)	(1.05)	(0.98)
Croatia	0.15	1.64**	0.09	-0.32	0.45	-20.98***	-20.07***	-0.06	0.16	-0.04	3.07	-3.65	0.19	0.00
	(0.12)	(0.81)	(9.78)	(15.26)	(9.67)	(2.21)	(2.2)	(0.05)	(0.35)	(4.17)	(6.51)	(4.13)	(0.96)	(0.95)
Czechia	-1.09***	3.29***	-0.73	-3.37	0.24	-24.14***	-22.25***	-0.17	-0.13	0.18	-2.85	1.58	-0.19	-0.09
	(0.35)	(1.13)	(1.05)	(7.43)	(5.16)	(3.47)	(3)	(0.15)	(0.48)	(0.45)	(3.17)	(2.2)	(1.5)	(1.3)
Hungary	-2.46***	10.23***	-2.15	-58.19***	-62.58***	-20.14***	-18.66***	-0.12	-0.90	-0.04	2.23	1.59	0.83	0.71
	(0.6)	(1.51)	(3.71)	(11.31)	(11.9)	(2.58)	(2.44)	(0.26)	(0.65)	(1.58)	(4.86)	(5.11)	(1.11)	(1.06)
Latvia	-0.09	2.23*	5.41	2.23*	33.45	-9.24***	-9.14***	0.00	-0.17	-0.04	-0.17	-2.62	-0.99	-0.93
	(0.06)	(1.23)	(18.31)	(1.23)	(25.11)	(2.43)	(2.46)	(0.03)	(0.52)	(7.82)	(0.52)	(10.72)	(1.04)	(1.05)
Lithuania	0.00	2.12*	0.21	-18.31	-59.33	-15.15***	-14.88***	0.00	0.01	-0.87	0.85	1.36	-0.04	-0.09
	(0)	(1.11)	(4.46)	(819.16)	(37.46)	(2.25)	(2.22)	(0)	(0.47)	(1.9)	(349.63)	(15.96)	(0.97)	(0.96)
Poland	-3.9***	4.06***	-2.18	-37.27***	-16.52***	-24.28***	-21.02***	-0.53**	-0.67	0.20	-0.72	-0.64	-0.97	0.03
	(0.57)	(1.21)	(1.4)	(5.74)	(5.47)	(2.91)	(2.6)	(0.24)	(0.52)	(0.6)	(2.48)	(2.34)	(1.26)	(1.13)
Romania	-0.41	7.61***	-121.31***	-98.08**	-93.49***	-18.39***	-16.47***	0.08	-0.51	-0.16	-0.87	1.70	0.53	-0.34
	(0.28)	(1.57)	(7.52)	(38.56)	(14.68)	(2.22)	(4.92)	(0.12)	(0.67)	(3.38)	(16.48)	(6.31)	(0.96)	(2.11)
Russia	0.93	-0.88	-2.45	8.71	7.96	-19.73***	-18.08***	0.44	-0.66	-3.00	4.05	-1.79	-1.02	-1.01
	(1.1)	(1.5)	(27.08)	(29.24)	(30.36)	(4.08)	(3.52)	(0.47)	(0.64)	(11.56)	(12.48)	(12.96)	(1.75)	(1.51)
Serbia	0.13	(1.78)	1.23	-13.55	-13.55	-0.80	-0.96	-0.08	(0.76)	0.60	0.18	0.18	0.28	0.18
	(0.35)	(1.49)	(12.85)	(22.2)	(22.2)	(2.11)	(1.54)	(0.15)	(0.64)	(5.48)	(9.48)	(9.48)	(0.9)	(0.66)
Ukraine	0.95	-1.85	-18.30	n/a	n/a	-6.70	-11.15*	-0.26	0.68	-7.04	-18.24	n/a	-0.29	-0.33
	(1.78)	(2.05)	(64.23)	n/a	n/a	(5.47)	(6.01)	(0.76)	(0.87)	(27.42)	(92.55)	n/a	(2.34)	(2.57)

Source: own calculations based on data from Reuters' Datastream and ECB policy announcements
Note: *** p<0.01, **p<0.05, *p<0.1. Standard errors are reported in parentheses.

Table 6: Spillover effects of PSPP announcements on REE financial variables (2009-2017)

	Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)
Bulgaria	0.00	0.36	0.23	-2.44	1.34	0.55	0.50
	(0)	(0.51)	(0.62)	(7.73)	(4.41)	(0.89)	(0.83)
Croatia	-0.01	-0.11	-0.05	-0.76	0.68	0.58	0.53
	(0.04)	(0.29)	(3.52)	(5.5)	(3.49)	(0.81)	(0.81)
Czechia	0.09	-0.35	0.08	-0.78	3.18*	0.31	0.30
	(0.13)	(0.41)	(0.38)	(2.68)	(1.86)	(1.26)	(1.09)
Hungary	0.13	0.01	-0.04	0.63	1.12	0.18	0.21
	(0.22)	(0.55)	(1.34)	(4.1)	(4.31)	(0.94)	(0.89)
Latvia	0.00	-0.35	0.42	-0.35	0.27	0.18	0.31
	(0.02)	(0.44)	(6.6)	(0.44)	(9.05)	(0.88)	(0.89)
Lithuania	0.00	0.82**	0.33	1.00	2.44	0.26	0.27
	(0)	(0.4)	(1.61)	(295.22)	(13.48)	(0.82)	(0.81)
Poland	0.02	0.15	0.22	1.27	0.54	0.41	0.41
	(0.21)	(0.44)	(0.51)	(2.09)	(1.97)	(1.06)	(0.95)
Romania	-0.03	-0.25	0.33	-0.73	-1.80	-0.50	-0.27
	(0.1)	(0.57)	(2.86)	(13.92)	(5.33)	(0.81)	(1.78)
Russia	1.51***	0.08	-4.24	5.35	6.49	0.75	0.42
	(0.39)	(0.54)	(9.76)	(10.54)	(10.94)	(1.48)	(1.27)
Serbia	0.07	(0.64)	-0.02	-0.98	-0.98	0.15	0.10
	(0.12)	(0.54)	(4.63)	(8)	(8)	(0.76)	(0.55)
Ukraine	-0.69	-0.36	2.67	16.01	n/a	1.63	1.55
	(0.64)	(0.74)	(23.15)	(78.14)	n/a	(1.97)	(2.17)

Source: own calculations based on data from Reuters' Datastream and ECB policy announcements
Note: *** p<0.01, **p<0.05, *p<0.1. Standard errors are reported in parentheses.

The ECB also implemented three covered bond purchase programs to improve liquidity conditions in the euro area. Grouped under one event-dummy variable, these programs generated scattered spillover effects (Table 7), with rising stock market indices in Bulgaria, Czechia, Romania, Russia and Ukraine. CBPP1, implemented in mid-2009, produced the most significant spillover effects compared to subsequent CBPPs (Table 7). In response to CBPP1 announcements, stock market indices in Bulgaria, Croatia, Czechia, Romania and Ukraine rose between 1.5 and 3.3 percent, whereas sovereign bond yields in Bulgaria and Lithuania dropped. Furthermore, CDS spreads dropped in Croatia, Romania and Russia, while rising in Latvia and Lithuania. However, as Table 8 suggests, CBPP2 and CBPP3 related announcements generated fewer significant spillover coefficients. This result may be due to the lower purchase volumes of these later programs, but also the unprecedented nature of CBPP1. The non-monotonicity of spillover effects across the three CBPPs is also confirmed in Markmann and Zietz (2017), who found that CBPP1 led to tightening of yields, while CBPP2 and CBPP3 widened yields. These mixed results are

reflective of two factors: country specific risk differences and vastly different liquidity conditions in 2009 compared to later sample periods.

The lack of spillovers related to CBPP2 and CBPP3 announcements reflects a change in international liquidity conditions as well as the smaller scope of the later CBPP programs. Announcements related to CSPP and ABSPP, which targeted the corporate bond market as well as asset backed securities, led to only limited spillover effects (Table 9), which is also confirmed by Falagiarda et al. (2015).

Table 7: Spillover effects of CBPP announcements on REE financial variables (2009-2017)

	CBPP1, CBPP2, CBPP3 program announcements								CBPP1 program announcements						
	Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)		Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)
Bulgaria	0.00	0.88*	0.02	-5.14	-1.29	-0.69	-0.88		0.00	2.64***	-1.07	-53.76***	-6.61	-0.99	-1.10
	(0)	(0.45)	(0.55)	(7.23)	(3.89)	(0.78)	(0.73)		(0)	(0.95)	(1.15)	(20.37)	(8.24)	(1.66)	(1.55)
Croatia	-0.04	0.27	-1.93	-7.83	-8.91***	-0.54	-1.00		-0.21***	1.59***	-3.60	n/a	0.47	-2.85*	-3.14**
	(0.04)	(0.26)	(3.11)	(5.5)	(3.07)	(0.72)	(0.71)		(0.08)	(0.55)	(6.58)	n/a	(6.51)	(1.51)	(1.5)
Czechia	-0.12	0.94***	-0.22	-0.58	2.76*	-0.48	-0.46		-0.45*	1.73**	-0.52	-2.95	-1.15	1.53	1.47
	(0.11)	(0.36)	(0.34)	(2.36)	(1.64)	(1.11)	(0.96)		(0.24)	(0.76)	(0.71)	(5)	(3.47)	(2.36)	(2.04)
Hungary	-0.07	-0.28	-2.42**	2.94	4.99	-0.37	-0.52		0.00	-0.63	-0.50	0.85	1.19	-1.74	-1.20
	(0.19)	(0.48)	(1.18)	(3.62)	(3.8)	(0.83)	(0.79)		(0.41)	(1.03)	(2.5)	(7.66)	(8.05)	(1.76)	(1.67)
Latvia	0.00	0.05	8.36	0.05	0.22	0.86	1.13		0.00	0.20	36.9***	0.20	0.09	6.85***	7.11***
	(0.02)	(0.39)	(5.83)	(0.39)	(7.99)	(0.77)	(0.78)		(0.04)	(0.83)	(12.39)	(0.83)	(16.91)	(1.64)	(1.66)
Lithuania	0.00	-0.17	8.09***	-12.44	-26.48**	0.46	1.23*		0.00	0.31	35.18***	-63.91	-142.18***	4.27***	7.42***
	(0)	(0.35)	(1.41)	(260.39)	(11.87)	(0.72)	(0.71)		(0)	(0.75)	(2.92)	(551.3)	(24.99)	(1.53)	(1.5)
Poland	-0.23	0.42	-0.22	-1.63	-2.26	-0.30	-0.49		-0.43	0.75	-0.23	1.27	-1.46	-0.20	-0.20
	(0.18)	(0.39)	(0.45)	(1.84)	(1.74)	(0.94)	(0.84)		(0.39)	(0.82)	(0.95)	(3.9)	(3.69)	(1.99)	(1.77)
Romania	0.00	0.86*	-2.68	-1.68	2.50	-2.12***	-2.20		-0.28	3.26***	-9.64*	3.27	16.77*	-8.16***	-6.81**
	(0.09)	(0.5)	(2.52)	(12.27)	(4.7)	(0.71)	(1.57)		(0.19)	(1.06)	(5.36)	(25.99)	(9.95)	(1.51)	(3.32)
Russia	0.28	0.9*	-2.62	-1.60	-0.17	-1.99	-2.06*		0.10	1.35	-14.52	2.64	-1.47	-5.93**	-5.23**
	(0.35)	(0.48)	(8.61)	(9.29)	(9.65)	(1.3)	(1.12)		(0.74)	(1.01)	(18.23)	(19.68)	(20.43)	(2.75)	(2.38)
Serbia	0.06	(0.57)	-0.43	0.56	0.56	0.61	0.42		-0.02	(1.2)	7.20	1.40	1.40	0.02	0.04
	(0.11)	(0.47)	(4.09)	(7.06)	(7.06)	(0.67)	(0.49)		(0.23)	(1)	(8.64)	(14.94)	(14.94)	(1.42)	(1.04)
Ukraine	-0.52	1.32**	-45.54**	197.93**	n/a	-1.05	-1.43		0.34	2.96**	-177.71***	n/a	n/a	-4.42	-5.05
	(0.57)	(0.65)	(20.41)	(77.98)	n/a	(1.74)	(1.91)		(1.2)	(1.38)	(43.19)	n/a	n/a	(3.69)	(4.05)

Source: own calculations based on data from Reuters' Datastream and ECB policy announcements
Note: *** p<0.01, **p<0.05, *p<0.1. Standard errors are reported in parentheses.

Table 8: Spillover effects of CBPP announcements on REE financial variables (2009-2017)

	CBPP2 program announcements								CBPP3 program announcements						
	Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)		Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield (3Y)	Sovereign bond yield (10Y)	CDS (5Y)	CDS (10Y)
Bulgaria	0.00	0.18	0.64	4.21	-1.02	-2.18	-2.57**		0.00	0.51	0.10	0.04	1.17	0.58	0.50
	(0)	(0.77)	(0.94)	(11.79)	(6.73)	(1.35)	(1.26)		(0)	(0.67)	(0.82)	(10.21)	(5.83)	(1.17)	(1.09)
Croatia	0.02	-0.08	-3.74	5.41	-18.48***	-0.58	-1.65		0.00	-0.12	0.28	-17.75**	-6.37	0.65	0.56
	(0.06)	(0.45)	(5.37)	(8.39)	(5.3)	(1.24)	(1.23)		(0.05)	(0.39)	(4.66)	(7.26)	(4.61)	(1.07)	(1.06)
Czechia	-0.19	1.61**	-0.41	2.79	2.63	-2.73	-2.67		0.10	0.03	0.08	-1.91	4.79*	0.21	0.25
	(0.19)	(0.62)	(0.58)	(4.09)	(2.84)	(1.92)	(1.67)		(0.17)	(0.54)	(0.5)	(3.54)	(2.45)	(1.67)	(1.45)
Hungary	-0.52	-0.32	-7.09***	2.19	1.39	-0.63	-1.35		0.23	-0.08	0.14	4.54	9.57*	0.51	0.45
	(0.33)	(0.84)	(2.03)	(6.25)	(6.58)	(1.43)	(1.36)		(0.29)	(0.73)	(1.77)	(5.42)	(5.7)	(1.24)	(1.18)
Latvia	-0.01	0.54	0.09	0.54	0.24	-1.91	-1.66		0.00	-0.40	0.42	-0.40	0.27	-0.05	0.25
	(0.03)	(0.68)	(10.07)	(0.68)	(13.81)	(1.34)	(1.35)		(0.03)	(0.59)	(8.72)	(0.59)	(11.96)	(1.16)	(1.17)
Lithuania	0.00	-1.16*	0.33	3.91	10.78	-1.60	-1.48		0.00	0.33	0.33	1.13	3.66	0.09	0.15
	(0)	(0.61)	(2.45)	(450.31)	(20.55)	(1.25)	(1.23)		(0)	(0.53)	(2.12)	(390.16)	(17.81)	(1.08)	(1.07)
Poland	-0.40	0.55	-0.66	-4.82	-4.18	-1.29	-1.84		0.01	0.16	0.12	-0.68	-1.20	0.40	0.38
	(0.32)	(0.67)	(0.77)	(3.18)	(3.01)	(1.62)	(1.45)		(0.27)	(0.58)	(0.67)	(2.76)	(2.61)	(1.41)	(1.25)
Romania	0.06	0.71	-2.83	-3.20	1.44	-1.76	-2.64		0.09	-0.25	0.89	-3.00	-3.87	0.65	0.44
	(0.15)	(0.87)	(4.36)	(21.23)	(8.13)	(1.24)	(2.71)		(0.13)	(0.75)	(3.77)	(18.39)	(7.04)	(1.07)	(2.35)
Russia	0.19	1.42*	-1.85	-5.85	-1.36	-2.40	-2.58		0.44	0.26	2.78	-0.52	1.37	0.31	-0.07
	(0.6)	(0.83)	(14.89)	(16.07)	(16.69)	(2.25)	(1.94)		(0.52)	(0.72)	(12.9)	(13.93)	(14.46)	(1.95)	(1.68)
Serbia	0.16	(0.98)	-7.27	-3.91	-3.91	1.62	1.14		0.03	(0.85)	0.83	3.50	3.50	0.14	0.06
	(0.19)	(0.82)	(7.09)	(12.21)	(12.21)	(1.16)	(0.85)		(0.16)	(0.71)	(6.11)	(10.58)	(10.58)	(1.01)	(0.73)
Ukraine	-0.16	2.02*	-41.59	420.19***	n/a	-0.26	-0.24		-1.22	-0.03	17.65	29.85	n/a	0.05	-0.50
	(0.98)	(1.12)	(35.3)	(118.64)	n/a	(3.01)	(3.31)		(0.85)	(0.97)	(30.59)	(103.25)	n/a	(2.61)	(2.87)

Source: own calculations based on data from Reuters' Datastream and ECB policy announcements

Note: *** p<0.01, **p<0.05, *p<0.1. Standard errors are reported in parentheses.

Table 9: Spillover effects of ABSPP and CSPP announcements on REE financial variables (2012-2017)

	ABSPP program announcements							CSPP program announcements						
	Exchange Rate	Stock Market Index	Interbank Rate (3M)	Sovereign Bond yield (3Y)	Sovereign Bond Yield (10Y)	CDS (5Y)	CDS (10Y)	Exchange Rate	Stock Market Index	Interbank Rate (3M)	Sovereign Bond yield (3Y)	Sovereign Bond Yield (10Y)	CDS (5Y)	CDS (10Y)
Bulgaria	0.00	-0.08	-0.03	3.73	2.01	0.29	0.19	0.00	0.39	-0.55	3.22	-1.46	0.21	0.13
	(0)	(0.51)	(0.34)	(4.2)	(2.75)	(0.76)	(0.59)	(0)	(0.56)	(0.37)	(4.59)	(3.01)	(0.83)	(0.64)
Croatia	0.03	-0.12	2.05	-7.47	-2.59	0.34	0.26	0.09**	0.32	0.34	2.39	0.15	0.24	0.14
	(0.04)	(0.26)	(1.82)	(5.84)	(4.14)	(0.59)	(0.51)	(0.04)	(0.29)	(1.99)	(6.39)	(4.53)	(0.65)	(0.55)
Czechia	0.07	-0.17	0.04	-2.98	3.04*	0.01	0.00	0.00	0.34	0.05	-0.65	-0.11	0.13	0.05
	(0.09)	(0.4)	(0.19)	(2.11)	(1.61)	(0.54)	(0.41)	(0.1)	(0.44)	(0.2)	(2.31)	(1.76)	(0.59)	(0.45)
Hungary	0.10	0.14	0.31	2.61	6.75**	0.31	0.23	0.02	-0.26	0.09	-1.12	-0.86	0.35	0.25
	(0.16)	(0.46)	(1)	(2.53)	(3.21)	(0.72)	(0.56)	(0.18)	(0.5)	(1.1)	(2.77)	(3.51)	(0.78)	(0.62)
Latvia	0.07	-0.44	0.19	-0.10	0.32	0.13	0.08	0.03	0.01	0.19	2.43	3.44	0.19	0.13
	(0.14)	(0.38)	(0.45)	(2.26)	(2.25)	(0.82)	(0.52)	(0.16)	(0.42)	(0.49)	(2.47)	(2.46)	(0.9)	(0.57)
Lithuania	0.00	-0.25	0.03	-0.25	0.51	-0.02	0.14	0.00	0.32	0.02	0.32	0.23	0.17	0.08
	(0.01)	(0.38)	(0.11)	(0.38)	(1.73)	(0.59)	(0.45)	(0.01)	(0.41)	(0.12)	(0.41)	(1.89)	(0.64)	(0.5)
Poland	0.00	-0.09	0.07	2.18	3.55	0.00	0.01	0.00	0.13	0.07	-0.14	0.30	0.18	0.14
	(0)	(0.26)	(0.66)	(2.42)	(2.23)	(0.58)	(0.49)	(0)	(0.29)	(0.73)	(2.65)	(2.44)	(0.63)	(0.53)
Romania	0.08	-0.15	0.13	-1.14	-0.98	0.32	0.23	-0.01	0.08	-0.15	0.45	-0.90	0.26	0.19
	(0.09)	(0.36)	(1.83)	(2.95)	(2.82)	(0.52)	(0.41)	(0.1)	(0.4)	(2)	(3.23)	(3.08)	(0.57)	(0.45)
Russia	0.01	0.14	9.65	0.34	2.83	0.42	0.05	0.16	-0.63	6.13	2.23	3.15	-0.33	-0.30
	(0.51)	(0.44)	(7.5)	(8.23)	(6.62)	(1.51)	(1.24)	(0.56)	(0.48)	(8.2)	(9)	(7.24)	(1.66)	(1.35)
Serbia	0.06	(0.82)	0.27	1.86	1.86	0.19	0.11	0.04	(0.89)	-1.03	0.06	0.06	-0.14	-0.12
	(0.09)	(0.38)	(3.84)	(10.19)	(10.19)	(0.75)	(0.59)	(0.1)	(0.42)	(4.2)	(11.14)	(11.14)	(0.82)	(0.64)
Ukraine	-1.57*	-0.43	17.74	22.92	n/a	-0.10	-0.49	-0.81	0.74	-3.73	-4.04	n/a	-0.22	-0.25
	(0.82)	(0.79)	(20.18)	(87.29)	n/a	(2.55)	(2.84)	(0.89)	(0.87)	(22.08)	(95.47)	n/a	(2.83)	(3.15)

Source: own calculations based on data from Reuters' Datastream and ECB policy announcements

Note: *** p<0.01, **p<0.05, *p<0.1. Standard errors are reported in parentheses.

VI. Transmission Channels

The ECB's policy announcements led to significant spillovers to REE countries, but it is central to identify the transmission channels through which they operated. We test for the presence of the *portfolio-rebalancing channel* and *confidence* channels. It is important to keep in mind that the *portfolio-rebalancing channel* operates via international capital flows. A rebalancing towards REE assets, or vice-versa, necessitates foreign exchange transactions. Therefore, a significant relationship between asset prices in the euro area and REE exchange rates on days of ECB policy announcements supports the theory that the *portfolio-rebalancing channel* transmitted spillover effects. The following regression estimates the relationship between euro area 10-year sovereign bond yields (Y_{EUR}) and daily exchange rates (FX) in five REE economies on ECB announcement days:

$$\Delta FX_{i,t} = \beta_0 + \beta_1 \Delta Y_{EUR,t} + \varepsilon_{i,t},$$

where *i* represents Czechia, Hungary, Poland, Romania and Serbia and *EUR* represents either German, French, Italian or Spanish 10-year sovereign bond yields. Only five REE countries were included, because all others follow an exchange rate anchor as the monetary policy framework. Germany, France, Italy and Spain are chosen as a representative set of euro area countries, given that the first two are considered non-crisis countries and the latter crisis countries. Exchange rates are converted into daily percent change and sovereign bond returns into daily percentage point changes. Figure 4 presents the results.

Figure 4: REE Foreign Exchange Rates vs. Euro Area Sovereign Bond Yields
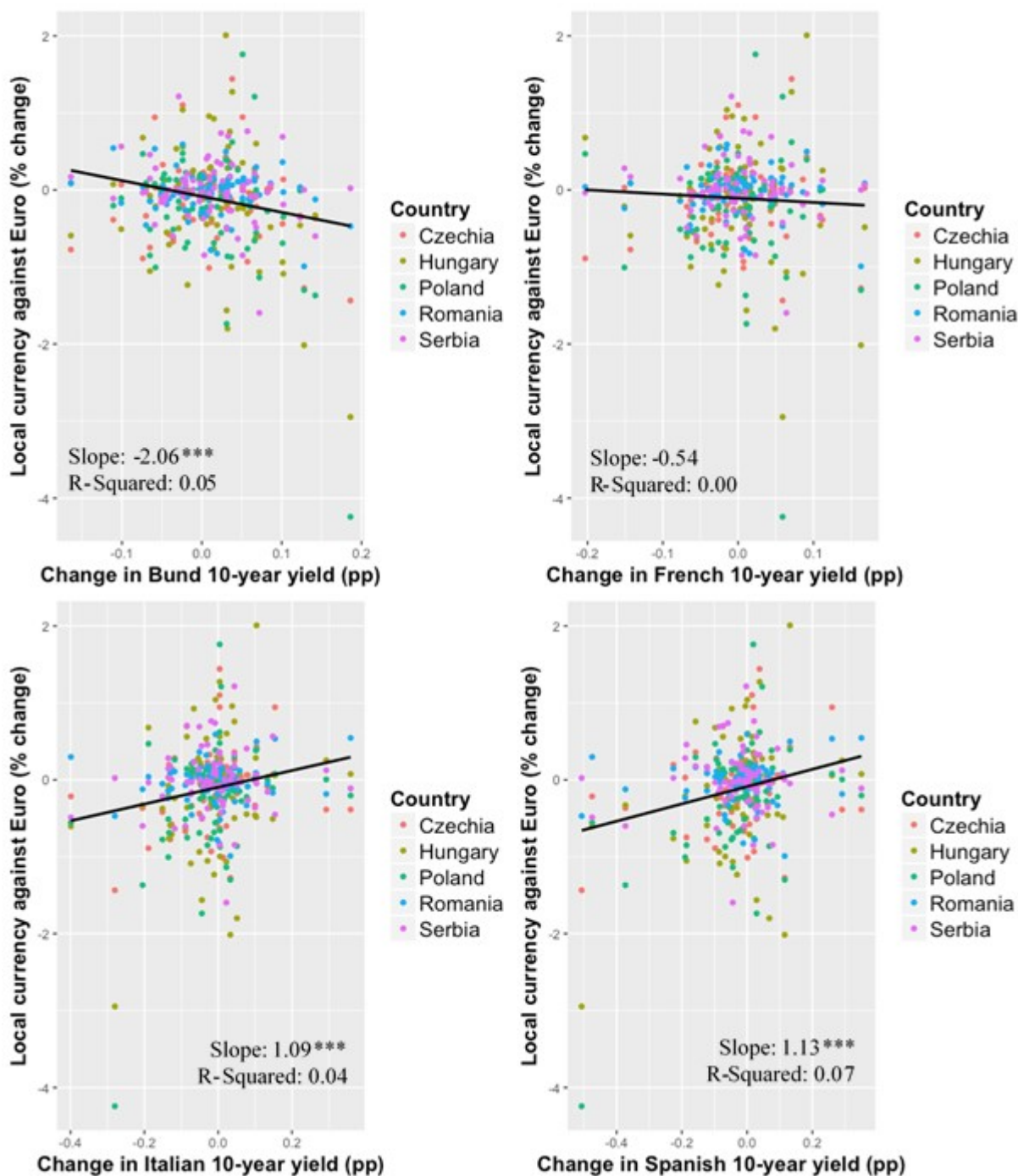
Source: own calculations based on data from Reuters' Datastream and ECB policy announcements.

The results presented in Figure 4, which plots changes in REE exchange rates against changes in euro area sovereign bond yields, indicate that the portfolio rebalancing channel played a significant role in transmitting ECB monetary policy to the REE region. For example, as ECB asset purchase programs lowered sovereign bond yields in Italy and

Spain, investors searched for higher risk-adjusted returns with REE assets as likely substitutes, particularly in non-euro EU countries. The substitution of REE assets for euro area assets represents an increase in demand for REE currencies. The positive regression coefficients on Italian and Spanish yields indicate that REE currencies appreciated as yields declined in response to ECB asset purchases through programs such as SMP. This suggests the presence of active portfolio rebalancing towards REE assets. Regressions on German and French sovereign bonds generated negative coefficients; however, only the coefficient on Bund yields is significant. Germany and France were not crisis countries and the ECB's purchases of sovereign bonds did not target either country. Instead, the opposite sign of regression coefficients for Germany and France provides evidence of the differences between crisis and non-crisis countries in the euro area (Jäger and Grigoriadis, 2017).

A second set of regressions tests the *confidence channel*. The following regression tests the *confidence channel* by regressing daily stock market returns to the Europe MSCI Index on returns to stock market indices in REE countries on days of ECB announcements:

$$\Delta MSCI_{i,t} = \beta_0 + \beta_1 \Delta MSCI_{EUR,t} + \varepsilon_{i,t}$$

Table 10: Confidence channel test: REE MSCI Indices vs. Europe MSCI Index

	Coef.	Std. Err.	t	P > |t|
Bulgaria	0.06	0.08	0.66	0.52
Croatia	0.08	0.06	1.34	0.19
Czechia	0.38***	0.07	5.69	< 0.00
Hungary	0.78***	0.09	8.62	< 0.00
Latvia	0.18***	0.06	3.25	< 0.00
Lithuania	0.05	0.07	0.78	0.44
Poland	0.51***	0.08	6.33	< 0.00
Romania	0.61***	0.09	6.57	< 0.00
Russia	0.53***	0.06	8.11	< 0.00
Serbia	0.14	0.11	1.30	0.20
Ukraine	0.10	0.10	1.06	0.29

Source: own calculations based on data from Reuters' Datastream and ECB policy announcements. Note: *** p<0.01, **p<0.05, *p<0.1

Figure 5: REE MSCI Indices vs. Europe MSCI Index (2009-2017)
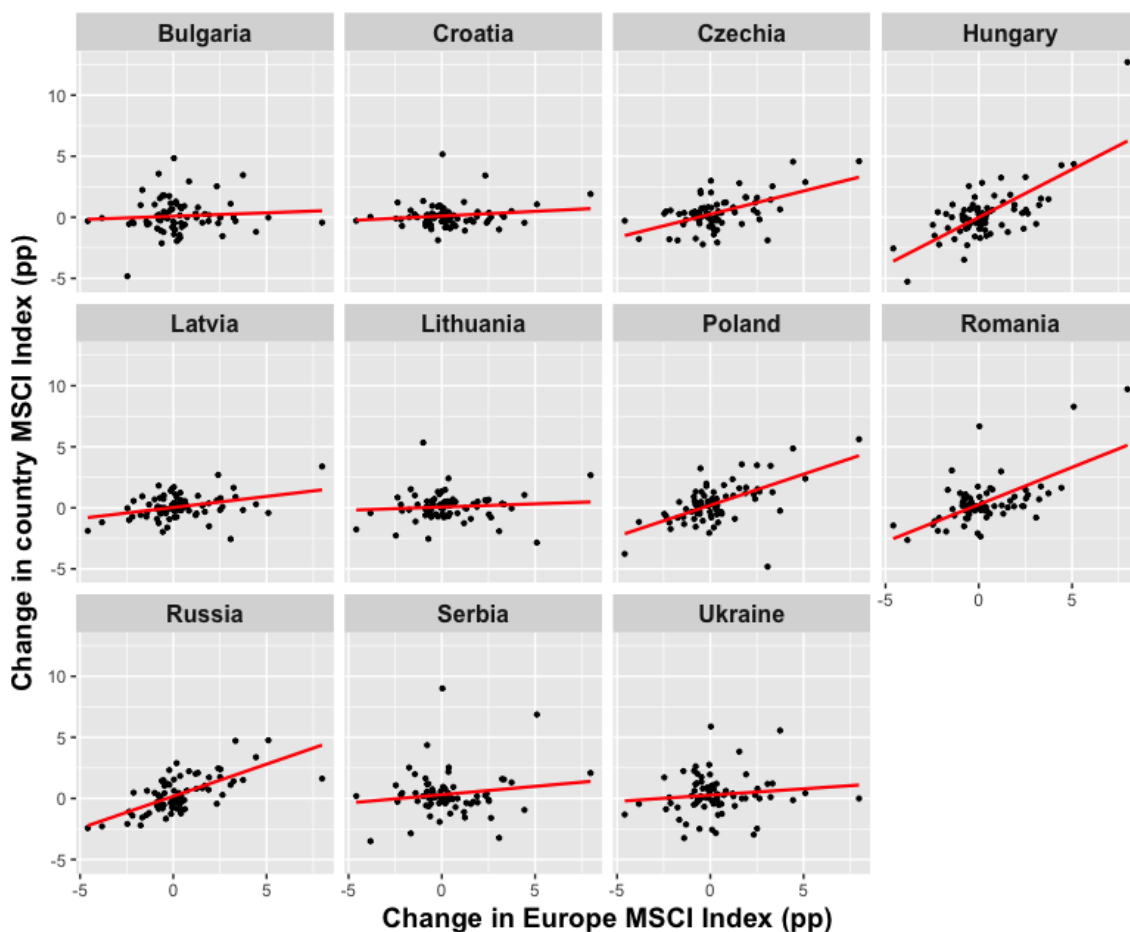
Source: own calculations based on data from Reuters' Datastream and ECB policy announcements.

The presence of the *confidence channel* suggests strong correlation between stock prices in the euro area and REE countries. The scatterplots of stock market returns presented in Figure 5 show significant correlation between stock market returns in six of the eleven sample countries (Czechia, Hungary, Latvia, Poland, Romania and Russia) and ECB policy announcements. The positive coefficients presented in Table 10 indicate that when returns on the Europe MSCI index are positive, REE returns are also positive, and vice versa. This high level of comovement suggests the *confidence channel* played a role in transmitting spillovers from ECB announcements to REE economies.

VII. Conclusions

This paper provides evidence that asset-purchasing program announcements generated stronger spillover effects than liquidity-providing measures. While liquidity-providing measures such as LTROs, FRFA and FOR primarily produced spillovers to CDS spreads and exchange rates in non-euro EU economies only, asset-purchase related

announcements impacted all asset classes more broadly and across a larger set of REE countries.

With respect to individual programs, the SMP has generated the most significant spillover effects, in terms of both asset classes and countries affected. For example, SMP announcements led to declines in 3-year sovereign bond yields of 36 bps in Bulgaria, 58 bps in Hungary, 37 bps in Poland and 98 bps in Romania. Moreover, they produced declining 5- and 10-year CDS spreads in every sample country except Serbia and 5-year CDS spread in Ukraine. These spillovers were likely driven by the lack of forward guidance given by the ECB regarding the SMP.

The analysis of this paper also provides evidence of time-varying spillover effects. Split-sample regressions show that announcements in the first half of the sample period (2009-2012) led to more spillovers than later programs. Furthermore, CBPP1, implemented in 2009, generated the most spillover effects, while CBPP2 and CBPP3 led to far fewer significant spillovers. More importantly, the ECB continuously increased its forward guidance throughout the crisis, a fact mirrored by the decline in significant spillover effects in later programs. In the absence of forward guidance early in the crisis, the ECB's monetary policy announcements generated significant spillover effects, whereas announcements made later in the crisis generated very few spillovers. The utter lack of spillovers related to policy announcements from CBPP2, CBPP3, PSPP, CSPP and ABSPP shows that forward guidance is indeed an effective monetary policy tool which completely changed the timing of transmission of monetary policy spillovers. In this regard, other empirical methods are necessary to test for spillover effects in the presence of forward guidance.

Empirical tests of monetary policy transmission channels show that both the *portfolio rebalancing channel* and *confidence channel* transmitted spillovers to REE economies. The presence of the *portfolio rebalancing channel* is justified by significant relationships between euro area crisis-country bond yields and REE exchange rate fluctuations on days of ECB announcements. A second test detects the presence of the *confidence channel* in comovement between stock market indices in the euro area and REE countries around ECB announcements. These transmission channels were not mutually exclusive, but rather worked simultaneously. Further research is required to evaluate the persistence of spillover effects, particularly with respect to the bilateral nature of spillovers and the role of monetary policy frameworks and exchange rate regimes.

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Appendix

Table A.1: List of ECB non-standard monetary policy announcements

Date	Event	Source
16/01/2009	FOR	ECB
03/02/2009	FOR	Falagiarda et al. (2015)
05/03/2009	FRFA, LTRO	Falagiarda et al. (2015)
19/03/2009	FOR	Falagiarda & Reitz (2015), Falagiarda et al. (2015)
06/04/2009	FOR	Falagiarda & Reitz (2015), Falagiarda et al. (2015)
07/05/2009	LTRO, CBPP	Falagiarda & Reitz (2015), Kilponen et al. (2015), Rivolta (2014), ECB Monthly Bulletin (Jan. 2010), Falagiarda et al. (2015)
04/06/09	CBPP	Falagiarda & Reitz (2015), Kilponen et al. (2015), Rivolta (2014), Falagiarda et al. (2015)
10/06/2009	FOR	ECB
25/06/2009	FOR	Falagiarda & Reitz (2015), Falagiarda et al. (2015)
24/09/2009	FOR	Falagiarda & Reitz (2015), Falagiarda et al. (2015)
20/11/2009	COLL	ECB
03/12/2009	FRFA, LTRO	Falagiarda & Reitz (2015), Rivolta (2014), Falagiarda et al. (2015)
15/12/2009	LTRO	Rivolta (2014)
27/01/2010	FOR	ECB
04/03/2010	FRFA, LTRO	Falagiarda & Reitz (2015), ECB Monthly Bulletin (Oct. 2012), Falagiarda et al. (2015)
15/03/2010	FOR	ECB
08/04/2010	COLL	Kilponen et al. (2015)
03/05/2010	COLL	Kilponen et al. (2015)
10/05/2010	SMP, LTRO, FRFA, FOR	Falagiarda & Reitz (2015), Kilponen et al. (2015), Rivolta (2014), ECB Monthly Bulletin (Oct. 2012), Falagiarda et al. (2015)
10/06/2010	LTRO	Falagiarda & Reitz (2015), ECB Monthly Bulletin (Oct. 2012), Falagiarda et al. (2015)
02/09/2010	FRFA, LTRO	Falagiarda & Reitz (2015), ECB Monthly Bulletin (Oct. 2012), Falagiarda et al. (2015)
02/12/2010	LTRO, FRFA	Falagiarda & Reitz (2015), ECB Monthly Bulletin (Oct. 2012), Falagiarda et al. (2015)
17/12/2010	FOR	Falagiarda & Reitz (2015), Falagiarda et al. (2015)
21/12/2010	FOR	Falagiarda & Reitz (2015), Falagiarda et al. (2015)
03/03/2011	FRFA, LTRO	Falagiarda & Reitz (2015), ECB Monthly Bulletin (Oct. 2012), Falagiarda et al. (2015)
09/06/2011	FRFA, LTRO	Falagiarda & Reitz (2015), ECB Monthly Bulletin (Oct. 2012), Falagiarda et al. (2015)
29/06/2011	FOR	Falagiarda & Reitz (2015), Falagiarda et al. (2015)
07/07/2011	COLL	Kilponen et al. (2015), Falagiarda et al. (2015)
04/08/2011	FRFA, LTRO	Falagiarda & Reitz (2015), Kilponen et al. (2015), ECB Monthly Bulletin (Oct. 2012), Falagiarda et al. (2015)
07/08/2011	SMP	Rivolta (2014), Falagiarda & Reitz (2015), Falagiarda et al.

		(2015)
25/08/2011	FOR	Falagiarda & Reitz (2015), Falagiarda et al. (2015)
15/09/2011	FOR	Falagiarda & Reitz (2015), Falagiarda et al. (2015)
06/10/2011	FRFA, LTRO, CBPP2	Falagiarda & Reitz (2015), Rivolta (2014), Kilponen et al. (2015), ECB Monthly Bulletin (Oct. 2012), Falagiarda et al. (2015)
03/11/2011	CBPP2	Falagiarda & Reitz (2015), Rivolta (2014), Falagiarda et al. (2015)
30/11/2011	FOR	Falagiarda & Reitz (2015), Falagiarda et al. (2015)
08/12/2011	LTRO, COLL	Falagiarda & Reitz (2015), Kilponen et al. (2015), Rivolta (2014), ECB Monthly Bulletin (Oct. 2012)
16/12/2011	LTRO	ECB
09/02/2012	COLL	Falagiarda & Reitz (2015), ECB Monthly Bulletin (Oct. 2012), ECB Monthly Bulletin (Jan. 2014), Falagiarda et al. (2015)
28/02/2012	LTRO, COLL	Rivolta (2014), Kilponen et al. (2015), Falagiarda et al. (2015)
08/03/2012	COLL	Kilponen et al. (2015)
06/06/2012	FRFA, LTRO	Falagiarda & Reitz (2015), ECB Monthly Bulletin (Oct. 2012), ECB Monthly Bulletin (Jan. 2014), Falagiarda et al. (2015)
22/06/2012	COLL	Falagiarda & Reitz (2015), Kilponen et al. (2015), Falagiarda et al. (2015)
20/07/2012	COLL	Kilponen et al. (2015)
26/07/2012	OMT	Falagiarda & Reitz (2015), Kilponen et al. (2015), Rivolta (2014), Falagiarda et al. (2015)
02/08/2012	OMT	Rivolta (2014), Falagiarda et al. (2015)
27/08/2012	OMT	Falagiarda & Reitz (2015)
6/09/2012	OMT, COLL	Falagiarda & Reitz (2015), Kilponen et al. (2015), ECB Monthly Bulletin (Oct. 2012), ECB Monthly Bulletin (Jan. 2014), Falagiarda et al. (2015)
12/09/2012	FOR	Falagiarda & Reitz (2015), Falagiarda et al. (2015)
31/10/2012	CBPP2	ECB
6/12/2012	FRFA, LTRO	Falagiarda & Reitz (2015), ECB Monthly Bulletin (Jan. 2014), Falagiarda et al. (2015)
13/12/2012	FOR	Falagiarda & Reitz (2015), Falagiarda et al. (2015)
22/03/2013	COLL	Kilponen et al. (2015), Falagiarda et al. (2015)
02/05/2013	COLL, LTRO, FRFA	Kilponen et al. (2015)
28/06/2013	COLL	Kilponen et al. (2015)
16/09/2013	FOR	ECB, Falagiarda et al. (2015)
10/10/2013	FOR	ECB
31/10/2013	FOR	ECB, Falagiarda et al. (2015)
05/06/2014	TLTRO, OMT, FRFA, COLL	ECB, Falagiarda et al. (2015)
17/06/2014	FOR	ECB, Falagiarda et al. (2015)
03/07/2014	TLTRO	ECB, Falagiarda et al. (2015)
05/07/2014	LTRO, COLL	ECB, Kilponen et al. (2015)
29/07/2014	TLTRO	Falagiarda et al. (2015)
04/09/2014	ABSPP, CBPP3	Falagiarda et al. (2015)

18/09/2014	TLTRO	Falagiarda et al. (2015)
02/10/2014	CBPP3, ABSPP	ECB, Falagiarda et al. (2015)
17/11/2014	PSPP	Falagiarda et al. (2015)
26/11/2014	PSPP	Falagiarda et al. (2015)
04/12/2014	PSPP	Falagiarda et al. (2015)
22/01/2015	ABSPP, CBPP3, TLTRO, PSPP	Falagiarda et al. (2015), ECB
23/09/2015	ABSPP	ECB
10/03/2016	TLTRO, CSPP	ECB
21/04/2016	CSPP	ECB
02/06/2016	CSPP	ECB
27/09/2016	FOR	ECB
05/10/2016	COLL	ECB
08/12/2016	PSPP	ECB
15/12/2016	ABSPP	ECB
19/01/2017	PSPP, CBPP3, ABSPP, CSPP	ECB
26/10/2017	APP, CSPP, ABSPP, PSPP, CBPP3	ECB
14/12/2017	COLL	ECB

Table A.2: List of European Stability Mechanism policy announcements

Date	Event	Source
09/05/2010	EFSF/ESM	Kilponen et al. (2015), Jäger & Grigoriadis (2017)
28/10/2010	EFSF/ESM	Kilponen et al. (2015), Jäger & Grigoriadis (2017)
29/11/2010	EFSF/ESM	Kilponen et al. (2015), Jäger & Grigoriadis (2017)
16/12/2010	EFSF/ESM	Kilponen et al. (2015), Jäger & Grigoriadis (2017)
21/03/2011	EFSF/ESM	Kilponen et al. (2015), Jäger & Grigoriadis (2017)
20/06/2011	EFSF/ESM	Kilponen et al. (2015), Jäger & Grigoriadis (2017)
21/07/2011	EFSF/ESM	Kilponen et al. (2015), Jäger & Grigoriadis (2017)
29/11/2011	EFSF/ESM	Kilponen et al. (2015), Jäger & Grigoriadis (2017)
02/02/2012	EFSF/ESM	Kilponen et al. (2015), Jäger & Grigoriadis (2017)
30/03/2012	EFSF/ESM	Kilponen et al. (2015), Jäger & Grigoriadis (2017)
09/07/2012	EFSF/ESM	Kilponen et al. (2015), Jäger & Grigoriadis (2017)

Table A.3: Reuters DataStream Time Series Codes for Country Level Data

	Exchange rate	Stock market index	Interbank rate (3M)	Sovereign bond yield	Sovereign bond yield	Credit default	Credit default

				(3Y)	(10Y)	swap (5Y)	swap (10Y)
Bulgaria	BLECBSP	MSBLGNL	BLIBK3M	TRBL3YT	TRBL10T	BGV5$AC	BGVA$AC
Croatia	CTEUOSP	MSCROAL	ZIBOR3M	TRHR3YT	TRHR10T	HRG5$AC	HRGA$AC
Czechia	CZECBSP	MSCZCHL	PRIBK3M	TRCZ3YT	TRCZ10T	CZG5$AC	CZGA$AC
Hungary	HNEU.NB	MSHUNGL	HNIBK3M	TRHN3YT	TRHN10T	HUG5$AC	HUGA$AC
Latvia	LVEURSP	LNVILSE	LVIBK3M	TRLV3YT	TRLV10T	LVG5$AC	LVGA$AC
Lithuania	LNEURSP	MSLITHL	LNIBK3M	TRLT3YT	TRLT10T	LTG5$AC	LTGA$AC
Poland	POEU.SP	MSPLNDL	POWIB3M	TRPO3YT	TRPO10T	PLG5$AC	PLGA$AC
Romania	RMECBSP	MSROMNL	RMIBK3M	TRRO3YT	TRRO10T	ROV5$AC	ROVA$AC
Russia	RSEU.SP	MSRUSSL	MOWIB3M	TRRS3YT	TRRS10T	RUG5$AC	RUGA$AC
Serbia	SBEURSP	MSSERBL	BELIB3M	TRSB5YT	TRSB5YT	RSV5$AC	RSVA$AC
Ukraine	UREURSP	MSUKRNL	UAHIB3M	TRUAZ2Y	-	UAG5$AC	UAGA$AC
Germany	-	-	-	-	TRBD10T	-	-
France	-	-	-	-	TRFR10T	-	-
Italy	-	-	-	-	TRIT10T	-	-
Spain	-	-	-	-	TRES10T	-	-

Note: On Serbia there is data on 5Y rather than 3Y bonds due to data availability. On Ukraine there is data on 2Y rather than 3Y bonds.

Table A.4: Reuters DataStream Time Series Codes for Control Variables

ECB Marginal Lending Facility	EUROMLR
ECB Main Refinancing Operations	EMYRVAM
MSCI EUROPE Price Index	MSEROP$
VSTOXX Volatility Index	VSTOXXI

Table A.5: Summary Statistics of the Financial Variables of Interest

Country	Variable	Mean	Max	Min	Variance
Bulgaria	Foreign Exchange	1.96	1.96	1.96	0.00
	Stock Market	175.33	277.51	94.99	1,768.92
	3M Interbank (pp)	1.57	6.87	-0.18	2.80
	3Y Sovereign Bond (pp)	2.23	6.73	-0.05	3.04
	10Y Sovereign Bond (pp)	4.16	8.36	1.15	3.36
	5Y Credit Default Swap (bps)	202.30	692.65	90.16	10,444.92
	10Y Credit Default Swap (bps)	233.66	667.56	128.76	7,499.37
Croatia	Foreign Exchange	7.49	7.72	7.18	0.02
	Stock Market	578.24	783.30	390.99	5,483.66
	3M Interbank (pp)	2.32	11.65	0.30	6.84
	3Y Sovereign Bond (pp)	3.65	6.93	0.46	2.62
	10Y Sovereign Bond (pp)	5.01	7.47	2.29	2.06
	5Y Credit Default Swap (bps)	285.61	592.50	104.29	9,253.46
	10Y Credit Default Swap (bps)	319.46	602.00	158.69	8,269.70
Czechia	Foreign Exchange	26.18	29.49	24.02	1.16
	Stock Market	288.83	392.92	208.14	2,395.14

	3M Interbank (pp)	0.66	3.43	0.17	0.39
	3Y Sovereign Bond (pp)	1.03	4.06	-0.92	1.36
	10Y Sovereign Bond (pp)	2.38	5.89	0.24	2.45
	5Y Credit Default Swap (bps)	76.86	350.00	38.59	1,949.25
	10Y Credit Default Swap (bps)	98.30	330.00	63.51	1,412.91
Hungary	Foreign Exchange	295.62	321.93	261.60	260.30
	Stock Market	1,124.87	1,859.79	516.63	71,944.19
	3M Interbank (pp)	4.09	10.00	0.03	8.06
	3Y Sovereign Bond (pp)	4.95	14.60	0.47	8.91
	10Y Sovereign Bond (pp)	5.93	12.72	2.08	5.43
	5Y Credit Default Swap (bps)	262.61	729.89	90.05	18,529.13
	10Y Credit Default Swap (bps)	290.22	718.94	135.53	14,790.20
Latvia	Foreign Exchange	0.70	0.71	0.70	0.00
	Stock Market	1.64	23.50	0.16	12.28
	3M Interbank (pp)	479.66	1,052.77	203.16	34,949.52
	3Y Sovereign Bond (pp)	6.26	16.00	0.05	10.30
	10Y Sovereign Bond (pp)	4.69	17.00	0.54	18.34
	5Y Credit Default Swap (bps)	221.67	1,176.30	46.96	42,887.92
	10Y Credit Default Swap (bps)	244.06	1,085.90	85.33	28,672.18
Lithuania	Foreign Exchange	3.45	3.45	3.45	0.00
	Stock Market	1,001.02	1,217.73	495.94	22,607.64
	3M Interbank (pp)	1.45	9.89	0.00	4.54
	3Y Sovereign Bond (pp)	2.85	319.11	0.04	50.83
	10Y Sovereign Bond (pp)	4.32	15.14	0.40	13.08
	5Y Credit Default Swap (bps)	185.12	850.00	52.63	20,891.12
	10Y Credit Default Swap (bps)	212.07	780.00	88.45	14,155.14
Poland	Foreign Exchange	4.20	4.90	3.84	0.02
	Stock Market	1,604.09	2,035.73	894.02	42,732.50
	3M Interbank (pp)	3.07	5.78	1.55	1.60
	3Y Sovereign Bond (pp)	3.51	6.03	1.43	1.90
	10Y Sovereign Bond (pp)	4.41	6.48	2.00	1.74
	5Y Credit Default Swap (bps)	117.81	421.00	50.56	4,269.33
	10Y Credit Default Swap (bps)	152.39	396.00	91.26	3,081.17
Romania	Foreign Exchange	4.39	4.66	4.02	0.02
	Stock Market	647.94	1,074.54	187.77	34,876.24
	3M Interbank (pp)	4.16	14.73	0.49	11.54
	3Y Sovereign Bond (pp)	5.22	15.02	1.14	10.66
	10Y Sovereign Bond (pp)	6.01	11.50	2.66	5.55
	5Y Credit Default Swap (bps)	226.02	767.70	95.74	15,490.50
	10Y Credit Default Swap (bps)	255.86	742.70	99.00	12,311.44
Russia	Foreign Exchange	51.82	91.18	37.42	183.06
	Stock Market	774.33	1,026.02	348.85	12,022.43
	3M Interbank (pp)	9.12	23.72	3.89	13.42
	3Y Sovereign Bond (pp)	8.54	18.43	5.49	5.51
	10Y Sovereign Bond (pp)	8.85	16.24	6.44	3.32
	5Y Credit Default Swap (bps)	231.11	793.20	116.41	13,575.98
	10Y Credit Default Swap (bps)	266.00	708.70	143.75	9,314.93
Serbia	Foreign Exchange	111.94	124.06	88.61	96.28
	Stock Market	369.03	551.19	172.79	3,684.97

	3M Interbank (pp)	9.02	19.18	3.05	15.70
	5Y Sovereign Bond (pp)	7.32	13.51	3.31	7.70
	10Y Sovereign Bond (pp)	7.32	13.51	3.31	7.70
	5Y Credit Default Swap (bps)	323.44	700.00	129.29	10,644.98
	10Y Credit Default Swap (bps)	366.51	650.00	164.26	8,323.07
Ukraine	Foreign Exchange	16.96	37.85	9.45	62.19
	Stock Market	262.80	657.81	109.83	16,433.29
	3M Interbank (pp)	15.48	32.16	3.59	36.61
	2Y Sovereign Bond (pp)	17.71	47.57	-17.88	20.39
	10Y Sovereign Bond (pp)	n/a	n/a	n/a	n/a
	5Y Credit Default Swap (bps)	2,636.00	15,028.76	406.77	18,375,057.66
		2,445.47	13,402.61	443.50	15,597,676.77

Table A.6: Index of Openness for Russia and Eastern Europe

Country	1990	1995	2000	2005	2010	2015
Bulgaria	69.8%	101.8%	78.3%	100.5%	103.2%	128.1%
Croatia	-	63.5%	76.0%	84.2%	75.7%	94.1%
Czechia	63.8%	83.9%	98.2%	122.0%	129.0%	156.1%
Hungary	-	78.2%	137%	127.3%	158.3%	171.6%
Latvia	-	73.9%	81.7%	100.8%	108.8%	121.3%
Lithuania	-	84.9%	83.3%	114.9%	132.6%	152.2%
Poland	45.3%	43.7%	60.8%	70.3%	82.1%	96.0%
Romania	42.9%	55.9%	70.7%	75.9%	71.3%	82.6%
Russia	36.1%	55.2%	68.1%	56.7%	50.4%	49.2%
Serbia	-	23.2%	24.2%	74.3%	80.8%	103.1%
Ukraine	56.4%	97.2%	119.8%	102.1%	98.1%	107.1%

Source: World Bank Series Trade (% of GDP).

Table A.7: Trade with the Euro Area (% of total trade)

Country	1990	1995	2000	2005	2010	2015
Bulgaria	43.2%	35.6%	45.0%	49.8%	43.2%	45.8%
Croatia	-	67.4%	61.4%	55.1%	50.7%	58.8%
Czechia	-	65.9%	67.3%	68.7%	63.6%	62.1%
Hungary	43.0%	60.5%	63.6%	59.9%	54.9%	59.0%
Latvia	-	41.5%	50.5%	52.8%	53.5%	52.8%
Lithuania	-	35.3%	41.5%	42.1%	39.3%	42.2%
Poland	43.2%	59.4%	58.8%	60.5%	57.5%	56.9%
Romania	23.4%	49.7%	54.8%	51.6%	53.0%	54.4%
Russia	-	34.9%	36.0%	41.1%	35.2%	35.4%
Serbia	-	-	-	-	38.2%	42.5%
Ukraine	-	15.5%	20.3%	21.0%	17.8%	23.0%

Source: own calculations based on the IMF's Direction of Trade Statistics.

Source: own calculations based on data from the Reuters' Datastream

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