Weathering global shocks and macrofinancial vulnerabilities in emerging Europe: Comparing Turkey and Poland

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While both Turkey and Poland weathered the 2008/2009 crisis relatively well compared to other countries in Central, Eastern and Southeastern Europe (CESEE), their macrofinancial indicators responded fairly strongly to the Federal Reserve System's tapering announcement in May 2013. Among other things, marked currency depreciation and reversals in capital flows challenged policymakers in the region. To get a deeper understanding of the transmission of global shocks to macrofinancial variables in CESEE, we use a Bayesian global vector autoregressive model to investigate the effects of a U.S.-based monetary policy shock. Our simulation results suggest that both Turkey and Poland exhibit pronounced short- to medium-run macroeconomic responses to U.S. monetary policy shocks. The responses of Turkey tend to be somewhat stronger than those of Poland and the CESEE average, signaling the structurally different nature of the Turkish economy. Overall, the identified impulse responses largely resemble the actual post-tapering announcement developments.

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Central, Eastern and Southeastern Europe (CESEE[2]) was one of the fastest-growing regions in the world, with average annual real GDP growth rates of around 6.5% between 2003 and 2007. This outstanding growth performance was mainly driven by large foreign capital inflows, which fueled domestic credit growth, led to a surge in asset prices (in particular housing prices) and considerably boosted domestic demand. However, sizable GDP growth was generated on the back of rising vulnerabilities. Soaring prices and wages were one of the consequences of sharply rising domestic demand. As a matter of fact, double-digit inflation rates were not unusual during the pre-2008 boom years in several countries. Not only was lending growth in the years preceding the crisis very strong, but a large part of domestic loans to households and nonfinancial corporates was also denominated in foreign currency in a number of CESEE countries. Growing internal imbalances were also reflected in the development of the external sector. Increasing internal demand led to an appreciation of the exchange rate in countries with floating exchange rate regimes, which made exports more expensive and led to the buildup of substantial current account deficits in a number of countries.

Apparently, CESEE countries that were subject to stronger vulnerabilities and imbalances up to 2007 were hit harder during the 2008/2009 global financial crisis (see EBRD, 2009, or Bakker and Klingen, 2012). A sudden stop of capital

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[2] *Unless mentioned otherwise, our data is for the 11 CESEE EU Member States (CESEE-11: Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia) and Turkey (referred to as the 12 CESEE economies in the following).*

inflows in the fall of 2008 triggered a sharp contraction of domestic demand, just when the slump in global trade hit the region's exports. This halt in capital inflows was a combination of a liquidity (credit supply) shock and a slump in export demand. The "Vienna Initiative," which ensured that banks maintained an exposure to subsidiaries in CESEE, together with stabilization packages of international financial institutions and the European Union (EU), was decisive in avoiding a much sharper contraction.

Only a few economies managed to escape relatively unscathed. Poland and Turkey share a rather favorable management of the 2008/2009 global financial crisis. In contrast to all the other EU countries, Poland did not experience a recession, while Turkey, after a short-lived contraction in 2009, quickly returned to sizable GDP growth rates. From 2010 to 2012, when foreign investors searched for yields in a low-interest global environment, both countries were among the main magnets for foreign capital in CESEE, with inflows approaching pre-crisis magnitudes. But the U.S. tapering announcement in May 2013 triggered a sharp repricing of risks and had large effects on emerging markets, resulting in substantial drops in stock market indices and large exchange rate depreciations (IMF, 2013; Aizenman et al., 2014). Both Poland and Turkey were affected, reflecting that CESEE is one of the regions which are perceived to be vulnerable to "risk on" and "risk off" modes (Bernanke, 2012) in global financial markets. These countries' particular way of managing the series of global economic and financial shocks since 2008, together with the fact that Poland and Turkey are the two largest economies in the investigated CESEE region, motivated a focus on these two countries in this article.

The paper is structured as follows: Section 1 discusses the reasons behind the relative success of Poland and Turkey in managing the impact of the 2008/2009 global financial crisis comparatively well. Section 2 looks at the post-2009 evolvement of macrofinancial risks in a comparative perspective, with a special emphasis on external vulnerabilities and banking sector risks. Section 3 studies the transmission of a contractionary monetary policy shock in the U.S.A. – exemplary for a global-scale, external shock – to domestic macroeconomic variables by means of a global vector autoregressive (GVAR) model. Section 4 concludes.

1 Poland and Turkey perform outstandingly in weathering the 2008/2009 crisis

During the 2008/2009 crisis, the CESEE region as a whole suffered larger output declines than any other region in the world (Berglöf et al., 2009). However, cross-country variation in crisis-related output declines was large. While several CESEE countries have still not been able to achieve significantly larger GDP than in 2008, Turkey and Poland in 2014 surpassed their 2008 GDP levels (at market prices) by 24% and 19%, respectively.

Poland was the only country in the EU to avoid a recession in 2009. Thereafter, it posted average annual real GDP growth of around 3% through 2014. Several factors are responsible for this success (EBRD, 2009; Bakker and Klingen, 2012): In the years before the crisis, Poland avoided significant macroeconomic imbalances, reduced fiscal deficits to 2% of GDP in 2007, ensured that inflation expectations were well-anchored, and restrained strong lending in foreign

currency early on. As a consequence, at about 24%, the share of domestic foreign exchange loans in total loans to the nonbank private sector was one of the lowest shares in the region in 2007. A Financial Stability Committee that issues early warnings and recommendations was established already in 2008.

When the crisis hit, exports contracted sharply and asset prices declined amid a sharp slowdown of capital inflows. But Poland had built up enough space to conduct countercyclical policies, implementing fiscal stimulus measures and lowering policy rates from 6% to 3.5% and reserve requirement rates from 3.5% to 3%. Prior to the crisis of 2008/2009, the Polish government lowered taxes in an effort to curb domestic consumption. As the Polish economy's export dependence is comparatively low, these fiscal stimulus measures helped to diminish the impact of the crisis significantly. The exchange rate appreciated by 50% against the euro between 2004 and 2008 and played a shock-absorbing role during the crisis when the złoty depreciated by 30% against the euro through February 2009 (see Stątżka-Gawrysiak, 2009). Furthermore, liquidity (foreign exchange swaps) and banking stabilization measures (increase in the deposit insurance limit, credit guarantee program) were taken. Also, the (unused) IMF Flexible Credit Line of 2009 was effective in stabilizing market expectations and helped maintain access to international capital markets (Bakker and Klingen, 2012).

Like Poland, Turkey experienced robust growth in the run-up to the crisis. Given low domestic savings, growth was largely fueled by capital inflows. But the real exchange rate appreciation led to the buildup of current account deficits, with the current account moving from a surplus in 2001 into a deficit of about 6% of GDP in 2007. In 2009, Turkey suffered a relatively moderate recession – compared to other countries in the region – followed by an immediate and very significant recovery in 2010 and 2011 and a renewed moderation of growth thereafter. As a result, Turkey's average annual real GDP growth rate of about 5.5% between 2010 and 2014 was not only one of the largest in the region but also associated with comparatively strong volatility.

The resilience of the Turkish economy and in particular of the Turkish banking sector during the short, V-shaped recession can be partly explained by the legacy of financial system restructuring and by the early implementation of macroprudential tools in the aftermath of the crisis of 2001, which led to benign credit growth (Akkoyun et al., 2013). In 2007, the share of foreign currency loans in total loans to resident private nonbanks was about 30%, somewhat below the CESEE average. Foreign currency lending of corporates was restrained, and in 2009, banks were prohibited from lending in foreign currency (or foreign-indexed loans) to households. In 2008, dividend payouts were curtailed to bolster bank-retained earnings and capital. During the crisis, banks' capital adequacy ratios were higher than the Basel II requirement of 8%. Another factor behind Turkey's relative crisis resilience was the swift and decisive use of countercyclical macroeconomic policies during 2008/2009 (Bakker and Klingen, 2012). Turkey implemented a fiscal stimulus package, and the Turkish central bank (Türkiye Cumhuriyet Merkez Bankası, TCMB) lowered the policy rate by 10.25 percentage points between the end of 2008 and 2009. Reserve requirements were reduced as well. As a consequence, the exchange rate depreciated and the current account deficit declined.

In the run-up to and during the 2008/2009 crisis, Poland and Turkey shared some similarities. Both instituted macroeconomic reforms that created room for maneuver to conduct countercyclical policies during the crisis. Another parallel is the early use of macroprudential tools, in particular to curb foreign currency lending.

2 Macrofinancial risks in a comparative perspective

Picking up the argument that countries might be hit more strongly by external shocks if domestic macrofinancial vulnerabilities are more pronounced (e.g. EBRD, 2009; Bakker and Klingen, 2012; IMF, 2013; Mishra et al., 2014), this section aims to provide a brief overview of the macrofinancial risk profiles of Turkey and Poland by investigating the developments of capital flows, exchange rates, cross-border banking and domestic banking sector stability indicators since 2009 in general and since the Federal Reserve System's (Fed's) tapering announcement in May 2013 in particular.

Macrofinancial developments in emerging market economies after 2009 can be characterized by two different stages. During the 2010 to 2012 period, capital inflows resumed quite strongly, associated with a shift of capital from low yields in advanced economies to higher returns in emerging markets. At the same time, private sector credit growth regained momentum. However, Federal Reserve Chairman Ben Bernanke's remark before the U.S. Congress on May 22, 2013, that the Federal Open Market Committee could take a step down in the pace of asset purchases if economic improvement appeared to be sustained (Bloomberg, 2013) stood for a new turning point. This indication of a phaseout of the Fed's expansionary monetary policy stance and the related expectation of an increase in interest rates in the U.S.A. implied sizable capital outflows and/or a reduction in capital inflows as well as a depreciation of currencies in emerging markets. As a result, several emerging market economies, including Turkey, sharply hiked policy rates in early 2014 to stabilize their exchange rates and to rein in capital outflows. However, macrofinancial pressure on emerging markets has continued not only due to tapering in the U.S.A., eventually followed by the first hike in the federal funds rate in December 2015 in seven years from near zero, but also due to geopolitical tensions and a cooling-off of the Chinese economy. At the same time, expansionary monetary policy in the euro area was intensified in March 2015 with the start of the Eurosystem's Public Sector Purchase Programme, which is likely to have cushioned, at least to a certain extent, the international spillovers of tighter monetary policy in the U.S.A.[3]

The spillovers of advanced economies' monetary policy decisions to emerging markets point to pronounced global macrofinancial interdependencies. It should be noted that domestic macroeconomic fundamentals in emerging markets play a decisive role, too. Apparently, emerging market economies with stronger macroeconomic fundamentals, deeper financial markets, and a tighter macroprudential

[3] *So far, there is hardly any empirical evidence on the international spillovers of combined monetary policy shocks in the U.S.A. and the euro area. Chen et al. (2015) use a global vector error correction framework to compare the impact of unconventional monetary policy measures both in the U.S.A. and in the euro area. They find that U.S. unconventional monetary policy generally has stronger domestic and cross-border impacts than euro area nonstandard measures; this partly also holds for the cross-border transmission to selected CESEE countries. Feldkircher (2015) resorts to a global vector autoregression model and shows that the real economy in CESEE reacts nearly equally strongly to a contractionary U.S. monetary policy shock and to a corresponding euro area shock.*

policy stance (including capital flow management measures) in the run-up to the tapering announcement experienced smaller currency depreciations and smaller increases in government bond yields in 2013 to 2014 (IMF, 2013; Mishra et al., 2014).

Turning to the countries of interest in this study, chart 1 shows that the Turkish lira depreciated comparatively strongly against the U.S. dollar from May 2013 until the end of January 2014, before the TCMB raised the one-week repo rate by 550 basis points from 4.5% to 10%. In the summer of 2014, when the downward pressure on the currency subsided and the risk premium on Turkish assets fell, the TCMB was in a position to cut the policy rate (by a total of 175 basis points until early summer 2015). However, in the third quarter of 2014, renewed depreciation set in and continued until very recently. Overall, since the beginning of 2013, the Turkish lira has lost about 40% of its value against the U.S. dollar and about 25% against the euro.

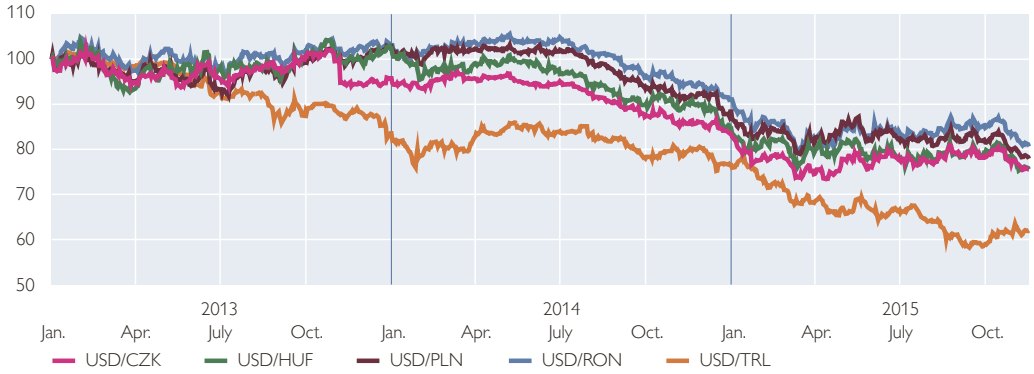
In contrast to the Turkish economy, the Polish economy is more affected by developments of the euro than of the U.S. dollar, given the structure of foreign trade and foreign exchange liabilities. Immediately after the Fed's tapering announcement, the Polish złoty experienced only a short-lived depreciation against the euro; thus, Narodowy Bank Polski (NBP) did not have to raise the policy rate. Since then, the NBP has kept the currency's value against the euro more or less unchanged, while the value weakened against the U.S. dollar because the euro depreciated against the U.S. dollar.

Chart 1

CESEE exchange rates and policy rates

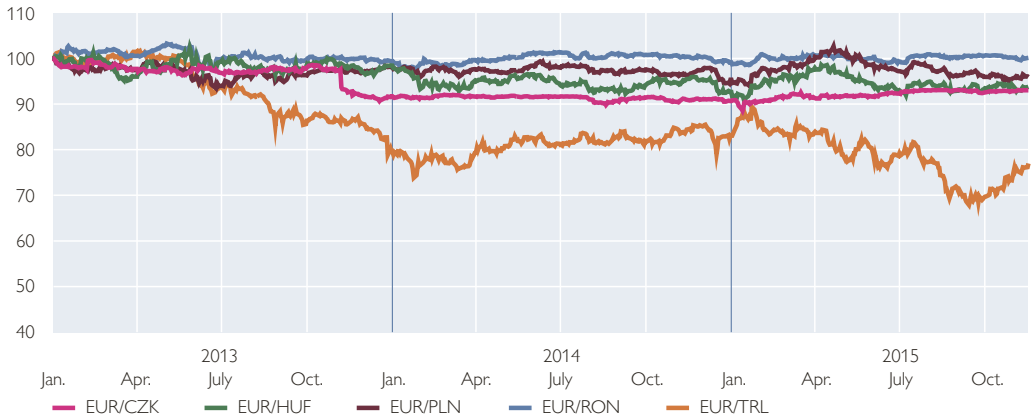
Exchange rate developments versus the U.S. dollar

January 1, 2013=100 (rise=appreciation) *Latest observation: November 17, 2015*



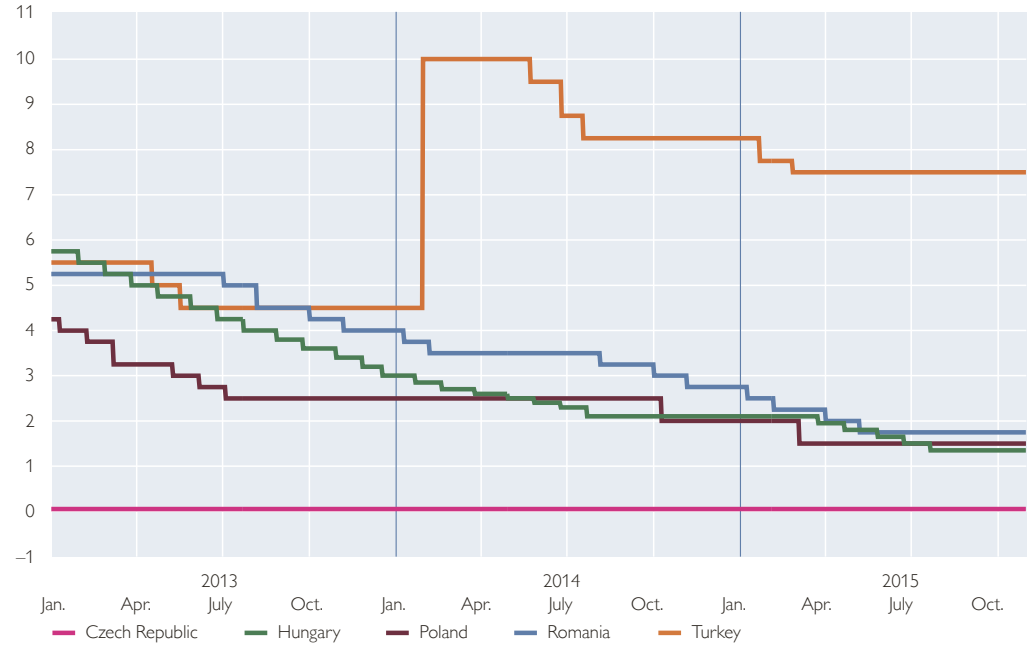
Exchange rate developments versus the euro

January 1, 2013=100 (rise=appreciation) *Latest observation: November 17, 2015*



Policy rate developments in CESEE

% *Latest observation: October 30, 2015*



Source: Thomson Reuters, national central banks.

Capital flows to Poland and Turkey surged considerably again after the marked drops in 2009 (see chart 2). In Poland, these dynamics lasted until mid-2011 and largely reflected net portfolio inflows. Spillovers from the euro area sovereign debt crisis were apparently responsible for a pronounced net outflow of currency and deposits in Poland from late 2011 until early 2013. Following the Fed's tapering announcement, net portfolio inflows also declined quite substantially and ultimately resulted in a financial account deficit in the first half of 2014. Since then, portfolio and other investment inflows have not yet resumed considerably. It should be noted, however, that this reduction in net capital inflows also went hand in hand with a correction of the current account deficit. While the Polish income balance deficit (much of which can be explained by repatriated earnings of foreign-owned firms) is still quite sizable, the goods and services balance has recorded surpluses since 2013.

Turkey was able to keep the positive capital flow dynamics until early 2013. Net portfolio inflows widened steadily during this period, but inflows of loans and deposits (e.g. remittances) also played a considerable role as part of "other investment." However, after the tapering announcement, portfolio investment inflows steadily declined, while inflows of loans largely kept their level. In the first half of 2015, Turkey was confronted with some additional reduction in portfolio investment flows. In contrast to Poland, Turkey has so far not been able to substantially correct its current account deficit (largely a deficit in the goods and services balance). The current account deficit moderated somewhat in the first half of 2014, falling to around 6% of GDP (down from 8% at the end of 2013). However, this rebalancing was mostly driven by the normalization in the gold balance along with weak domestic demand. Moreover, the financing of the current account deficit remains rather fragile, given the comparatively large share of short-term (non-FDI) flows in the financial account.

Parts of the discussed changes in capital flows consist of changes in banking capital flows, i.e. direct cross-border lending activities. Another channel of international shock transmission via banks consists of lending through foreign-owned affiliates, which is generally perceived to be less volatile than direct cross-border lending (Milesi-Ferretti and Tille, 2011). Chart 3 shows that claims of BIS-reporting banks on CESEE economies have declined since the 2008/2009 crisis primarily through cross-border lending (right-hand panel), while consolidated claims (including lending through affiliates, left-hand panel) have also clearly lost momentum but have on average remained unchanged. This development is partly indicative of the success of the Vienna Initiative.[4]

In the search-for-yield period from 2010 to 2011, cross-border lending to both Poland and Turkey experienced a remarkable revival. However, in 2012, when countries in CESEE were increasingly confronted with contagion effects from the euro area sovereign debt crisis, cross-border claims on CESEE declined again (even more strongly than in 2009), with the notable exception of those on Turkey, which was able to avoid a reduction in both consolidated and cross-border claims. Finally, associated with the Fed's tapering announcement in May 2013, cross-

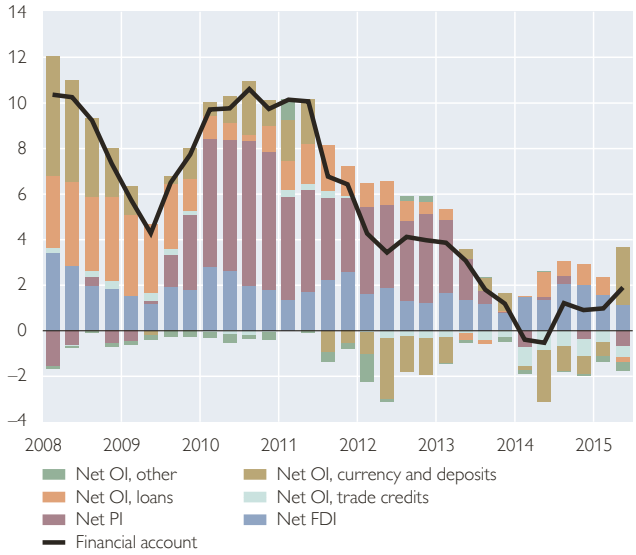
[4] *See http://vienna-initiative.com/. De Haas et al. (2012) show that foreign banks that participated in the Vienna Initiative were relatively stable lenders in CESEE. This is also confirmed by Hameter et al. (2012), who find that intragroup cross-border credit from Austrian banks was more stable than lending to nonaffiliated borrowers in CESEE during the 2008/2009 crisis.*

Chart 2

Decomposition of annualized balance of payments

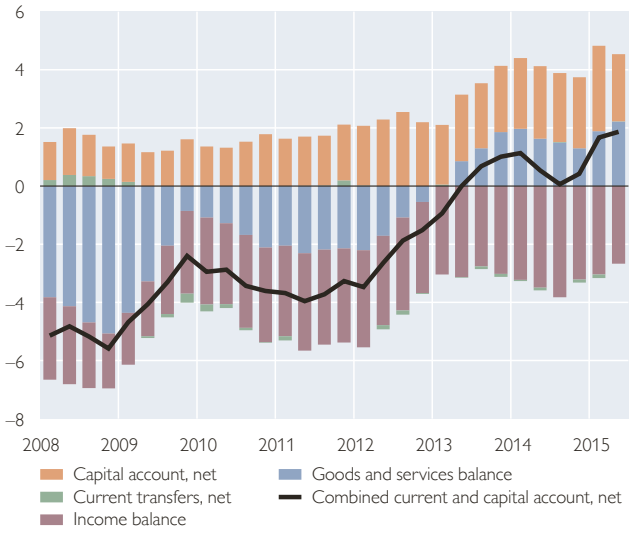
Poland: financial account

% of GDP (cumulative four-quarter moving sums)



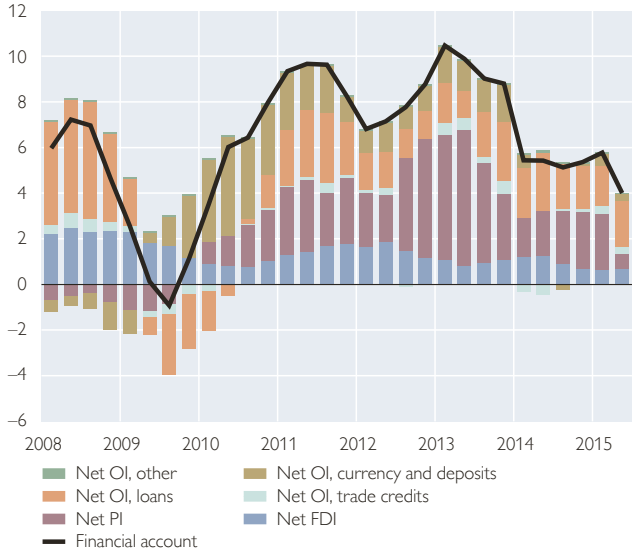
Poland: current and capital account

% of GDP (cumulative four-quarter moving sums)



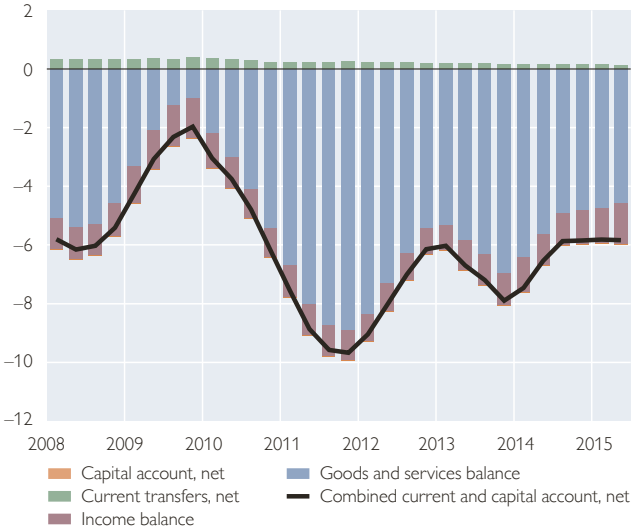
Turkey: financial account

% of GDP (cumulative four-quarter moving sums)



Turkey: current and capital account

% of GDP (cumulative four-quarter moving sums)



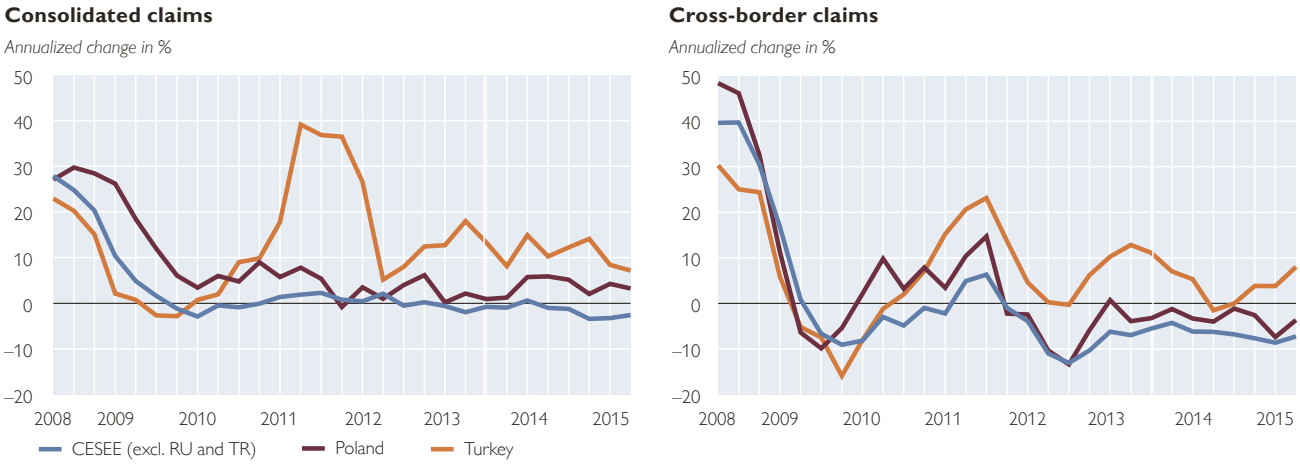
Source: IMF, Eurostat, OeNB, national central banks.

Note: OI=other investment; PI=portfolio investment; FDI=foreign direct investment.

border bank lending has continued to decline in Poland, while Turkey experienced a pronounced slowdown from an annual growth rate of 13% in the first quarter of 2013 to –1.5% in the first quarter of 2014 before growth rebounded remarkably to 8% in the first quarter of 2015. At the same time, it should be noted that consolidated claims have not lost considerable momentum since early 2013.

Chart 3

Outstanding stocks of all BIS reporting banks vis-à-vis CESEE



Source: national central banks, IMF, OeNB.

As emphasized by the EBRD (2009) or Bakker and Klingen (2012) for the 2008/2009 crisis and by Mishra et al. (2014) for the impact of the Fed's tapering announcement, structural banking sector variables are crucial in explaining the intensity of domestic macroeconomic responses to an external shock.

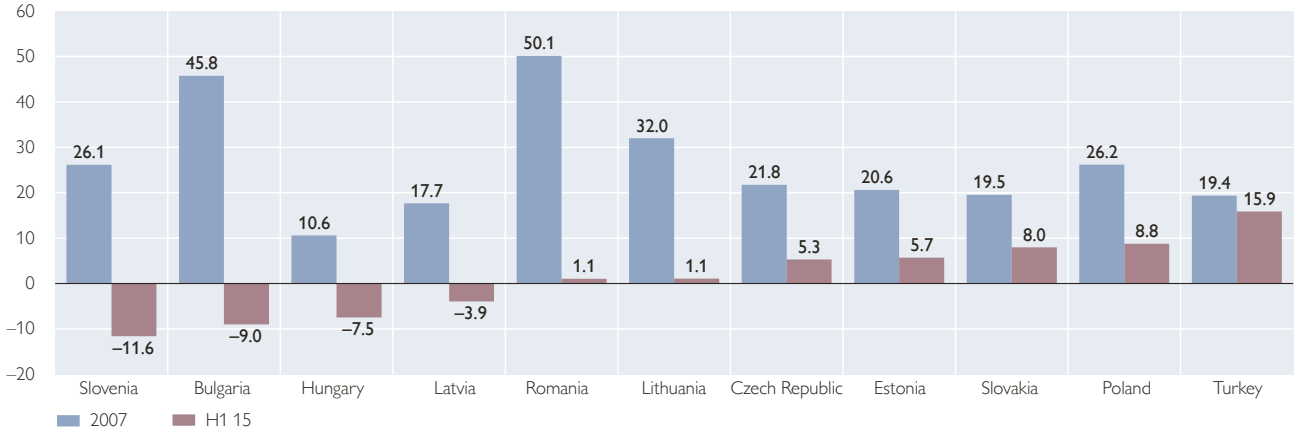
Compared to very strong private sector credit growth in several CESEE economies before 2008, we have seen subdued or negative credit growth rates in the region since 2009 (chart 4). Clear signs of a revival in credit in the region as a whole have yet to emerge. Turkey is an important exception and has continued to record respectable credit growth rates after 2009. Although it fell somewhat in the first half of 2014, growth of domestic credit to the nonbank private sector experienced some pickup in Turkey in 2015 and expanded by more than 15% (year on year, inflation-adjusted) in the first half of 2015. Looking at the composition of domestic credit, the share of foreign currency loans in total loans to resident private nonbanks reached about 37% in Turkey and 27% in Poland in September 2015. As mentioned before, Turkish banks are no longer permitted to lend to households in foreign currency; they can offer foreign currency loans only to corporates that have income in foreign currency. Consequently, new foreign exchange loans have been mainly extended to large trading firms that have sufficient access to financial hedging (OECD, 2014). Credit dynamics also have to be seen relative to the development of deposits. While at the end of 2009, nearly 85% of loans to resident nonbanks were covered by deposits in Turkey, the above-mentioned pronounced credit growth caused this ratio to deteriorate steadily to just 70% in September 2015. Poland, on the other hand, was not able to significantly raise the coverage of loans by deposits (75% in 2009 compared to about 77% in September 2015).

Basel II standards have been implemented in Turkey since July 2012, so far with a limited impact on capital adequacy in the banking sector. While the tier 1 capital adequacy ratio (CAR) stood at more than 17% in Turkey at the end of 2009, it steadily declined amid a marked credit expansion to a bit more than 12%

Chart 4

Domestic credit to the nonbank private sector: pre-crisis versus post-crisis growth

Year-on-year percentage change in period-end stock, HICP-deflated



Source: national central banks, OeNB.

in June 2015. In the same period, Poland was able to raise the the tier 1 CAR from 12% to 14%. The profitability of banks has deteriorated in Turkey since 2009, though it is still large compared to that in other countries in the region. Whereas the return-on-assets ratio stood at 1.3% in Turkey in June 2015, it has halved compared to end-2009. In Poland, in turn, the return-on-assets ratio improved somewhat from 0.8% to 1% in the same period.

3 GVAR simulation of the economic transmission of a U.S. monetary policy shock

While in the previous section, we reviewed domestic macrofinancial vulnerabilities that are considered relevant for the intensity of country-specific responses to external shocks, in this section we try to get a better understanding of the possible macroeconomic responses of CESEE countries – in particular Turkey and Poland – to a global-scale external shock. For this purpose, we use a global vector autoregressive (GVAR) model and simulate the impact of a contractionary monetary policy shock in the U.S.A. in recognition of that country's pivotal role in shaping the global business cycle (see Feldkircher, 2015). Given the comparably stronger trade integration of the CESEE region with the euro area than with the U.S.A., the ongoing monetary accommodation in the euro area might have some counterbalancing impact,[5] but a systematic comparison of the impact of Fed- versus ECB-induced monetary policy shocks would be beyond the scope of the present paper.

In recent years, several authors have started to focus on the international economic transmission of U.S. monetary policy shocks across the globe. Among others, Canova (2012) studies the influence of U.S.-based shocks on Latin American economies. He finds that monetary policy shocks produce significant fluctuations

[5] *Globan (2015) analyzes the spillover effects of monetary policy shocks in the euro area to seven non-euro area CESEE EU Member States. He finds that over the last years, macroeconomic developments in the euro area have become increasingly important drivers of capital inflows in CESEE.*

abroad, while demand and supply shocks tend to produce insignificant responses. The IMF (2014) detects a lagged, relatively short-lived, negative GDP growth response in emerging market economies (including Turkey and Poland) to a contractionary U.S. monetary policy shock. The impact of external shocks on capital flows has been explicitly analyzed for Turkey in Özen et al. (2013). The authors determine that external financial stress (proxied by a positive shock in the Chicago Board Options Exchange's Volatility Index, VIX) results in a marked decline in net portfolio investment.

While the literature surveyed above explicitly investigates the international transmission of shocks by means of conventional vector autoregressive (VAR) models, most of these studies remain confined to two-country models, neglecting second- and third-round spillover effects. This exclusion implies that these simpler specifications potentially provide biased estimates, underestimating relevant effects by ignoring reactions stemming from other countries. Thus, modeling approaches that simultaneously model a large set of economies have gained popularity recently. Georgiadis (2015) studies global spillovers from identified U.S. monetary policy shocks in a GVAR model and finds that U.S. monetary policy generates sizable output spillovers to the rest of the world. Feldkircher and Huber (2016) use a Bayesian GVAR model to analyze international spillovers of a contractionary U.S. monetary policy shock and of expansionary U.S. aggregate demand and supply shocks. They show that the monetary policy shock has strong cross-border spillovers on output and prices.

In the present paper, we apply the same methodological framework as in Feldkircher and Huber (2016), but we differ by using an updated dataset, by including financial account variables and by explicitly showing country-specific evidence for Poland and Turkey.

3.1 The GVAR model

The GVAR model put forward by Pesaran et al. (2004) constitutes a flexible means of incorporating large information sets in the modeling framework. Successful applications of the GVAR methodology range from the analysis of global shocks (see e.g., Dees et al., 2007, Pesaran et al., 2007, Feldkircher and Huber, 2016) to forecasting (Crespo Cuaresma et al., 2016).

The point of departure is the individual country model for country $i = 0,...,N$, which is assumed to be a VAR(1,1) model[6] featuring exogenous regressors

$$x_{it} = a_{i0} + a_{i1}t + \Psi_{i1}x_{it-1} + \Lambda_{i0}x^{*}_{it} + \Lambda_{i1}x^{*}_{it-1} + \epsilon_{it} \quad (1)$$

where x_{it} is a $k_i \times 1$ vector of endogenous variables measured at time t and a_{ij} $(j = 1,2)$ denotes $k_i \times 1$ vectors of coefficients associated with the constant and trend. Furthermore, Ψ_{i1} is a $k_i \times k_i$ parameter matrix corresponding to the first lag of the endogenous variables and Λ_{ik} $(k=0,1)$ are $k_i \times k^{*}_i$ dimensional parameter matrices corresponding to the (weakly) exogenous variables x^{*}_{it} defined as:

[6] *Our model is heavily parameterized, and even in the presence of a Bayesian approach, the limited time span available suggests that higher lag orders lead to a proliferation of parameters, ultimately producing unstable and imprecise results. Thus, we have opted to include only one lag of each variable type showing up in the VAR model.*

$$x_{it}^{*} = \sum_{j \neq i} w_{ij} x_{jt} \tag{2}$$

where w_{ij} are weights between countries i and j, usually set to bilateral trade linkages.[7] These weakly exogenous variables aim to approximate cross-country linkages. It can easily be seen that the specific structure of the model in (1) implies parametric restrictions on variables of other countries. Finally, $\epsilon_{it} \sim N(0, \sum_i)$ is a standard vector white noise error term.

It is straightforward to show that a sequence of the models described in equation (1) can be solved to yield a global representation of the model. As a consequence, (weakly) exogenous variables become effectively endogenous, and the global system resembles a standard large dimensional VAR given by

$$x_t = b_0 + b_1 t + F\ x_{t-1} + e_t \tag{3}$$

where x_t denotes the global vector, consisting of the stacked endogenous variables of all countries, i.e. $x_t = (x'_{0t}, \ldots, x'_{Nt})'$. The coefficient matrices of the deterministic part b_0, b_1 and the matrix corresponding to the lagged endogenous variables F are complex functions of the underlying estimates originating from the local models and the weightings used.

Note that equation (3) is a standard VAR(1,1) model with a deterministic constant and trend. All textbook formulas for functions of the parameters like impulse responses, forecasts or forecast error variance decompositions apply. To ensure stationarity of the model, we have to impose that $eig(F) < 1$. Technically, this rules out explosive behavior of the model. From an economic point of view, this restriction states that policymakers try to smooth possible impacts of shocks hitting the economy.

3.2 Prior setup and estimation

The GVAR model is usually estimated using standard techniques like maximum likelihood. However, recently Bayesian methods have proved to be a good alternative (see Crespo Cuaresma et al., 2016; Feldkircher and Huber, 2016). While standard techniques are easy to use, they are prone to overfitting the data. This directly translates into the well-known "curse of dimensionality," which implies that a strong in-sample fit leads to weak out-of-sample forecasting performance. Hence, following the literature on Bayesian VARs (Sims and Zha, 1998), we use a conjugate Minnesota prior, which has a proven track record in forecasting applications. This implies using a Gaussian prior on the coefficients in equation (1) and an inverted Wishart prior on $\sum_i$. Intuitively, the mean and variance for the prior on the coefficients are set such that the model in equation (1) is shrunk toward a random walk, implying that the first own lag of a variable is perceived to be an important predictor. Higher lag orders are assumed to be less important, implying that the prior variances on the corresponding coefficients are set to small values.

[7] *For a very similar dataset, Crespo Cuaresma et al. (2016) and Feldkircher and Huber (2016) find that while mixtures of weights (i.e. using trade weights for real variables and financial weights for financial variables) outperform other alternatives in terms of marginal likelihoods, the final impact on the results is rather negligible.*

Estimation and computation of the impulse response functions is a straightforward application of Monte Carlo integration. Because impulse responses are highly nonlinear functions of the parameters, we have no closed-form posterior solutions for them. However, in the natural conjugate case, the (conditional) posteriors for the coefficients have well-known distributional forms. Thus, it is straightforward to set up a simple Markov chain Monte Carlo scheme to estimate the local models and compute the corresponding impulse response schedules. More detailed information on the Minnesota prior in a GVAR framework can be found in Crespo Cuaresma et al. (2016).

3.3 Data overview

We rely on an updated variant of the dataset put forward in Feldkircher and Huber (2016). This dataset covers 42 economies and the euro area as a regional aggregate (representing over 90% of global output) for the time period from Q1 1995 to Q4 2013. Table 1 presents the countries included in the analysis.

Table 1

Country coverage

Rest of the world (11): US, EA, GB, CA, AU, NZ, CH, NO, SE, DK, IS
CESEE (12): CZ, HU, PL, SK, SI, BG, RO, HR, LT, LV, EE, TR
CIS & Western Balkans (6): RU, UA, BY, GE; AL, RS
Asia (9): CN, KR, JP, PH, SG, TH, ID, IN, MY
Latin America (5): AR, BR, CL, MX, PE

Source: Authors' compilations.

Note: Abbreviations generally represent the two-digit ISO country code; EA denotes euro area.

We use a standard set of macroeconomic aggregates, including GDP, inflation, real exchange rates measured vis-à-vis the U.S. dollar, short- and long-term interest rates, trade and financial account balances and finally the price of oil as a global control variable. Table 2 provides a brief description of the variables included.

Table 2

Variable description

Variable	Description	Source
y	Real, seasonally adjusted GDP, 2005=100, in logarithms	IMF
Δp	Rate of consumer price inflation, based on seasonally adjusted CPI	IMF
e	Real exchange rate relative to the U.S. dollar (deflation based on national CPI levels)	IMF
i_s	Typically, three-month money market rate (annualized)	IMF
i_L	Typically, yield on 10-year-government bonds (annualized)	IMF
tb	Ratio of real exports to real imports, in logarithms	IMF
fa	Financial account (excl. reserve assets) relative to GDP, cumulative moving annual values	IMF, NCBs
$poil$	Price of oil, seasonally adjusted, in logarithms	IMF
w_{ij}	Bilateral average trade flows between countries i and j	OECD

Source: Authors' compilations.

Note: For more details on data definitions and compilation, see Feldkircher (2015).

The choice of the variables is standard in the literature on GVAR modeling. However, inclusion of the financial account allows us to gain a deeper understanding

of the role of capital movements in the transmission of economic shocks. Note that in this part of the analysis, we have not included the additional variables discussed in section 2, such as structural banking sector indicators, although they could affect the intensity of domestic macroeconomic responses to an external shock. The main reasons are limited data availability for the large country sample and limited degrees of freedom in the estimations.

The set of weakly exogenous variables is constructed using bilateral average trade flows over the estimation window. This choice aims to approximate the underlying relationship between countries. Other possible choices include weighting schemes based on financial or geographical weighting. However, we focus exclusively on a weighting scheme based on trade weights because this seems to deliver more robust results than financial weights (as proxied through bilateral banking exposure), as the latter usually prove to be more volatile.

It is worth noting that the individual country models are constructed to include all variables described in table 2 for all countries, if available. One exception is the long-term interest rate, which is not available for some emerging market economies. Moreover, in the case of the U.S. country model, we obviously did not use the real exchange rate vis-à-vis the U.S. dollar but the real effective exchange rate (based on the CPI). All weakly exogenous variables except the weakly exogenous real exchange rate are included. The latter is included only in the U.S. country model. For more information, see Feldkircher and Huber (2016).

3.4 Shock identification

The model described in section 3.1 is completely atheoretical, as reduced-form impulse responses generally report the response of some interesting variable of interest to a weighted average of different structural shocks. To identify the effects of a monetary policy shock, researchers have opted for several possible identification schemes. However, we follow Eickmeier and Ng (2015) and Feldkircher and Huber (2016) and impose sign restrictions on the impulse response functions of the U.S. country model to retrieve the structural GVAR representation. In contrast to other identification schemes, this scheme gives us more flexibility than restrictions on the short-run behavior of the impulse response functions. As alternatives to structural identification schemes, Pesaran et al. (2004) advocated the use of generalized impulse response functions (GIRFs). These GIRFs, however, have no theoretical interpretation, rendering the use of this approach unfeasible for our research objectives.

Loosely speaking, sign restrictions rotate a given set of orthogonal responses until a prespecified set of restrictions is fulfilled. This is achieved by sampling orthonormal rotation matrices using the algorithm outlined in Rubio-Ramirez et al. (2010). Using such a rotation matrix, we compute the corresponding impulse response schedules using Monte Carlo integration.[8]

[8] *More details on how this procedure works can be found in Feldkircher and Huber, 2016.*

Specifically, we impose the following set of sign restrictions:

Table 3

Sign restrictions

Shock	y	Δp	i_S
AD	↑	↑	↑
AS	↑	↓	↓
MP	↓	↓	↑

Source: Authors' compilations.

Note: AD refers to aggregate demand, AS to aggregate supply and MP to monetary policy. We impose the restrictions as ≥ and ≤. The restrictions are binding for one quarter after impact.

As more restrictions typically lead to stronger identification in a sign restriction framework (see Fry and Pagan, 2011), we not only identify the monetary policy shock, but simultaneously also identify an aggregate demand and an aggregate supply shock. The orthonormal rotation matrices establish a relationship between our reduced-form GVAR and the underlying structural representation of the model. In light of the sign restrictions described in table 3, our structural GVAR model shares features commonly observed in the standard dynamic stochastic general equilibrium models usually employed by central banks and policy institutions. In particular, the contractionary monetary policy shock is defined as an unexpected increase in the U.S. short-term interest rate that is assumed to trigger a decline in output and inflation in the U.S.A. at least until the first quarter after impact.

3.5 Impulse response analysis

Chart 5 depicts the responses of key macroeconomic variables to a contractionary U.S. monetary policy shock for Poland, Turkey and the CESEE average.[9] Interestingly, in several cases, the responses in Turkey deviate from those in Poland and the CESEE average. This heterogeneity can most likely be explained by the fact that in the observation period, Turkey was characterized by stronger economic volatility (recall the 2001 crisis) than the CESEE region on average (recall the introduction and section 1).

Examining the response of output, we see a pronounced decline in real GDP that has a persistent nature (corroborating the findings of Feldkircher and Huber, 2016, and Willems, 2013). Compared to other CESEE economies, Turkey displays the strongest GDP drop on impact. Output contracts by –0.7% and then recovers somewhat until the end of the first year after the shock but continues to decline at a steady rate of about –0.3% (statistically significant until three years after the shock). CESEE countries reach their minimums of output declines on average within the first year after the shock (–0.4%) and are then able to relieve the pressure only slowly.[10]

[9] *CESEE responses are shown as simple unweighted averages across the 12 CESEE economies. Purchasing power parity (PPP) weighted responses would be an alternative, but they limit the responses to those of dominant countries (such as Poland or Turkey).*

[10] *The finding of a stronger GDP decline in Turkey compared to Poland in response to a contractionary monetary policy shock in the U.S.A. is consistent with IMF findings (IMF, 2014).*

The significant output decline is also mirrored by the developments of other variables in the model. Consumer prices decline, with this effect being statistically significant only in Turkey. A pronounced hike in the short-term interest rate that lasts at least for two quarters after the shock is only briefly able to reverse the price decline in Turkey. Inflation and interest rates in Poland, on the other hand, do not show a statistically significant pattern.

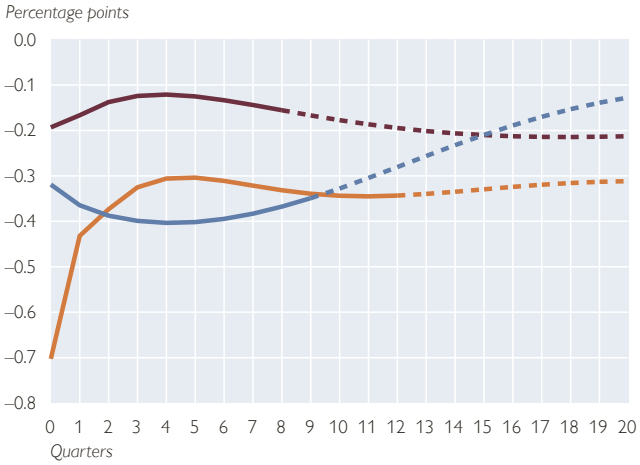
The contractionary U.S. monetary policy shock also results in a marked real depreciation of CESEE currencies vis-à-vis the U.S. dollar, which remains persistent in the CESEE region on average at least up to one-and-a-half years after the shock. Having the nominal depreciation figures of chart 1 in mind, interestingly, the real depreciation in Turkey is apparently not as strong and persistent as in Poland. In line with these currency depreciations, trade balances improve, though we are able to identify a statistically significant improvement only for Turkey up to one quarter after the shock.

Finally, we see a strong medium-run deterioration of the financial account in Turkey, reflecting capital outflows (or a reduction in capital inflows) right after the monetary contraction in the U.S.A. The mentioned initial hike in the Turkish short-term interest rate might be a reflection of domestic policymakers' attempts to contain these capital outflows. A short-run deterioration in the financial account can also be observed in Poland, though it is less pronounced than in Turkey.

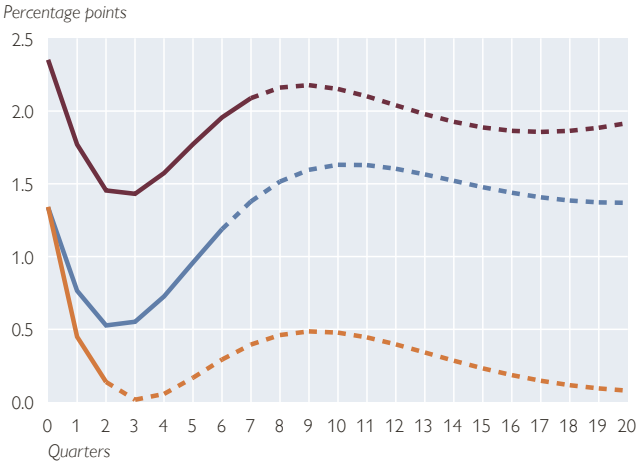
Chart 5

Response to a (one standard deviation) contractionary U.S. monetary policy shock

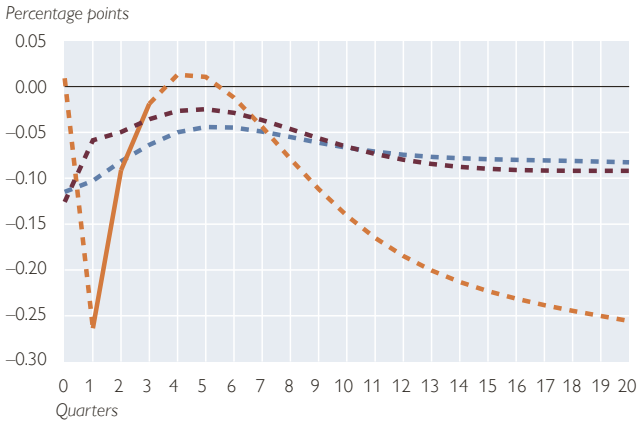
Median response of real GDP



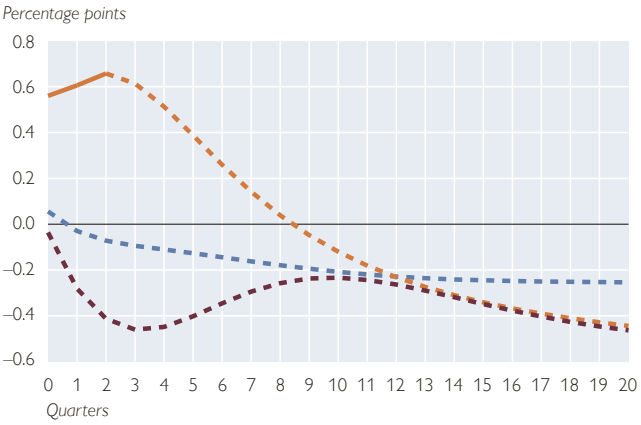
Median response of real exchange rate (vis-à-vis USD)



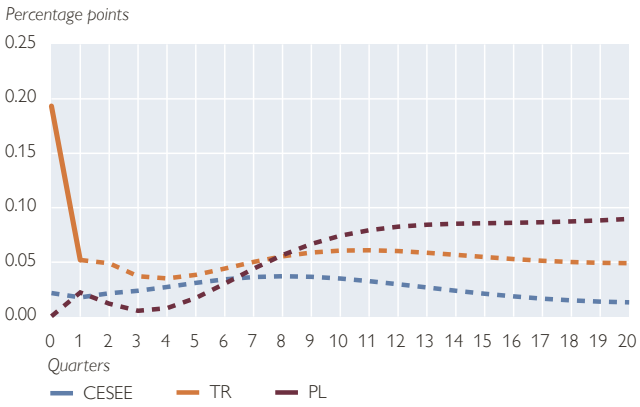
Median response of consumer price inflation



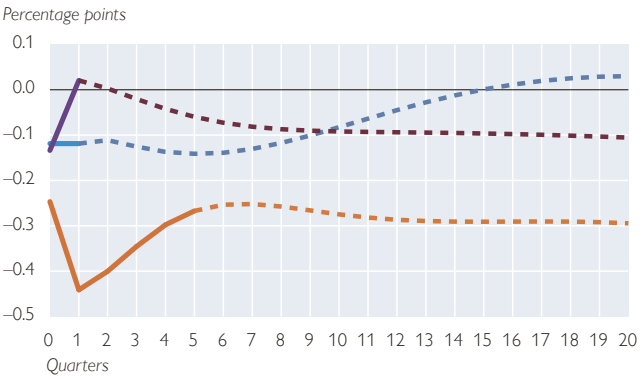
Median response of short-term interest rate



Median response of trade balance



Median response of financial account



Source: Authors' calculations.

Note: Median impulse response in percentage points, based on 1,000 draws that are randomly extracted from the posterior of the impulse responses. Solid lines represent statistically significant responses in the sense that zero does not lie between the 25th and 75th percentile, whereas dotted lines indicate statistically insignificant responses. t=0 denotes the quarter in which the shock occurs. CESEE figures are based on unweighted averages across the 12 CESEE economies.

4 Concluding remarks

In this paper, we have tried to describe Turkey's and Poland's relative economic performance in the situation of two recent global shocks: first, the global economic crisis in 2008/2009 and second, the Fed's tapering announcement in May 2013. Our description places an emphasis on the underlying macrofinancial vulnerabilities.

While both Turkey and Poland weathered the 2008/2009 crisis comparatively well, macrofinancial indicators responded fairly strongly to the Fed's tapering announcement. Among other things, marked currency depreciation, reversals in capital flows and a slowdown in cross-border bank lending challenged policymakers in the region.

To improve our understanding of the actual responses of domestic macroeconomic variables to a global-scale external shock, we investigate the international transmission mechanism of a contractionary U.S. monetary policy shock by means of a Bayesian GVAR model. This multicountry model provides a more coherent picture of the underlying transmission channels by taking cross-country effects seriously. We investigate the economic responses in the CESEE region, with a specific focus on Turkey and Poland, to a U.S.-based contractionary monetary policy shock.

Our simulation results suggest that both Turkey and Poland tend to exhibit significant short- to medium-run responses to an unexpected increase in the short-term interest rate in the U.S.A., while long-run responses tend to become insignificant after a few quarters for most variables under scrutiny. Taking a regionally comparative stance unveils somewhat stronger responses for Turkey than for Poland or the CESEE average, signaling the structurally different nature of the Turkish economy. More specifically, as a traditional emerging market economy outside the EU, Turkey is less interlinked with the euro area, suggesting a business cycle decoupling from Poland and the other CESEE countries. In addition, the higher volatility of the macroeconomic fundamentals in Turkey might translate into different risk profiles, leading to more pronounced responses. Moreover, the strong trade ties between Turkey and the U.S.A. suggest a stronger transmission mechanism for U.S.-based shocks. Overall, for most of the studied macroeconomic variables, the identified responses mimic the actual developments that we have observed since early 2013. It remains to be seen whether potential further interest rate hikes in the U.S.A. will still lead to pronounced short-term macroeconomic responses in CESEE or whether financial markets have already largely priced in such increases.

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