Economic Spillovers from the Euro Area to the CESEE Region via the Financial Channel: A GVAR Approach

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In this paper we examine the spillovers of a shock to real output in the euro area to Central, Eastern and Southeastern Europe (CESEE) and its subregions Central Europe, Southeastern Europe, Russia, and the other members of the Commonwealth of Independent States (CIS). To this effect, we apply a global vector autoregressive (GVAR) model and go beyond existing work by examining the relative importance of the financial channel compared with the trade channel. Moreover, we assume that shocks spill over from the euro area to the CESEE region via the financial channel whereas financial spillovers within CESEE are negligible (except for spillovers between Russia and the other CESEE countries, which we do capture). Our results are as follows: We find spillovers transmitted via the trade channel to be larger than spillovers via the financial channel for Southeastern Europe, but smaller for Russia and the other CIS countries. For Central Europe, the two channels have a broadly similar impact. When we assess the relative importance of the two channels based on how well they explain historical movements in the data we see that spillovers via the two channels have indeed been of equal importance for Central Europe. However, the financial channel has traditionally dominated the trade channel in Southeastern Europe, whereas the trade channel has traditionally played a stronger role for the CIS region. Overall spillovers reflecting both transmission channels are comparatively more moderate for Central Europe and Russia, while they are a bit larger for Southeastern Europe and considerably higher for the CIS region excluding Russia: The long-run effect of a +1% euro area output shock ranges from 0.3% in Central Europe and Russia to 0.7% in the other CIS countries.

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Central, Eastern and Southeastern Europe is strongly integrated with the euro area. Reaping the benefits of comparative advantages in production and in capital allocation, both trade links and financial ties have intensified over the past two decades. At the same time, the global financial crisis of 2007–2009 and the ensuing sovereign debt crisis in Europe have demonstrated the downside of the region's strong exposure to the euro area. After the collapse of Lehman, the crisis spilled over to emerging Europe, which had remained largely unaffected during the early stages of the financial crisis. A thorough understanding of how the CESEE region is exposed to fluctuations in euro area output and how the resulting spillovers are likely to work is thus very important for an adequate assessment of the region's economic prospects.

Shocks in one market can propagate to other markets through a number of channels. Pritsker (2001) identifies and categorizes five channels through which real shocks spread from one country to another: (i) real linkages, (ii) a common lender, (iii) financial markets, (iv) financial institutions and (v) the interaction of financial institutions and markets. As Pritsker stresses, it is perfectly rational that shocks would spread through any of these channels. While shocks can proliferate on the back of financial market irrationality, Pritsker hence interprets economists'

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limited success in explaining crisis propagation as evidence that more channels for propagation need to be theoretically modeled and empirically tested. However, empirical tests in particular are quite a challenge due to the very limited availability of data on channels other than real economy linkages.

It is thus not surprising that the empirical literature on economic spillovers to the CESEE region is rather limited. Two recent additions to the literature are EBRD and IMF policy notes assessing the dependence of Eastern Europe on fluctuations in real output in the euro area. In its latest Transition Report, the EBRD (2012) finds the business cycle of various CESEE economies plus Russia and Ukraine to be strongly correlated with that of the euro area. Country-by-country vector autoregressions (VARs) estimated by the EBRD to assess the response of individual CESEE economies to a shock to real GDP in the euro area revealed the Baltic states, Ukraine, Armenia and Romania to be particularly closely linked to GDP growth dynamics in the euro area.

The aggregate vulnerability of the CESEE region to shocks emanating from Western Europe[1] has been assessed in a Spillover Report produced by the IMF (2012). While distinguishing spillovers transmitted via the trade channel from spillovers through the financial channel, the IMF points out that the two channels typically interact; after all, a tightening in credit, for example, is likely to cut demand for imports and thus is soon felt in trade flows. The IMF's trade channel analysis is based on elasticities of import demand of CESEE countries to output shocks emanating from Western Europe. In a next step, the IMF uses historical trade shares to calculate the impact of the output shock on trading partners' exports. The results imply that a 1% decrease in GDP in Western Europe translates into a 0.4% drag on real output in the CESEE region on average. Analyzing the potential outcome of smaller cross-border credit flows from Western Europe to the CESEE region, the IMF finds a 1% decrease in cross-border credit to dampen real output by 0.3%. As this shock is assumed to originate in the financial sector rather than the real economy, it can be interpreted as a financial shock rather than a real shock transmitted via the financial channel. Finally, the analysis is complemented by an econometric investigation based on a VAR model, which is unable to distinguish between different transmission channels. The results indicate that a shock to Western European GDP fully feeds through to the economies of the CESEE region. That is, the impact is generally felt one to one.

While assessing spillovers from the West to the East, both the EBRD and the IMF only regard first-round effects given the model framework they use. In other words, knock-on effects resulting from first-round outcomes in other countries are implicitly assumed to be zero, and therefore the role of economies that may function as "gatekeepers" passing on stress from the global economy to the CESEE region is not adequately captured. Feldkircher (2013) overcomes these problems by putting forward a global VAR (GVAR) model for the CESEE region. In general, one of the primary objectives of GVAR approaches is to model the transmission of external shocks, taking into account bilateral economic linkages within the global economy. Feldkircher covers the first channel discussed in Pritsker (2001) – contagion via real linkages – and models the transmission of shocks by means of

[1] *The IMF takes a broad definition of Western Europe that extends the euro area by six Western European advanced economies.*

bilateral trade flows. According to his results, the CESEE region shows a positive and qualitatively similar response to an economic expansion in the euro area and the U.S. economy. An increase in euro area short-term interest rates dampens real output throughout the region. The same holds true for a positive oil price shock, except for Russia and – to some extent – the other countries of the CIS region.

While Feldkircher (2013) focuses on spillovers transmitted via the trade channel and Galesi and Sgherri (2009) model the financial channel using bilateral bank lending exposures, in this paper we contribute to the existing literature by considering the financial channel jointly with the trade channel. We collect bilateral financial data that comprise at least three countries/regions that are potentially important sources or transmitters ("gatekeepers") of shocks for the CESEE region: the euro area, the United States and Russia. In particular, we assess the consequences of a positive output shock in the euro area to the real economy of the CESEE region. To put our results into context, we contrast them with the traditionally employed spillovers via the trade channel. Furthermore, we assess for each country in the region the relative importance of the two channels based on how well they can explain historical movements in the data. Finally, we calculate an "overall" effect that comprises financial and trade spillovers and present the results for the region.

The paper is structured as follows: Section 1 outlines the econometric framework and section 2 introduces the data. Section 3 examines the transmission of a euro area output shock to the focus region, and section 4 concludes.

1 Empirical Approach – The GVAR Model

The global vector autoregressive (GVAR) model is an empirical model that captures economic and financial interdependencies in the global economy. The GVAR model has been successfully employed to study the propagation of macroeconomic shocks (see e.g. Dees et al., 2007; Pesaran et al., 2004 and 2007) and financial stress (Chudik and Fratzscher, 2011; Galesi and Sgherri, 2009). The remainder of this section sets out the key elements of the GVAR framework; a more detailed account of the model can be found in Feldkircher (2013).

The model comprises *two layers* that account for cross-sectional linkages among the economies. First, there are N country-specific submodels, each of which comprises domestic (y_t), foreign (x_t) and global/deterministic (d_t) variables that are not determined within the model. Since macroeconomic time series predominantly share common stochastic trends, these country models are typically specified in vector error correction form. For a particular country j, and $z_t=(y_t,x_t)$ comprising the data, the following system of equations is estimated:

$$\Delta z_t = c_0 + c_1 t + \Pi\, z_{t-1} + \sum_{i=1}^{p-1} \Gamma_{y,i} \Delta y_{t-i} + \sum_{i=0}^{q-1} \Gamma_{x,i} \Delta x_{t-i} + \sum_{i=0}^{lex-1} \Psi_i \Delta d_{t-i} + u_t \qquad (1)$$

with $u_t \sim N(0,\Sigma_u)$. For each country i, foreign (weakly exogenous) variables are constructed as a cross-country weighted average: $x_t^i=\sum_{j\neq i} w_{ij}\, y_t^j$, with $w_{ij} \geq 0;\ w_{ii}=0;$ $\sum_{j=1}^{N} w_{ij}=1$. The weights $w_{ij} \in W_b$ represent economic ties between countries. The coefficients attached to the set of foreign variables indicate how the economy depends on movements of variables related to macroeconomic developments abroad. Note that both weakly exogenous and exogenous variables enter equation (1)

both contemporaneously and in lagged form for *q, lex >1.* Finally, each country model contains a trend and/or intercept term.

In the *second layer* of the GVAR framework, the *N* single-country models are re-written into their VAR representation and then linked to yield a global macro model. For that purpose we have to introduce a spillover/link matrix that need not necessarily contain the same weights as W_b above. More specifically, W^i_{global} is a $K_i x K$ matrix, with K_i being the sum of endogenous and weakly exogenous variables in country model *i* and $K=\sum_{i=1}^{N} K_i$ being the total number of endogenous and weakly exogenous variables in the system. We can now link the models by making use of the fact that

$$z_t^i = \begin{pmatrix} y_t^i \\ x_t^i \end{pmatrix} = W^i_{global} \begin{pmatrix} y_t^1 \\ \vdots \\ y_t^N \end{pmatrix} = W^i_{global} y_t \ .$$

Consequently, the stacked model is given by:

$$Gy_t = c_0 + c_1 t + \sum_{k=1}^{P} H_k y_{t-k} + \sum_{k=1}^{L} \Upsilon_k d_{t-k} + u_t \qquad (2)$$

with *H* and □ containing the stacked coefficient matrices from the single countries, $P=max(p_i, q_i)$, $L=max(lex_i)$ and *G* containing the stacked weighted coefficients, i.e. $G^i=(I,-\Lambda_x)z^i W^i_{global}$. Since the square matrix *G* is nonsingular, equation (2) can be left-multiplied by G^{-1} to finally yield the GVAR model:

$$y_t = \tilde{c}_0 + \tilde{c}_0 t + \sum_{k=1}^{r} \tilde{H}_k y_{t-k} + \sum_{k=0}^{p} \tilde{\Upsilon}_k \Delta d_{t-k} + \tilde{u}_t \qquad (3)$$

The GVAR framework requires weights to be specified at two instances, as outlined above: W_b is used to construct the set of foreign variables, which in turn yields coefficients that reflect how the domestic economy reacts to movements in foreign variables. By contrast, W_{global} governs the propagation or distribution of external shocks through the system. This is in line with the recent GVAR literature (e.g. Cesa-Bianchi et al., 2012) which explicitly distinguishes between W_{global} and W_b. The particular settings we employ will be described in more detail in the next section.

2 The Dataset and the Challenge of Capturing Financial Linkages

We have collected data on *N=39* economies, including the euro area (EA)[2] as a regional aggregate. The country coverage and the country groups are displayed in table 1 below:

The inclusion of European emerging economies limits the time span of the analysis to the period following the initial phase of transition to market-based economies. We thus have quarterly data from the first quarter of 1995 to the fourth quarter of 2011, or 68 quarterly observations per variable. We include the

[2] *Note that the country composition on which data for the euro area are based changes over time. That is, while historical time series are based on data for the 11 original Member States, the most recent data are based on 17 countries. We nevertheless report separate results for Slovenia and Slovakia since we are also interested in emerging Europe. Our results are qualitatively unchanged if we use a consistent set of 14 euro area states rather than the rolling country composition of the euro area throughout the sample period, as the relative economic size of the three excluded countries (Slovenia, Slovakia and Estonia) is quite small.*

following five domestic variables: real GDP *(y),* inflation *(Dp),* the nominal exchange rate vis-à-vis the U.S. dollar deflated by national price levels *(rer),* short-term interest rates *(stir)* and long-term interest rates *(ltir).* Among the variables, only real GDP, inflation and the real exchange rate are available for all 39 economies. In particular, long-term interest rates are often not available for emerging economies. The set of domestic variables is complemented by oil prices.[3]

Table 1

Country Coverage and Regional Groupings

1) CZ, HU, PL, SK, SI (CEE)
2) BG, RO, HR (SEE)
3) RU
4) UA, BY, KG, MN, GE (other CIS and Mongolia)
5) JP*, IN*, KR*, PH, SG, TH, ID, CN (Asia)
6) BR*, AR, CL*, MX*, PE (Latin America)
7) EA*, US, UK*, CA*, AU*, NZ, CH*, NO, SE*, DK*, IS, TR* (RoW)

Source: Authors' compilation.

*Note: * BIS reporting countries.*

Given the regional focus of our study and considering that our empirical approach requires data on bilateral linkages, i.e. data for country pairs, the locational international banking statistics compiled and published by the Bank for International Settlements (BIS) appear to be the most suitable dataset available to capture the financial contagion channel. We therefore use these data to construct the spillover matrix. The locational statistics capture information about the currency, sectoral and geographical composition of banks' balance sheets (see BIS, 2013). They display outstanding assets and liabilities of banking offices located in BIS reporting countries, including positions between related offices (for a list of BIS reporting banks see BIS, 2013).[4] The statistics are reported to the BIS at a country rather than individual bank level. Central banks collect data from the banks in their jurisdiction and compile national aggregates on the basis of which the BIS calculates global aggregates. The BIS aggregates are published on a quarterly basis with a lag of close to four months.

While the BIS locational statistics are, in our view, the best choice for capturing financial interlinkages across countries in our sample, they are still not a perfect data source for our purpose. In fact, they pose a couple of challenges. First, with a view to modeling the financial contagion channel we are interested primarily in the mutual exposure of the banking sectors. However, the locational statistics provide information only about outstanding positions of banks in reporting country *A* vis-à-vis all sectors in country *B* as well as vis-à-vis the nonbanking sector in country *B*. In other words, there are no direct statistics indicating the positions of country *A* outstanding vis-à-vis the banking sector in country *B*. We therefore approximate these data implicitly by subtracting the positions vis-à-vis the nonbanking sector from the total figures for the whole economy.

The second challenge relates to the fact that out of the 39 economies in our sample only 15 are BIS reporting countries (marked with an asterisk in table 1). Hence, in our 39 by 39 matrix capturing bilateral financial interlinkages we are able to fill only some 40% of the cells with primary BIS data. As this would not be

[3] *To keep the model small we excluded foreign inflation as a further control variable. This can be further argued by the fact that the empirical cross-country correlation of inflation is much smaller than for the other variables employed.*

[4] *This is in contrast to the other BIS banking statistics concept, the so-called consolidated banking statistics capturing the worldwide consolidated claims of banks headquartered in the BIS reporting countries, including claims of their own foreign affiliates but excluding positions between related offices.*

enough to conduct a meaningful contagion analysis we apply two gimmicks to close major gaps in our connectivity matrix. First, we make the assumption that the liabilities (assets) of the banking sector in a reporting country *A* vis-à-vis the banking sector in a nonreporting country *B* correspond to the assets (liabilities) of *B*'s banking sector toward *A*'s banking sector. To give a concrete example, the liabilities of Australian banks toward the banking sector in the Czech Republic are assumed to correspond to the assets that the Czech banking sector holds in Australia. We are aware that this is not a perfect approximation for various reasons.[5] However, for the BIS reporting countries the correlation between these series ranges from 60% to 95%, which makes us sufficiently confident that this is a justifiable approach also for the nonreporting countries.

By applying this assumption we can fill up to 62% of the cells in our interlinkages matrix. More importantly though, this gives us a fairly good picture of banking sector exposures between countries in Central Europe (CEE), Southeastern Europe (SEE) and the CIS region on the one hand and all major economies on the other as well as among major global economies (i.e. the BIS reporting countries).

This leaves us with the problem that there is one country not covered by the BIS data which plays an important role for financial markets in several emerging European economies, namely Russia. Hence, a meaningful contagion analysis needs to take into account also financial interdependencies with this important financial hub. Fortunately, the Central Bank of the Russian Federation (CBR) collects data on foreign assets and liabilities of the Russian banking sector which are comparable with the locational statistics of the BIS (even if the CBR does not report these data to the BIS). Hence, we use these data for Russia in our interlinkages matrix and again apply the symmetry assumption laid out above so that we end up with about two-thirds of the cells of the matrix capturing financial linkages across our country set filled. The remaining gaps are set to 0, which seems a plausible approach for the remaining country pairs. This allows us to trace the propagation of shocks from BIS reporting countries (e.g. the euro area) to Eastern Europe, assuming that financial linkages within CESEE (apart from links between Russia and the other countries of the region) are negligible.[6]

The quarterly data compiled by the CBR are available from 2007 onward. We decided to exclude data relating to the financial crisis and its aftermath to construct the matrix W_{global} which governs the propagation of external shocks through the system. Hence, we compute a normalized matrix of bilateral financial exposures defined as the sum of assets and liabilities of country *A* toward country *B* for 2007 and 2008. Subsequently we take the average over both years to reduce the volatility of the financial exposures and use these constant values of the entire period from 1995 to 2011. As a robustness check we add the data for the crisis year 2009 to our analysis (i.e. we average both BIS and CBR bank exposure data over 2007–2009).

To construct the foreign variables using the matrix W_b we follow Eickmeier and Ng (2011) and use trade weights for foreign variables related to the real economy *(y*)* and financial weights for foreign variables related to the financial side *(stir*, ltir*)*.

[5] *For example, while in a reporting country not all banks report to the BIS, their exposure in the locational statistics comprises the entire banking sector (including small banks and the central bank) in the counterparty country.*

[6] *We are not aware of any evidence that would conflict with this assumption. In particular, banks headquartered in other CESEE countries than Russia usually do not use major funding from banks of other CESEE countries, and also ownership links among these banks are rather the exception (OTP Bank) than the rule.*

While the trade weights, which are available on an annual basis, are time-varying to keep track with the shift of power in the global economy induced by the steady rise of emerging economies (see e.g. Feldkircher and Korhonen, 2014), we use the average financial flows in 2007 and 2008 to construct the foreign financial variables for data availability reasons. To benchmark our results, we use the standard model that employs trade flows to construct the foreign variables (W_b) as well as to govern the propagation of shocks (W_{global}).

3 Spillovers to the CESEE Region – Empirical Results

Both trade and financial interlinkages between the CESEE region and the euro area have significantly intensified over the last two decades: During the timespan of our analysis from 1995 to 2011, trade with the euro area almost doubled in CEE, relative to output in CEE countries, rising from 35% to 63% of the combined GDP of CEE economies. For SEE, the respective share increased from 29% to almost 40% during the same time period. Russia and Ukraine reported comparatively smaller increases, to about 15% and 16%, respectively, in 2011. As for financial linkages, the exposure of BIS reporting banks from the euro area to CEE (on a locational basis) rose from about 6% to almost 25% of the combined GDP of CEE countries, and that to SEE from about 6% to more than 35% of their combined GDP. For Ukraine, in turn, it increased from about 3% to almost 10% of GDP. Russia is an outlier; while its exposure doubled in nominal euro terms during the same time period, it fell relative to Russian GDP due to the strong rise in Russian GDP (measured in EUR at market exchange rates). The exposure of BIS reporting banks from the euro area to CEE on a consolidated basis rose even more strongly over the same time period, from about 5% to almost 50% of GDP in CEE, and from about 6% to around 75% of GDP in SEE. For Ukraine, in turn, it increased from about 3% to almost 19% of GDP. The exposure vis-à-vis Russia tripled in nominal euro terms during the same time period, but fell as a share of Russian GDP. The increase in exposure went hand in hand with euro area banks acquiring large parts of banking sectors in CESEE: From 1995 to 2011, the share of foreign-owned banks in the banking sectors (total assets) rose from about 15% in CEE and SEE to around two-thirds and four-fifths, respectively. Most of the foreign owners (on average above 80%) are financial institutions from the euro area. In Russia, this share increased from 3% to 17%, in Ukraine from 8% to 38%.

Given increasing economic linkages between the euro area and the CESEE region, we are interested in the response of the real economy in the CESEE region to shocks in the euro area. Specifically, we analyze the impact of a +1% shock to euro area real GDP on CEE, SEE, CIS, and Russia as depicted in table 1. We follow the bulk of the literature in employing the generalized impulse response function (GIRF, see Pesaran and Shin, 1998), which is not sensitive to the ordering of the variables in the country models – in contrast to the standard VAR analysis. This benefit comes at the cost of having non-orthogonalized impulse responses, i.e. the shocks cannot be interpreted in a structural way. Yet our focus is on the *propagation* of a foreign shock through different channels, *not on the structural identification* of the original cause of the shock. Finally, the econometric framework we use implies linear and symmetric impulse response functions. That is, the results for a –1% shock are simply the mirror image of the results presented in the remainder of this study.

The impact of the +1% euro area output shock on CESEE and – for comparison – the impact on the euro area itself as well as on the U.S.A. and the U.K. is shown in charts 1 and 2. Each graph displays the response of real output to a shock that was transmitted (a) through the trade channel and (b) through the financial channel. Depending on the country, the effect might vary considerably.[7] Advanced economies, such as the U.S.A, the U.K. and the euro area, react more strongly if the shock is assumed to spread via the trade channel. The difference between the two channels is more pronounced for the U.S.A. and the U.K. than for the euro area, with the long-run impact on real output transmitted through the trade channel amounting to 0.6% (U.S.A.) and 0.7% (U.K.), compared with a more moderate impact of 0.2% and 0.3%, respectively, attributable to the financial channel. For the euro area, the response to shocks transmitted through the financial channel (0.5%) and through the trade channel (0.7%) is more balanced.

To present our results in an easily accessible way, we aggregated the country-specific responses of the smaller and middle-sized countries provided by the GVAR analysis for CEE, SEE and CIS using purchasing power parity-based GDP weights. The results for Russia are displayed separately, since this country would otherwise clearly dominate the aggregated results of the CIS subregion on account of its size. Ukraine is a borderline case, given that it has a considerable weight in the CIS grouping. We opted to keep Ukraine within this grouping to avoid an excess of detail in exhibiting our findings.

Let us first focus on the results for the two channels displayed by the triangles and crosses in charts 1 and 2. As regards the CEE region, we see that both channels result in a long-run response of about 0.3% to a 1% output shock in the euro area. This is contrasted by results for countries in the SEE region, which are more heavily affected on average by spillovers spreading through the trade channel (0.5%) than by spillovers spreading through the financial channel (0.3%). A different picture arises for the CIS region and Russia, with long-run responses through the financial channel of, respectively, 0.8% and 0.9%. For the CIS aggregate, the response via trade spillovers amounts to 0.6%, and for Russia it amounts to 0.1%.

When comparing these results it should be noted that countries are not solely linked via the connectivity matrix but also through elasticities to foreign variables featuring in the country models. That is, notwithstanding the strong financial ties between the euro area and the CEE region, these ties do not warrant the conclusion that the spillovers to the CEE region should be larger than the spillovers to other parts of the world. Indeed, the countries in the CIS region show a stronger response to the financial channel than the CEE region. This finding can, at least partially, be explained by historically larger interest rate elasticities for CIS countries, which amplify the effect for the financial channel through the calculation of financially weighted foreign short-term interest rates.

Finally, we assess the overall transmission of a shock emanating from the euro area to the focus regions, as reflected by the solid dots in charts 1 and 2. While the previous analysis separated the two channels, they (and possibly others, not operationalized here) are likely to be at work simultaneously and mutually

[7] *We also calculated bootstrapped confidence bounds. These are – owing to the short data span – quite large, which is not uncommon in GVAR applications (see, e.g., Galesi and Lombardi, 2009, Galesi and Sgherri, 2011). Nevertheless, the 68% bounds revealed significant impulse response functions for the trade model, while this was, though only marginally, not the case for the financial model.*

reinforcing (see the IMF's Spillover Report, 2012). Ideally one would therefore want to endogenize the channels (i.e. to have them determined within the model). Such an approach would, however, be beyond the scope of this paper. To broadly indicate the total effect of the two channels, we thus opted for another, more straightforward strategy: We calculated the country models' AIC criterion, which is a measure of fit including a penalty for model size under both the benchmark model, which is solely based on trade flows, and the one which allows for financial spillovers. Following Wagenmakers and Farrell (2004) we are then able to construct AIC-based weights for the two channels resembling their country-specific relative importance.

In line with our expectations, country specifics seem to play an important role: spillovers via the trade channel clearly outplay those of the financial channel for the U.S.A., while the opposite is the case for the U.K., which is, after all, known for its large financial industry. By contrast, the results for the euro area are more balanced. The same applies for the CEE region, although, as mentioned above, the difference between the two transmission channels for the region is only marginal. For the CIS region and Russia, our model indicates a predominance of the trade channel over the financial channel. That is, although the magnitudes for the financial spillovers are larger than those for trade spillovers, historical movements in the country variables can be better explained by the model that solely relies on trade flows to approximate economic ties between the countries. This finding can be explained with the fact that some of the countries in the region are large commodity exporters (e.g. Russia and Ukraine) and thus more dependent on foreign shocks emanating from their trading partners. In the SEE region, the financial channel dominates the trade channel, which could be due to the comparatively smaller export base of SEE countries (relative to that of the CEE countries).

Financial data tend to be volatile. However, as mentioned, our assumption is that the relative exposure between countries is more stable, given that it is a (typically slowly moving) stock variable. To examine this assumption in more detail, we added data for the crisis year 2009 to carry out a robustness check. More specifically, the financial weights reflect averages over the period from 2007 to 2009. We find the correlation between the impulse responses computed using weights based on 2007–2008 data and the impulse responses computed using weights based on 2007–2009 data to be very high (>0.98) for all countries. This implies that the shape of the response is virtually independent from the weights chosen to proxy financial ties. On top of that, the responses are also very similar in size. The mean of the average deviation of the responses between weights based on 2007–2008 averages versus 2007–2009 averages is 0.007 (in absolute terms) and the standard deviation thereof is 0.04. Our results are thus qualitatively unchanged when we approximate financial ties computed over this alternative time horizon.

4 Conclusions

In this paper we examine how GDP in the CESEE region (Central Europe, Southeastern Europe, Turkey, Russia, other CIS countries) reacts to an output shock emanating from the euro area. We contrast the standard empirical spillover literature that focuses on trade-related contagion by assessing spillovers via the financial

channel. Our interest is primarily in spillovers from the euro area to emerging Europe. We use locational international banking statistics from the BIS (as well as comparable data from the Central Bank of Russia) to capture financial interlinkages, while assuming that financial linkages within CESEE (apart from links between Russia and the other countries of the region) are negligible. Finally we propose a way to examine the likely overall impact of the foreign shock, assuming that both channels are at work, and examine their relative importance.

Our results are as follows: First, the *overall effect* of the euro area expansion translates into a long-run increase in real output in the euro area itself, the U.S.A. and the U.K. While the responses are broadly similar in size in the euro area and the U.S.A., they are about half as large in the U.K. Second, the results for emerging Europe reveal that overall spillovers are stronger for countries in the CIS region (excluding Russia), while they are smaller for SEE, for CEE and for Russia. The pronounced response of the CIS region, however, is to a good extent driven by the strong reaction of the Ukrainian economy, a finding that is well in line with EBRD (2012).

In addition, we assess the relative importance of the trade and the financial channel in transmitting shocks to the region. In the euro area itself we find the response to the 1% GDP shock to be nearly equally spread between both transmission channels. The same holds true for the CEE region, which can be taken as evidence for the strong (trade and financial) integration of the two regions. In the U.S.A., where the response is broadly similar in size, the trade channel outplays the financial channel, while the opposite applies for the U.K. given its traditionally strong financial sector. In turn, the trade channel also dominates the financial channel in the CIS region and Russia, reflecting the fact that the majority of the CIS countries are large commodity exporters. Finally, in the SEE region the financial channel dominates the trade channel on average.

In terms of policy implications, we want to highlight the following points: First, spillovers of shocks to output in the euro area to the CESEE region are rather sizeable. Therefore, policymakers seeking to limit fluctuations around trend growth need to be aware of the possible magnitude of these spillovers in order to design appropriate policies. In the event of negative output shocks, effective shock absorption capacities, i.e. adequate buffers to cushion economies against such shocks and market flexibility to facilitate the adjustment to such shocks are essential. Second, the transmission of shocks via the financial channel deserves due attention. While financial integration in Europe has brought notable benefits for the CESEE region in terms of know-how transfer and the funding of the catching-up process, it also has a dark side, in particular if and when the cost of this funding is mispriced, not adequately capturing the risks involved, or when capital buffers of financial institutions are insufficient. Financial regulation and supervisory policies need to address such instances of mispricing or inadequate capitalization so as to avoid financial boom-bust cycles. More specifically, policymakers need to put in place effective tools to be able to cope with excessive credit growth during boom times (including analytical tools to diagnose such events of overly high credit expansion in real time). They must also have the courage to use these policy instruments in a timely and sufficient manner to rein in credit dynamics when needed. With the creation of the Single Supervisory Mechanism (SSM), the Governing Council of the ECB will receive a macroprudential mandate

for euro area countries and for the other EU countries participating in the SSM, jointly with the respective national authorities. This supranational layer will help to make sure that macroprudential challenges in these countries are appropriately addressed. For the other countries, further improvements in home-host cooperation are key, not only but especially so in crisis times so as to prevent a disorderly reduction of foreign exposures of financial institutions vis-à-vis these economies from further aggravating downturns.

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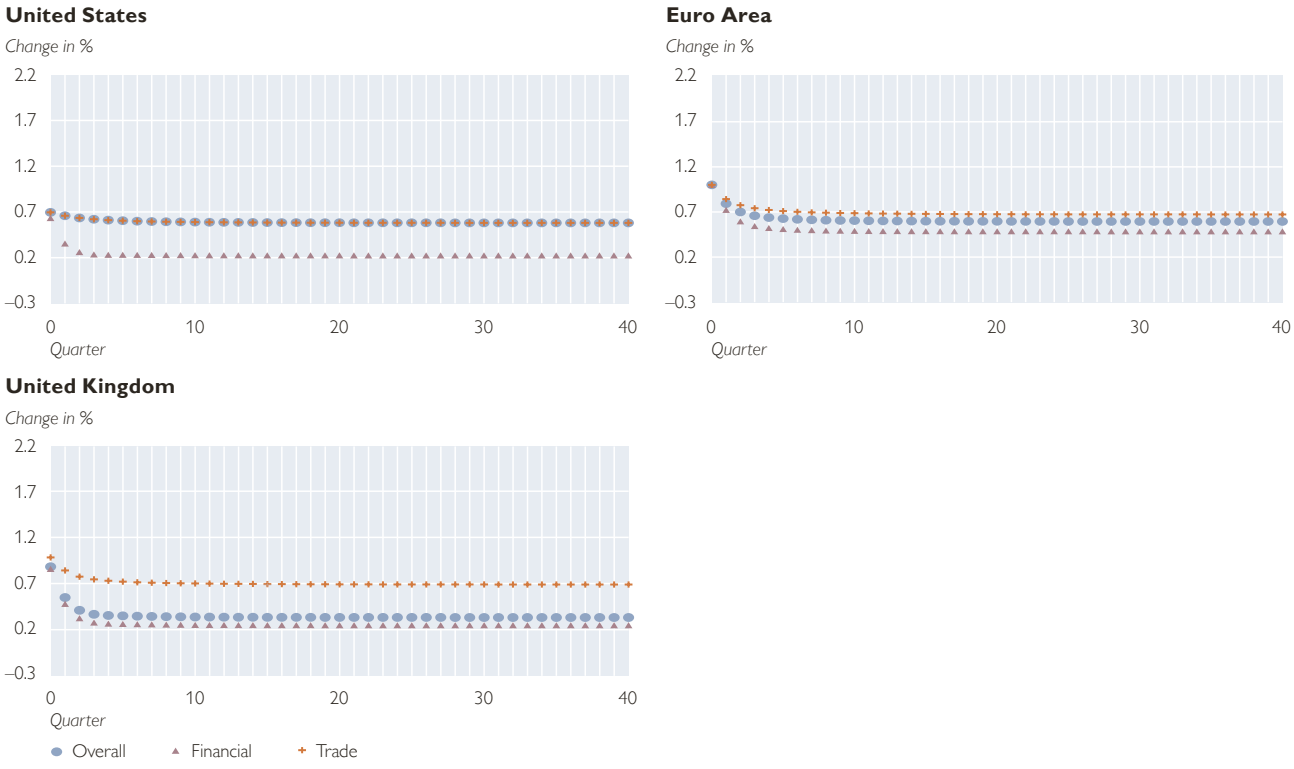
Annex A – Tables and Figures

Chart A1

Response of Output to a +1% Shock to Euro Area Output

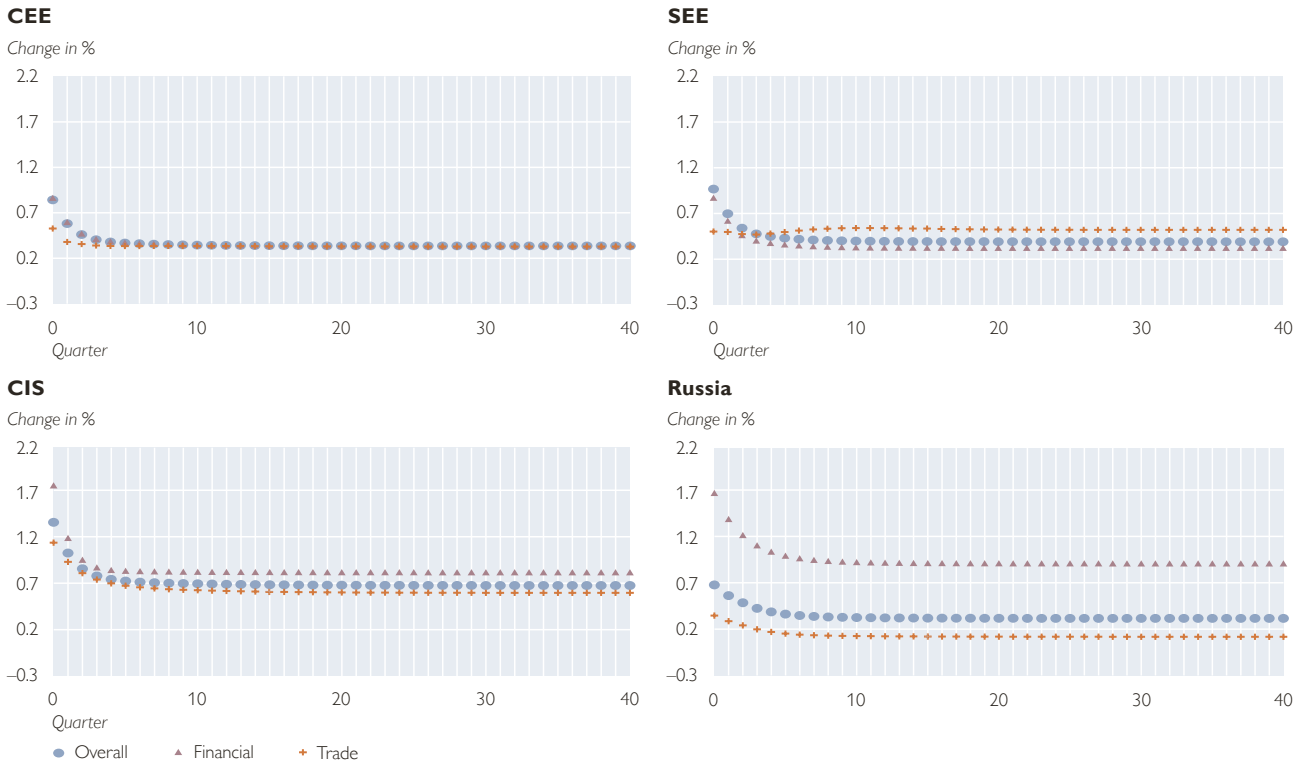


Source: Authors' calculations.

Note: Response of real output to a +1% shock to real output in the euro area. Regional aggregates based on purchasing power parities and defined as in table 1. "Trade" results based on the model that approximates interlinkages based on trade flows, "Financial" results based on financial flows; "Overall" refers to the AIC-based weighted average of those two. For the U.S.A., the overall impulse response function tends to coincide with the one based on trade weights.

Chart A2

Response of Output to a +1% Shock to Euro Area Output



Source: Authors' calculations.

Note: Response of real output to a +1% shock to real output in the euro area. Regional aggregates based on purchasing power parities and defined as in table 1. "Trade" results based on the model that approximates interlinkages based on trade flows, "Financial" results based on financial flows; "Overall" refers to the AIC-based weighted average of those two. For the CEE region, the overall, financial and trade impulse responses tend to coincide.

Annex B – Model Specification

The specification of the country models for both spillover channels are listed in table A1. We tested for the number of cointegration relationships for each submodel using a nested likelihood-ratio (LR) test that is based on the eigenvalues derived from the reduced rank regressions of the country models (see e.g. Pesaran et al., 2004). Following Cesa-Bianchi et al. (2012), we reduce the number of long-run relationships based on the persistence profiles. That is, we perturb the long-run relationships and examine how long it takes for the economy to restore the equilibrium. Cointegration ranks are reduced as long as all long-run relationships converge within 10 to 15 quarters. Deterministic trend and intercept components are tested for by means of a likelihood-ratio test. Following Juselius (2006) we can distinguish four cases: case I is a zero intercept, zero trend model; case II a restricted intercept, zero trend model; case III an unrestricted intercept, zero trend model; and case IV is an unrestricted intercept restricted trend model. We introduced dummy variables to control for extraordinary high interest rates in Turkey (Q4 2000 to Q1 2001), Russia (Q1 1995 to Q3 1995, and Q3 1998), Romania (Q4 1996 to Q3 1997, and Q3 1998 to Q2 1999) and the Czech Republic (Q1 1997 to Q2 1997). For the model using financial variables we had to adjust the specification for Romania by reducing the cointegration rank to 1 and modifying the intercept/trend specification to case IV in order to get a stable country model.

We carried out two diagnostic tests for both the financial and the trade model. First, we test whether it is appropriate to treat the foreign variables as weakly exogenous by means of an F-test (see, e.g., Dees et al., 2007). At the 1% significance level this holds also true for the major economies, the U.S.A. and the euro area, as well as rising emerging economies, such as China, India and Brazil. Out of 153 test statistics, only 6 (18) are significant at the 1% level for the trade (financial) model. Second, we test for first order-serial autocorrelation in the country models. At the 1% level 151 (152) equations pass the F-test out of the 171 equations in the system.

Table A1

Model Specification

					AIC weights	
Country	Domestic variables	Foreign variables	Cointegration rank	Trend/ intercept	Trade	Financial
Argentina	y, Dp, rer, stir	y*, stir*, ltir*	2	IV	0.08	0.92
Australia	y, Dp, rer, stir, ltir	y*, stir*, ltir*	2	IV	0.99	0.01
Bulgaria	y, Dp, rer, stir, ltir	y*, stir*, ltir*	2	II	0.01	0.99
Brazil	y, Dp, rer, stir	y*, stir*, ltir*, poil*	1	IV	0.93	0.07
Belarus	y, Dp, rer, stir	y*, stir*, ltir*	3	IV	0.04	0.96
Canada	y, Dp, rer, stir, ltir	y*, stir*, ltir*, poil*	1	I	0.24	0.76
Switzerland	y, Dp, rer, stir, ltir	y*, stir*, ltir*	2	IV	0.09	0.91
Chile	y, Dp, rer	y*, stir*, ltir*	2	II	0.52	0.48
China	y, Dp, rer, stir	y*, stir*, ltir*, poil*	1	IV	0.26	0.74
Czech Rep.	y, Dp, rer, stir	y*, stir*	2	II	0.19	0.81
Denmark	y, Dp, rer, stir, ltir	y*, stir*, ltir*	3	IV	1	0
Euro area	y, Dp, rer, stir, ltir	y*, stir*, ltir*, poil*	1	IV	0.58	0.42
Georgia	y, Dp, rer, stir	y*, stir*, ltir*	3	II	0.45	0.55
Croatia	y, Dp, rer, stir	y*, stir*, ltir*	1	IV	0.82	0.18
Hungary	y, Dp, rer, stir	y*, stir*, ltir*	1	IV	0.1	0.9
Indonesia	y, Dp, rer, stir	y*, stir*, ltir*	1	II	0.34	0.66
India	y, Dp, rer, stir	y*, stir*, ltir*, poil*	1	III	0.25	0.75
Iceland	y, Dp, rer, stir, ltir	y*, stir*, ltir*	3	IV	0.33	0.67
Japan	y, Dp, rer, stir, ltir	y*, stir*, ltir*, poil*	1	III	0.1	0.9
Kyrgyz Rep.	y, Dp, rer, stir	y*, stir*, ltir*	2	II	0.83	0.17
Korea	y, Dp, rer, stir, ltir	y*, stir*, ltir*	1	III	0.92	0.08
Mongolia	y, Dp, rer, stir	y*, stir*, ltir*	2	IV	0.05	0.95
Mexico	y, Dp, rer, stir, ltir	y*, stir*, ltir*, poil*	2	I	0.81	0.19
Norway	y, Dp, rer, stir, ltir	y*, stir*, ltir*, poil*	2	II	0.98	0.02
New Zealand	y, Dp, rer, stir, ltir	y*, stir*, ltir*	2	I	0.84	0.16
Peru	y, Dp, rer, stir	y*, stir*, ltir*	1	IV	0.26	0.74
Philippines	y, Dp, rer, stir	y*, stir*, ltir*	1	IV	0.05	0.95
Poland	y, Dp, rer, stir	y*, stir*, ltir*	2	IV	0.01	0.99
Romania	y, Dp, rer, stir	y*, stir*, ltir*	2	II	0.01	0.99
Russia	y, Dp, rer, stir	y*, stir*, ltir*, poil*	2	II	0.75	0.25
Sweden	y, Dp, rer, stir, ltir	y*, stir*, ltir*	1	IV	0.95	0.05
Singapore	y, Dp, rer, stir	y*, stir*, ltir*	1	I	0.01	0.99
Slovenia	y, Dp, rer, stir	y*, stir*, ltir*	1	IV	0.01	0.99
Slovakia	y, Dp, rer, stir	y*, stir*, ltir*	2	II	0.05	0.95
Thailand	y, Dp, rer, stir, ltir	y*, stir*, ltir*	1	II	0.03	0.97
Turkey	y, Dp, rer, stir	y*, stir*, ltir*	1	II	0.43	0.57
Ukraine	y, Dp, rer, stir	y*, stir*, ltir*	1	III	0.62	0.38
U.K.	y, Dp, rer, stir, ltir	y*, stir*, ltir*	1	IV	0.19	0.81
U.S.A.	y, Dp, stir, ltir, poil	y*, ltir*	1	IV	1	0

Source: Authors' calculations.

Note: y refers to real GDP, Dp to inflation, rer to the real exchange rate vis-à-vis the U.S. dollar, stir (ltir) to short-term (long-term) interest rates and poil to the oil price. The four trend and intercept specifications are described above in the text. For all countries we included one lag of the endogenous, weakly exogenous and exogenous variables.