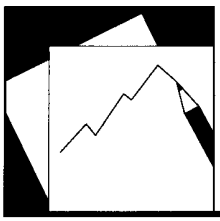
WP/13/194



IMF Working Paper

Cross-Country Linkages in Europe: A Global VAR Analysis

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INTERNATIONAL MONETARY FUND

 WP/13/194

IMF Working Paper

European Department

Cross-Country Linkages in Europe: A Global VAR Analysis

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Authorized for distribution by Bas Bakker

September, 2013

Abstract

This paper uses the Global VAR (GVAR) model proposed by Pesaran *et al.* (2004) to study cross-country linkages among euro area countries, other advanced European countries (including the Nordics, the UK, etc.), and the Central, Eastern and Southeastern European (CESEE) countries. An innovative feature of the paper is the use of combined trade and financial weights (based on BIS reporting banks' external position data) to capture the very close trade and financial ties of the CESEE countries with the advanced Europe countries. The results show strong co-movements in output growth and interest rates but weaker linkages bewteen inflation and real credit growth within Europe. While the euro area is the dominant source of economic influences, there are also interesting sub-regional linkages, e.g. between the Nordic and the Baltic countries, and a small but notable impact of CESEE countries on the rest of the Europe.

JEL Classification Numbers: C32, E17, F47

Keywords: Spillover, Global VAR, regional model, macro-financial linkages, emerging Europe

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EXECUTIVE SUMMARY

This paper uses a modified version of the Global VAR (GVAR) model proposed by Pesaran *et al.* (2004) to study how real or financial shocks are propagated across countries within the countries of Europe connected by deep and complex inter-linkages. The economic and financial linkages between the European economies (advanced and emerging) have increased significantly over the past two decades. Following the collapse of the Soviet Union in the early1990s, trade and financial ties between Central Eastern and Southeastern Europe (CESEE) and advanced Europe strengthened rapidly. The EU accession of ten CESEE countries in 2004 and 2007 accelerated this process, and the process of a few CESEE countries joining the euro zone in the late 2010 s also boosted the integration.

An innovative feature of the paper is the use of combined trade and financial weights (based on BIS reporting banks' external position data) to capture the trade and financial ties of the CESEE countries with the advanced Europe countries. These ties have helped create a tremendous boom and bust cycle in the CESEE countries. Over the past two decades, CESEE countries have become both a part of the production chain of, and new markets for, western European producers. At the same time Western European banks had gained a dominant position in the banking system of the majority of CESEE countries too. As a result, Western European banks and multinational companies from Europe have become the main source of capital in terms of bank funding and FDI for CESEE countries.

The GVAR model includes real GDP growth, inflation, real credit growth, and long term interest rates. The country coverage has an expanded focus on CESEE countries compared to other regional studies, and variables studied include both real and financial variables, slightly more balanced than other studies.

The model yields interesting results. There are strong co-movements in output growth, interest rates, and somewhat weaker co-movements in inflation and credit growth. Shocks to euro area output growth reverberates strongly across European countries including non-euro area Nordic countries and CESEE countries. Shocks originating from the UK—one of the main financial centers of Europe, to its long term interest rate, also have strong impact to long term interest rates in the euro area, Nordic countries, but weak impact on CESEE countries. The impact of interest rate shocks on output is also notable and felt more across Europe. Inflation pass through to the rest of Europe including CESEE —from shocks in the euro area inflation is much weaker; as is the impact on credit growth in CESEE from the shocks to credit growth in the euro area. There are interesting sub-regional ties. For example, the Baltic countries appear to be very sensitive to output shocks from the Nordic countries, given their very close trade and financial linkages with the Nordics. With the rise in size of CESEE economies (as driven by the income convergence process), shocks to their economies have increasingly notable impact on their Western European partners. In particular, shocks to GDP and credit in central European economies have some impact on euro area's GDP

growth. Shocks to the Baltic countries real GDP growth have a small impact on growth of the Nordic countries and Russia, while the impact elsewhere is very muted.

I. INTRODUCTION[1]

While there is a broad recognition that countries in Europe are closely linked through trade and financial channels, the mechanism of how such channels transmit shocks, and how real and financial sectors interact as the shocks are transmitted are less clear. These questions have drawn active interest from researchers in recent years. This paper tries to provide some insight on these issues by using the Global VAR (GVAR) model to account for such regional interdependencies, with a strong focus on linkages between advanced European and CESEE countries. The GVAR model is proposed by Pesaran, Schuermann and Weiner (2004, henceforth PSW) and further developed in Dées, di Mauro, Pesaran, and Smith (2007, henceforth DdPS).

The economic and financial linkages between the European economies (advanced and emerging) have increased significantly over the past two decades. Following the collapse of the Soviet Union in the early 1990s, trade and financial ties between Central Europe and Southeastern Europe (CESEE) and advanced Europe strengthened rapidly. The EU accession process has been one of the main drivers of closer east-west integration. The establishment of the euro has further cemented integration of the euro area member countries. Moreover, some of the CESEE countries joined the euro in the late 2000s.

Trade between Western Europe and CESEE countries has increased rapidly: by 2011, Western Europe was the destination of 75 percent of exports from CESEE, while 68 percent of imports into CESEE were from Western Europe. This largely reflects the fact that CESEE has become both a part of the production chain of, and new markets for western European producers. Exports from CESEE also grew during the period.

Financial integration also proceeded apace. Western European banks had gained a dominant position in the banking systems of most CESEE countries: the share of foreign banks (in terms of assets of local banking system) in 2011 exceeded 70 percent in most countries in the region, with the notable exception of the European CIS countries and Turkey.[2] As a result, Western European banks and companies have become the main foreign source of capital in terms of bank funding and FDI for CESEE countries.

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[1] The authors would like to thank Jessie Yang for help in data collection; Aqib Aslam, Bas Bakker, Christoph Klingen, Nadeem Ilahi, Carolina Osorio-Buitron, Hongyan Zhao, and seminar participants of the IMF European Department spillover working group for comments. The paper's estimation is done using the GVAR Toolbox (Version 1.1) developed by Alessandro Galesi, and L.Vanessa Smith. http://www-cfap.jbs.cam.ac.uk/research/gvartoolbox/index.html

[2] Western banks' emergence in many CESEE countries coincided with the privatization of state-owned banks to strategic foreign investors in the early stages of transition.

For the CESEE countries, these close linkages brought clear benefits, but also carried risks Trade links and financial capital inflows from advanced Europe made it possible for the CESEE countries to boost their growth potential faster than they otherwise could achieve shortly after they left the Soviet bloc. Growth for this region before the recent crisis was very impressive. Real per capita income increased by 4 percent annually in the period of 1995–2007 for the CESEE region, much higher than most other emerging market regions, with the exception of China and India. The close linkages also carried risks. As CESEE economies rely closely on Western Europe for capital and trade, economic slowdowns and financial market turmoil in Western Europe quickly spill over to CESEE countries. When Western European parent banks came under pressure in the fall of 2008, this triggered a sudden stop of capital flows to the region, which contributed to a deep crisis.[3] More recently, the CESEE region has also suffered from spillovers from the euro area crisis. CESEE regional growth has been declining since mid-2011, following the recession in the euro area.

In this paper, we attempt to explore the regional linkages between Western Europe and CESEE using the GVAR framework. The main innovation of the paper is that we aim to capture both trade and financial linkages. Out study also has slightly different country coverage and the key variables studied compared to similar regional studies.
A key innovation of this paper is that we use composite weights to reflect both trade and financial linkages between the countries of Europe. As explained later, a key step of GVAR analysis is to construct, for domestic variables of each country or region in the system, corresponding foreign variables, usually a weighted average of corresponding variables of its partners. For example, if the variable of interest is real GDP of country A, then its corresponding foreign variable (foreign real GDP) is constructed as a weighted average of the real GDP of its partners. The weighting scheme usually reflects the strength of economic ties of a particular country with its foreign partners. In the literature, the selection of weights often varies. Many GVAR studies - including PSW, DdPS (2007), Galesi and Lombardi (2009), and Feldkircher and Korhonen (2012) use weights based on trade flows; Vansteenkiste (2007) uses geographical distance based weights, whereas Hiebert and Vansteenkiste (2007) adopt weights based on sectoral input-output tables across industries. Galesi and Sgherri (2009) use financial weights based on bank lending data across countries. By using weights that reflect both trade and financial flows across countries, the results can better capture the rich transmission channels that exist among countries and regions in Europe.

In the paper, we focus on co-movements between output growth, inflation, real credit growth, and long-term interest rates. The objective is to show how real or financial shocks are

[3] IMF(2010) is a good overview of the recent boom and bust of the CESEE region, and Bas and Klingen (2012) provided a good account of CESEE countries' experience in the aftermath of the crisis. Also see Bakker and Sun (2012) for a discussion of the growth experience before the recent crisis and challenges post crisis of the CESEE region.

propagated across countries within Europe. The variables in our model are real GDP growth, inflation, real credit growth, and long term interest rates. The country sample includes all Western European countries and also a fairly representative set of CESEE economies.

The paper focuses on a larger set of CESEE countries than similar studies. For example, Galesi and Sgherri (2009) present results on financial spillovers in Europe that includes a smaller group of CESEE countries. Their paper focuses on the relevance of international spillovers following a historical slowdown in U.S. equity prices in 2008, with a model that contain equity prices, GDP, interest rates, and credit to corporations. Galesi and Lombardi (2009) focus on international inflation linkages in a dataset that includes a few European countries (some of which from CESEE).[4]

The model has yielded interesting results. There are strong co-movements in output growth, interest rates, and somewhat weaker co-movements in inflation and credit growth. Shocks to euro area output growth reverberate strongly across European countries including Nordic countries and CESEE countries. Shocks to the UK long-term interest rate have a strong impact on long term interest rates in the euro area, the Nordic countries, but weak impact on CESEE countries. The impact of the interest rate on output is felt in all countries. Shocks to euro area inflation have a weak pass through to CESEE countries and other western European countries[5]; so is the impact of shocks to credit growth in the euro area on credit growth in CESEE.[6] There are also interesting sub-regional ties. For example, the Baltic States appear to be very sensitive to shocks from the Nordic countries, which is not surprising given their very close financial and trade linkages with the Nordic countries. Shocks to central Europe countries appear to have a small impact on Western Europe. The impact of shocks to the Baltic countries on other countries is negligible (except for the Nordics and Russia).

The rest of the paper is structured as follows: Section 2 describes the analytical basics of the Global VAR framework and the data used in the analysis. Section 3 presents the estimation results. Section 4 analyzes country-specific and regional shocks by using the generalized impulse response functions and generalized forecast error variance decomposition from the GVAR model, and Section 5 concludes.

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[4] IMF(2011) contains a study of east-west linkages in trade and financial issues between CESEE and western Europe using a different framework.

[5] Galesi and Lombardi (2009) have also shown that direct inflationary effects of oil price shocks affect mostly developed countries while smaller effects are observed for emerging economies. In a different setting, Galesi and Sgherri (2009) find that the effects on credit growth from shocks to US equity prices are country-specific.

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II. The GVAR Model – Model Structure and Data Set Used

A. GVAR Model —A Non-Technical Summary

The GVAR model as developed in PSW and DdPS is a multi-country model. As the name suggests, the model is based on VAR models of individual countries. Its structure, however, makes it a good tool to study inter-country linkages for the chosen group of countries.

The main benefit of a GVAR model compared to individual country specific VAR model is that it allows full interactions of every country in the studied group to be captured explicitly, and in two aspects. First, the interactions among countries through trade, finance, or other channels are reflected in the construction of foreign variables specific to each individual country (see more on this below). Second, the estimation of a single, often fairly large, VAR model based on individual VAR models makes it possible to demonstrate how shocks specific to an individual country affect other countries, as the model is estimated globally at the group level.

A GVAR model is constructed in three stages. First, for each country, the conventional VAR model is extended with the addition of a set of (weakly exogenous) foreign variables. These variables are usually constructed as weighted averages of same type of variables of all its trading or financial partners. For example, if GDP is one of the variables in a country's original VAR model, then a foreign GDP variable - e.g. denoted as GDP* - will usually be constructed as a weighted average of GDP of the rest of the countries in the group. The choice of weights, as discussed below, should in principle, reflect the trade, financial, or geographical relationships among countries in the group. With the VAR models thus extended, the individual country models are estimated in a second step. The lag structure and the selection of foreign variables vary country by country, and this flexibility allows the country VAR to be modeled more accurately. In a third step, all individual country's VAR models are collected and estimated as a single VAR model, and the dynamic properties of the model is used to analyze how shocks are propagated across countries. The GVAR model allows a sub-group of countries to be model together as a region, so when discussing the GVAR model structure, country and region is interchangeable. The technical detail of the GVAR model is summarized in Appendix I.

B. The Data Set (2000–2011)

Data are collected for 33 European economies, including both Western European and CESEE countries. Western European countries include: all the Western European euro area countries, the Nordic countries— Denmark, Norway, Sweden, and other advanced economies—the

United Kingdom (UK), Switzerland, Iceland, Israel.[7] The CESEE countries include: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia, and Turkey.[8]

To control the dimensions of the GVAR to make it manageable, and also to sharpen the focus of the interactions of advanced European countries with CESEE, the Western European countries are grouped into three groups (see Table1). The first group is the Western European euro area countries ("EURO-West" in the tables and charts below) which includes all euro area countries except Finland—included in the Nordic group, and Estonia, Slovakia and Slovenia which are modeled individually as other CESEE countries.[9] The second group includes four Nordic countries ("NORD"). The UK, Switzerland, Iceland, and Israel[10] constitute the third group ("ADV").

The models are estimated over the period 2000Q2-2011Q4. The variables include real GDP growth
(dy_{it}), inflation ($\pi_{it} = p_{it} - p_{i,t-1}$), long term interest rate (r_{it}) (definitions vary country by county), and real credit growth (dCR_{it}).[11] Data sources are described in detail in Appendix Table A1. More specifically,

$$dy_{it} = 400 * (\ln(GDP_{it}) - \ln(GDP_{it-1})), p_{it} = \ln(CPI_{it})$$
$$r_{it} = \frac{1}{4} * \ln(1 + R_{it}^{L}/100), dCR_{it} = \Delta\ln\left(\frac{CR_{it}}{CPI_{it}}\right)$$

[7] UK and the rest of the ADV countries have the most linkages with western European and Nordic countries, but relatively weaker linkages with CESEE countries as shown later in Table 2-4.

[8] Among the four countries excluded from the euro area aggregated Slovenia, Slovakia and Estonia have only become members of the euro area in 2007, 2009 and 2011 respectively and they have not been part of the euro area in most of our sample period.

[9] So the EURO-West group covers over 98 percent of the euro area's total GDP (in PPP terms).

[10] Israel is a member of the countries in the IMF's European Department.

[11] Some variables that are used individually in similar studies like short-term interest rate, real effective exchange rate, or stock market index are not included to control the dimension of the model. These omissions have some drawbacks that we recognize. For example, without including short term interest rates and exchange rates, we could not test standard long-run relationships such as purchasing power parity and uncovered interest rate parity. The model would also be silent on the role of real effective exchange rate in the real-financial mix. The omission of stock market indices also deprived an opportunity to study linkages between equity and bond markets.

Table 1. Countries and Regions in the GVAR Model

EURO-West	**Czech Republic**
Austria	**Hungary**
Belgium	**Poland**
Cyprus	**Slovak Republic**
France	**Slovenia**
Germany	**Estonia**
Greece	**Latvia**
Ireland	**Lithuania**
Italy	**Croatia**
Luxembourg	**Romania**
Malta	**Russia**
Netherlands	**Turkey**
Portugal	
Spain	
NORD	**ADV**
Finland	UK
Denmark	Switzerland
Norway	Iceland
Sweden	Israel

where
GDP_{it} is (seasonally adjusted) real Gross Domestic Product, CPI_{it} is the Consumer Price Index (for mos
is long-term interest rates (which may be government bond rate or bank lending rate depending on countries), for country i and period t.[12] Before constructing the country specific foreign variables $dy^*_{it}, \pi^*_{it}, r^*_{it}$, and dCR^*_{it} , a key step is to build appropriate weights. These weights are calculated in this paper by using the trade flow *and* cross-border bank exposure data. The sample also includes the oil price which is treated as an exogenous variable for all countries except for the EURO-West group (the role of the oil price variable is to control for the global business cycle.)

Since the construction of the foreign variables is based on the weight matrix $\boldsymbol{W} = (w_{ij})$, it is important that the weights should reflect as close as possible the underlying economic linkages among countries. As noted in DdPS, "The weights, … could be used to capture the

[12] Regional aggregates are calculated from individual country data using aggregation weights which are based on average GDP levels (at Purchasing Power Parity) for the period 2006-2008. The GDP (at PPP price) is from IMF World Economic Outlook database.

importance of country j for country ith economy. Geographical patterns of trade provide an obvious source of information for this purpose and could also be effective in mopping up some of the remaining spatial dependencies." In fact, the choice of weights affect the quality of the foreign variables which is a critical factor determining whether GVAR is more advantageous than traditional VAR.

We build the weights by combining bilateral trade and financial flows. Compared to similar GVAR studies, e.g. Galesi and Sgherri (2009) which use financial weights based on bank lending data only, or PSW and DdPS which uses just trade weights, we believe the combined trade and financial weights capture more accurately the trade and financial linkages between CESEE and advanced Europe.

The weights are calculated as follows. First, for each country *i,* bilateral annual trade flows (including both exports and imports) with its trading partners are collected.[13] Then the financial data are collected. The financial data uses the external positions of international banks as published in the Bank for International Settlements (BIS) locational banking statistics.[14] For CESEE countries, as noted earlier, the funding from advanced Europe—mostly channeled through subsidiaries of advanced European banks were one of the driving forces of the boom and bust cycle. The sum of trade flow and foreign exposure positions are then used to derive the weight matrix. For the model estimated below, fixed weights based on the average weights for the period 2005–11 are used (see Table 2).[15] Given that the recent crisis has resulted in fairly large swings in the trade weights and BIS exposure data in the region, the choice of fixed weights averaged across the cycle would hopefully reflect better the normal relations among countries. We have also used time varying weights for the study, and the results are generally qualitatively similar, and are available upon request.

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[13] The trade flow data is from the IMF Direction of Trade Statistics (DOTS) database.

[14] The BIS locational banking statistics gather quarterly data on international financial claims and liabilities of bank offices in the BIS reporting countries. Total positions are broken down by currency, by sector (bank and non-bank), by country of residence of the counterparty and by nationality of reporting banks. Both domestically owned and foreign-owned banking offices in the reporting countries record their positions on a gross (unconsolidated) basis, including those vis-à-vis own affiliates in other countries. This is consistent with the residency principle of national accounts, balance of payments and external debt statistics. The BIS banking statistics are published here: http://www.bis.org/statistics/bankstats.htm.

[15] There are relatively small changes in the weight matrix for the period of 2000-2004 and the period of 2005-2011 (Appendix Table A2) with the exception of the Baltic countries. The changes during these two periods suggest that the Baltic countries (particularly Lithuania and Latvia) have tilted more towards the Nordic countries, away from the euro countries. Within the CEE countries, linkages among Poland, Hungary, Romania, Slovak Republic, and Czech Republic shifted slightly, reflecting most likely changes within the logistic supply chain originated from Germany. For example, share of EU in Hungary declined by about 2.8% while share of Romania and Slovakia increased by about 1.2% and 2.6% respectively. Russia shifted slightly more towards the Euro countries, away from the ADV group. On the other hand, Turkey shifted slightly more towards Russia, away from advanced European countries.

Table 2. Weight Matrix (average of weights for the period 2005-2011) 1/

Country	ADV	Czech Rep.	Estonia	EURO-West	Croatia	Hungary	Lithuania	Latvia	NORD	Poland	Romania	Russia	Slovakia	Slovenia	Turkey
ADV	0.00	0.04	0.02	0.60	0.02	0.04	0.03	0.03	0.21	0.05	0.05	0.11	0.03	0.03	0.17
Czech Rep.	0.00	0.00	0.00	0.04	0.01	0.02	0.01	0.01	0.01	0.03	0.01	0.02	0.11	0.02	0.01
Estonia	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.01	0.00	0.00	0.01	0.00	0.00	0.00
EURO-West	0.91	0.78	0.15	0.00	0.89	0.77	0.25	0.23	0.68	0.75	0.81	0.64	0.68	0.79	0.65
Croatia	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
Hungary	0.00	0.02	0.00	0.03	0.01	0.00	0.00	0.00	0.01	0.02	0.04	0.02	0.05	0.03	0.01
Lithuania	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.08	0.00	0.01	0.00	0.01	0.00	0.00	0.00
Latvia	0.00	0.00	0.05	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
NORD	0.06	0.02	0.67	0.15	0.01	0.02	0.39	0.50	0.00	0.06	0.01	0.08	0.02	0.01	0.03
Poland	0.01	0.04	0.02	0.05	0.01	0.03	0.06	0.03	0.02	0.00	0.02	0.04	0.04	0.02	0.01
Romania	0.00	0.01	0.00	0.01	0.00	0.03	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.02
Russia	0.01	0.03	0.05	0.06	0.02	0.04	0.16	0.06	0.04	0.05	0.02	0.00	0.04	0.02	0.10
Slovakia	0.00	0.05	0.00	0.01	0.00	0.03	0.00	0.00	0.00	0.02	0.01	0.01	0.00	0.01	0.00
Slovenia	0.00	0.00	0.00	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Turkey	0.01	0.00	0.00	0.03	0.01	0.01	0.00	0.00	0.01	0.01	0.03	0.05	0.01	0.01	0.00

1/ Bilateral weights are shown in columns and sum up to one. Weights are average annual weights for the period of 2005-2011. Weights for specific year are calculated based on the total of trade flow and BIS reporting banks' external position between countries for that year. Pink numbers indicate they are larger than zero but smaller than 0.05.

Table 3. Trade Weight Matrix (average of weights for the period 2005-2011)

Table 3. Trade Weight Matrix (average of weights for the period 2005-2011) 1/

Country	ADV	Czech Rep.	Estonia	EURO-West	Croatia	Hungary	Lithuania	Latvia	NORD	Poland	Romania	Russia	Slovakia	Slovenia	Turkey
ADV	0.00	0.06	0.04	0.39	0.05	0.06	0.04	0.05	0.19	0.06	0.05	0.10	0.04	0.04	0.14
Czech Rep.	0.01	0.00	0.01	0.07	0.02	0.04	0.01	0.01	0.02	0.06	0.03	0.02	0.18	0.03	0.01
Estonia	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.11	0.01	0.00	0.00	0.01	0.00	0.00	0.00
EURO-West	0.80	0.64	0.23	0.00	0.61	0.62	0.31	0.28	0.63	0.62	0.64	0.56	0.49	0.66	0.55
Croatia	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
Hungary	0.01	0.03	0.01	0.04	0.04	0.00	0.01	0.01	0.01	0.03	0.08	0.03	0.08	0.04	0.01
Lithuania	0.00	0.00	0.08	0.01	0.00	0.00	0.00	0.17	0.01	0.01	0.00	0.02	0.00	0.00	0.00
Latvia	0.00	0.00	0.10	0.00	0.00	0.00	0.09	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.00
NORD	0.10	0.03	0.38	0.17	0.03	0.03	0.11	0.16	0.00	0.08	0.02	0.09	0.03	0.02	0.04
Poland	0.02	0.07	0.04	0.09	0.02	0.05	0.10	0.07	0.04	0.00	0.04	0.06	0.07	0.03	0.02
Romania	0.00	0.01	0.00	0.03	0.01	0.05	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.04
Russia	0.02	0.04	0.10	0.10	0.09	0.07	0.26	0.13	0.07	0.08	0.05	0.00	0.07	0.03	0.17
Slovakia	0.00	0.09	0.00	0.03	0.01	0.05	0.00	0.01	0.00	0.03	0.02	0.02	0.00	0.02	0.01
Slovenia	0.00	0.01	0.00	0.02	0.09	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00
Turkey	0.02	0.01	0.01	0.05	0.02	0.01	0.01	0.01	0.01	0.01	0.07	0.07	0.01	0.02	0.00

1/ Bilateral weights are shown in columns and sum up to one. Weights are average annual weights for the period of 2005-2011. Weights for specific year are calculated based on the trade flow between countries for that year. Pink numbers indicate they are larger than zero but smaller than 0.05.

Table 4. Financial Weight Matrix (average of weights for the period 2005-2011)

Country	ADV	Czech Rep.	Estonia	EURO-West	Croatia	Hungary	Lithuania	Latvia	NORD	Poland	Romania	Russia	Slovakia	Slovenia	Turkey
ADV	0.00	0.02	0.00	0.87	0.01	0.01	0.01	0.01	0.24	0.03	0.04	0.14	0.01	0.01	0.21
Czech Rep.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Estonia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EURO-West	**0.95**	**0.98**	0.07	0.00	**0.99**	**0.99**	0.15	0.18	**0.76**	**0.92**	**0.95**	**0.80**	**0.98**	**0.98**	**0.79**
Croatia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hungary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lithuania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Latvia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NORD	0.05	0.00	**0.93**	0.12	0.00	0.00	**0.84**	**0.81**	0.00	0.04	0.00	0.05	0.00	0.00	0.01
Poland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Russia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Slovakia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Slovenia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1/ Bilateral weights are shown in columns and sum up to one. Weights are average annual weights for the period of 2005-2011. Weights for specific year are calculated based on the BIS reporting banks' external position between countries for that year. Pink numbers indicate they are larger than zero but smaller than 0.05.

Given that the financial linkages are generally between advanced Europe and CESEE rather than among CESEE countries themselves, there is a significant difference in the trade weights and financial based weights (see Table 3 and 4).[16] In fact, the financial weights accentuate the pattern shown in the trade weights. For example, Euro-west has a very high share in terms of financial weights with CESEE countries, while Nordic also has a very high financial share with the Baltics. Both these shares are higher than trade shares. While there is some intra-regional trade among CESEE countries, the financial links among CESEE are not strong, with only Turkey having some financial links with other CESEE countries. Euro countries and Nordic countries have the most financial exposure towards CESEE countries. On the other hand, countries in the ADV group have very large financial exposure in the EURO-West group countries and vice versa. They also have strong exposure in Russia and Turkey, but less so in the Nordic countries.

Clearly the cross-country relationships are better revealed when both the trade and financial linkages between advanced European countries and CESEE are considered together. Either one studied alone will not give a full picture. The different trade and financial linkages provides justification for combining these weights in the GVAR setup.

Within the group of CESEE countries, inter-linkages between individual countries are usually very low (below 5% in most cases) in spite of the geographical proximity in many cases. There are only a few exceptions with somewhat larger bilateral links. For example, the Czech Republic is an important partner for the Slovak Republic with a weight from the Czech Republic to Slovakia at 11%, but the influence is smaller the other way round—the weight from the Slovak Republic to the Czech Republic is only 5%, though it is still higher than most other countries. Also, Russia is an important partner for Lithuania (weight at 16%) and Turkey (10%). The Baltic countries trade closely with each other (weights between Baltic countries are close to or above 10%).[17]

The weight matrix itself yields interesting information on cross-country linkages. It shows the dominant role of the euro area as the main partner for the rest of the countries. The weight for the euro area as a foreign partner ranges between 64% - 91% for all countries in the sample, except for the Baltic countries. For the Baltic countries, the Nordic countries (in this study including Finland) are clearly the most important partners, with their joint weights ranging between 39%-67% for the three countries, exceeding the influence from the euro

[16] BIS data only records exposure from reporting banks. So this may not cover other flows among countries. But it is largely safe to assume that cross-border non-bank financial flows among CESEE countries are miniscule if any,

[17] Flows between emerging Europe countries are mostly trade flows since there is little cross-border lending between them.

area.[18] The link between the rest of the advanced economies ("ADV" group) and CESEE countries is relatively weak: its weights are generally below 5%, except for Russia and Turkey where ADV's weights are 11% and 17% respectively.

III. Estimation of the GVAR Model

A. Specification and Estimation of the Country-Specific Models

We start by assuming that foreign variables are weakly exogenous, and the VAR relationships (i.e. coefficients of individual country models) are stable over time. The result of unit root tests and of weak exogeneity tests are shown in Appendix II, and the issue of structural breaks is discussed later after the initial model is estimated.

Obvisouly no single structure can be imposed across the countries given both data constraints and different country circumstances. In fact, as noted earlier, the GVAR approach has the advantage to handle flexibly different specifications for different countries. The foreign inflation variable is excluded from entering the model for most of the countries except for Lithuania since they are I(0) (see Appendix II, and Appendix Tables A3-A5 for the unit root test results). Also since foreign interest rates are I(2) in ADV, Croatia, the Czech Republic, Hungary, Poland, Romania, Russia, Slovakia, Slovenia, and Turkey, they are excluded from entering the VARX model in those countries. Overall, most of the countries have the same set of domestic variables, except for a few countries where the interest rate is not included (Estonia, Croatia, Latvia, Lithuania, Slovenia, and Turkey)[19]. The interest rate for Turkey is more volatile and the VARX including the interest rate with the chosen domestic variables yielded a poor fit for interest rate. To avoid compromising the fit of the GVAR model, it is not included in Turkey's model.

After individual country models are specified, the lag length of the VARX(p, q) model is selected using Akaike Information Criterion (AIC) with a maximum length set at three for domestic variable (p_{max}) and two for foreign variables (q_{max}) to control the total dimension of the system. In the end, a majority of the domestic variables have a lag order of two. Then we proceed to conduct the co-integration analysis with a specification of unrestricted intercept in the co-integration relations.

The results of the lag order selection and co-integration tests are shown in Appendix Table A6. The co-integration results are based on trace statistic at the 95 significance level, with

[18] Obiora (2010) notes a similar strong influence of advanced EU (which includes the Nordic countries) to the Baltic countries based on trade links. Although not singling out the influence from the Nordic countries, he finds that the EU's influence outweighs that from Russia, the region's traditional trading partners.

[19] All except Turkey have either joined the euro area during the sample period (Estonia and Slovenia), or have a fixed or heavily managed foreign exchange regime against the euro (Latvia and Croatia).

critical values from MacKinnon, Haug, and Michelis (1999). The trace statistic has better small sample power compared to the maximal eigenvalue statistic. The diagnostic test results for all equations are given in Appendix Table A7. With the exception of Turkey which the original co-integration analysis shows a full rank co-integration matrix, all other countries have reasonable results.

B. Testing for Structural Breaks

We also test for structural stability of the model. Following DdPS, a battery of parameter constancy tests are carried out. The test is mainly on the structural stability of the short-term coefficients, rather than the long-run coefficients which is unlikely to be feasible given the data constraints, as pointed in DdPS. Nevertheless, the stability of short-run coefficients matters more to the transmission of shocks across countries which is the main interest of this study.

The tests include Ploberger and Krämer's (1992) maximal OLS cumulative sum (CUSUM) statistic, denoted by PK_{sup} and its mean square variant PK_{msq}; tests for parameter constancy against non-stationary alternatives proposed by Nyblom (1989), denoted by $\Re$. They also include several sequential Wald-type tests of a one-time structural change at an unknown change point: the Wald form of Quandt's (1960) likelihood ratio statistic (QLR), the mean Wald statistic (MW) of Hansen (1992) and Andrews and Ploberger (1994) and the Andrews and Ploberger (1994) Wald statistic based on the exponential average (APW). The heteroskedasticity-robust version of the above tests is also presented.

Table 5 summarizes the results of the tests by variable at the 5% significance level. The results show that structural instability is not a serious concern for the sample, although results vary by tests and by variables.[20] These are quite encouraging results given that the sample period covers a very severe boom and bust for CESEE and also a crisis for advanced Europe where economic variables have undergone significant fluctuations. Looking into the details, we note, for example, the two PK tests do not reject structural stability in any of the cases.

For the other three types of tests, both the constant variance version and the heteroskedasticity robust version of the tests seem to reject only a small share (4–10 percent) of all possible cases. Together, the three Wald-type tests suggest that a slightly higher probability of breaks in error variances than parameter coefficients.

[20] The structural stability results could change if we used a different set of weights. For example, if the average of 2000-2004 period weights is used, results might differ. However, as noted earlier, the changes in the weights are relatively small (with the exception of the Baltic countries), the favorable stability results are most likely to hold.

Table 5. Number of rejections of the null of parameter constancy per variable across the country-specific models at the 5% level

Alternative test statistics	Domestic variables				Number (%)
	dy	π	*r*	*dCR*	
PK_{sup}	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
PK_{msq}	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
$\Re$	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
robust-*N*	0(0.0)	0(0.0)	1(11.1)	1(6.7)	2(3.7)
QLR	1(6.7)	1(6.7)	2(22.2)	1(6.7)	5(9.3)
robust-*QLR*	0(0.0)	0(0.0)	0(0.0)	1(6.7)	1(1.9)
MW	1(6.7)	1(6.7)	2(22.2)	1(6.7)	5(9.3)
robust-*MW*	0(0.0)	0(0.0)	0(0.0)	2(13.3)	2(3.7)
APW	1(6.7)	1(6.7)	2(22.2)	1(6.7)	5(9.3)
robust-*APW*	0(0.0)	1(6.7)	0(0.0)	1(6.7)	2(3.7)

Note: Percent of rejection in parenthesis. The test statistics PK_{sup} and PK_{msq} are based on the cumulative sums of OLS residuals, $\Re$ is the Nyblom test for time-varying parameters and *QLR*, *MW* and *APW* are the sequential Wald statistics for a single break at an unknown change point. Statistics with the prefix 'robust' denote the heteroskedasticity-robust version of the tests. All tests are implemented at the 5% significance level.

C. Contemporaneous Effects of Foreign Variables on their Domestic Counterparts

We present in Table 6, the contemporaneous effects of foreign variables on their domestic counterparts. For example, for CESEE countries, a 1% increase in foreign output growth in a given quarter leads to an average 0.4% increase in domestic output growth within the same quarter. For credit growth, significant elasticity is observed in Hungary, Lithuania, Romania, Slovakia, and Turkey for CESEE, and ADV and NORD in advanced Europe. For a few countries where foreign inflation and interest rates are directly included in the model, there are high contemporaneous effect as well. For example, there is a high elasticity between domestic and foreign inflation, π and π^* for Lithuania, and we also observe a significant elasticity between domestic and foreign interest rates, *r* and *r**, for EURO-West and NORD indicating close co-movements of interest rates in these two regions.

D. Pair-wise Cross-Country Correlations: Variables and Residuals

Next we present results on how idiosyncratic shocks of the individual country models are correlated across countries. A low correlation is one of the main conditions for a well functioning GVAR model. A low correlation would suggest that the cross-dependence of idiosyncratic shocks is "sufficiently" small, therefore we can isolate the impact of country specific, idiosyncratic shocks from other shocks in the dynamic analysis we carry out later.

As suggested in DdPS, a simple diagnostic of the extent to which the country-specific foreign variables have been effective in reducing the cross-country correlations of the variables in the GVAR model could be the simple average pair-wise correlation for the endogenous variables, and those of the associated residuals over the estimation period. A low correlation

Table 6. Contemporaneous Effects of Foreign Variables on Their Domestic Counterparts

Country	Domestic variables			
	dy	π	*r*	*dCR*
ADV	0.1			0.3
	(2.7)			(1.5)
Czech Rep.	0.2			0.2
	(4.7)			(2.7)
Estonia	0.9			0.3
	(2.0)			(-1.0)
EURO-West	0.1		0.1	0.1
	(4.1)		(2.3)	(1.0)
Croatia	0.5			0.2
	(-0.5)			(1.5)
Hungary	0.1			0.5
	(5.0)			(0.9)
Lithuania	1.0	0.3		0.5
	(3.9)	(4.2)		(0.9)
Latvia	0.6			0.1
	(2.2)			(-0.4)
NORD	0.1		0.1	0.2
	(3.2)		(2.3)	(2.0)
Poland	0.1			0.3
	(3.3)			(0.0)
Romania	0.3			0.5
	(3.9)			(1.9)
Russia	0.2			0.2
	(3.8)			(0.1)
Slovakia	0.3			1.2
	(5.3)			(-0.7)
Slovenia	0.1			0.2
	(8.1)			(1.1)
Turkey	0.2			0.5
	(3.1)			(-0.3)

Note: Newey-West's heteroskedastic-robust *t*-ratios are given in brackets.

of the residuals is a strong indication that the GVAR model has been quite successful at capturing the common effects driving the endogenous variables, and the GVAR model should be considered fairly effective in explaining cross-country interdependencies. Consequently, shocks to a domestic variable in an individual model can be considered idiosyncratic.

It can be seen from the statistics shown in Table 7 that the average cross-section correlations are generally high for the level of domestic variables. The results vary somewhat for

Table 7. Average Pair-wise Cross-Section Correlations: Variables and Residuals

Country	Real Output Growth			Inflation		
	Levels	First Differences	VECMX Residuals	Levels	First Differences	VECMX Residuals
ADV	0.50	0.20	-0.02	0.23	0.16	0.13
Czech Rep.	0.68	0.35	0.07	0.38	0.21	0.11
Estonia	0.57	0.10	-0.03	0.40	0.19	0.11
EURO-West	0.66	0.45	-0.03	0.44	0.40	0.03
Croatia	0.17	-0.05	-0.06	0.08	-0.01	0.02
Hungary	0.62	0.28	-0.06	0.16	0.20	0.06
Lithuania	0.66	0.42	0.07	0.30	0.14	0.03
Latvia	0.62	0.26	-0.03	0.36	0.19	0.16
NORD	0.64	0.27	-0.01	0.34	0.31	0.03
Poland	0.36	-0.02	0.02	0.19	0.28	0.12
Romania	0.59	0.34	0.04	0.32	0.15	-0.06
Russia	0.68	0.41	0.06	0.36	0.23	0.06
Slovakia	0.54	0.37	0.00	0.13	0.15	0.05
Slovenia	0.67	0.37	0.05	0.33	0.34	0.11
Turkey	0.60	0.23	0.00	0.03	0.07	-0.02
Country	Interst rate			Real Credit Growth		
	Levels	First Differences	VECMX Residuals	Levels	First Differences	VECMX Residuals
ADV	0.56	0.03	0.02	0.17	-0.10	0.06
Czech Rep.	0.62	0.32	-0.01	0.22	0.08	-0.02
Estonia	---	---	---	0.53	0.12	0.08
EURO-West	0.65	0.31	0.00	0.34	0.01	-0.07
Croatia	---	---	---	0.46	0.13	0.04
Hungary	0.39	0.19	0.03	0.27	0.03	-0.08
Lithuania	---	---	---	0.50	0.04	0.05
Latvia	---	---	---	0.50	0.09	0.04
NORD	0.63	0.28	0.07	0.50	0.05	-0.05
Poland	0.58	0.31	0.10	0.14	0.08	0.01
Romania	0.22	0.25	-0.04	0.41	0.06	0.01
Russia	0.51	0.06	0.01	0.34	0.05	-0.06
Slovakia	0.51	0.11	-0.06	0.09	0.05	0.06
Slovenia	---	---	---	0.50	0.08	0.03
Turkey	---	---	---	0.46	0.04	-0.02

Note: VECMX residauls are based on co-integrating VAR models with countr-specific foreign variables.

individual countries and for specific variables. It is interesting to note that cross section correlations of real GDP growth are quite high (averaging 57%), as are interest rates (52%),

while cross-section correlations are slightly lower for inflation and real credit growth (with averages at around 27% and 36% respectively). This suggests a significant co-movement for output growth and interest rates, while domestic inflation and credit growth are less synchronized. The cross-section correlation falls as we move from level to first difference, with the reduction most pronounced in real credit growth, interest rates, output growth, and inflation in that order. There are still noticeable correlations in the first differences, as the average correlations range between 20%- 27%, except for real credit growth which is at 6%.

In contrast, correlations of the residuals from the VARX models are very small. The detailed results show that, with few exceptions, the (absolute) correlations are generally less than 10%. For example, for the real output growth equation, correlation of residuals are between -6% and +7%, much smaller compared to the correlations in level which range between 17% and 68%. The relative reduction in correlations for inflation is more modest. Nevertheless, the correlations in the residuals of the inflation equation are not large: they are below 16% for all countries, and for 60 percent of the countries, the correlation is below 6%.

IV. Dynamic Analysis Using Generalized Impulse Response Functions and Generalized Forecast Error Variance Decomposition

In this section we look at the propagation of shocks between different regions of Europe over time, considering both real and financial shocks from the euro area and other parts of Europe. Based on the estimated GVAR model, we conduct a few experiments and analyze the model's dynamic properties: i.e. the time profiles of the model's response following a shock (e.g. a shock to a specific variable of a particular country or region) using the generalized impulse response functions. This will give insight on how shocks are propagated across countries.

We organized the type of shocks into three categories, one is real shocks—e.g. direct shocks to real GDP growth in different regions, the second is financial shocks—e.g. shocks to interest rate or credit growth, the third shock includes shocks to inflation. The motivation of experimenting on these shocks is to see how the impact of these shocks—originating in a particular region are felt and transmitted across countries. For example, a few of the shocks experimented below is on the shock to real GDP growth originating in the EURO-West region, the Nordics, the CE region, and even in the Baltic countries. Such experiments can reveal how output, credit growth, and other variables are affected with these shocks.[21] On the other hand, motivated by questions such as how does pressure to strengthen western banks' balance sheet affect credit and output growth in CESEE, or whether an interest rate shock originated in the U.K. (following shocks in the US) will affect interest rate in the rest of the

[21] For brevity, not all the responses to shocks are presented in the paper, responses of variables not included in the paper is available upon request.

Europe, we also conduct a few experiment on the impact of shocks to credit growth and interest rates in some region. The question of how significant is the inflation pass-through in the region is also investigated as in Galesi and Lombardi (2009).

We use the method of generalized impulse response functions (GIRF) proposed by Koop *et al*. (1996) and Pesaran and Shin (1998). The GIRF method is an alternative to the orthogonalized impulse response function, and it is invariant to the ordering of the variables and countries in the model. The GIRF approach has the advantage that in the absence of strong *prior belief* of the ordering of the shocks or countries, it still can provide useful information on the transmission dynamics of the model to individual shocks.

The GIRF is presented over a relatively long period (over 20 quarters). Nevertheless, we generally try to focus on responses over a shorter period, say two years, which is a reasonable time frame for credible results. To avoid lengthy discussion of response for individual country and rather to focus on common pattern of response for countries in the same region for CESEE countries, we recast some countries in CESEE into sub regions: central Europe ("CE" in the tables and figures below) which includes Hungary, Poland, the Czech Republic, the Slovak Republic, and Slovenia; Southeastern Europe ("SE") which includes Romania and Croatia; the Baltics ("Baltic") which includes Estonia, Latvia, and Lithuania. The country weight is based on each country's GDP at PPP price. The two largest economies in the region: Turkey and Russia are not included in any of the aggregates. The regional weight matrix for the GIRF exercise is shown below (Table 8). The region based analysis provides a good summary of response to individual shocks. To keep the length of the main text in control, the detailed country level IRF figures are presented in the Appendix without discussion.[22]

We also present results of the Generalized Forecast Error Variance Decomposition (GFEVD) which give a picture of how forecast error variance can be traced (though not exclusively) to shocks to different variables (and regions). The GFEVD is based on the GIRF, and is a natural extension to the conventional (orthogonalized) forecast error variance. As GFEVD do not necessarily add to 1 due to contemporaneous correlations among innovations, we present relative contribution, based on rescaled GFEVD, of different variables (from different countries and regions). Such relative contribution can still provide an indication of how important shocks to different variables from a particular region or country are, compared to shocks to other variables from the rest of the region or countries.

[22] Country level analysis for individual emerging European countries is available upon request.

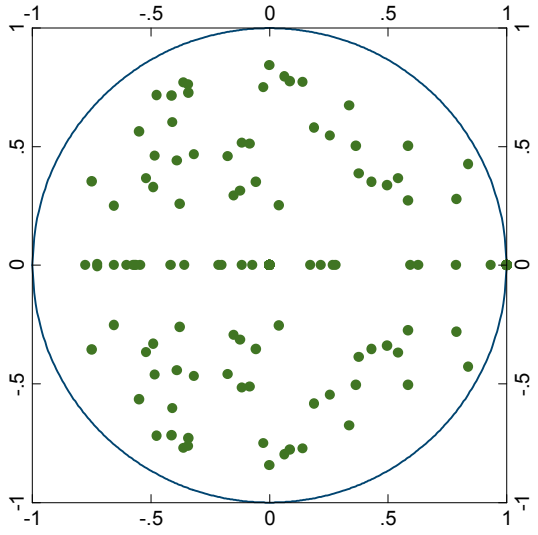
Table 8. Regional Weights for the GIRF Exercise

Region	Country	*dy*	π	*r*	*dCR*
EURO-West	EURO-West	1	1	1	1
ADV	ADV	1	1	1	1
NORD	NORD	1	1	1	1
BALTIC	Estonia	0.22	0.22	---	0.22
BALTIC	Latvia	0.29	0.29	---	0.29
BALTIC	Lithuania	0.49	0.49	---	0.49
CE	Hungary	0.15	0.15	0.15	0.15
CE	Poland	0.52	0.52	0.54	0.52
CE	Czech Rep.	0.20	0.20	0.21	0.20
CE	Slovenia	0.04	0.04	---	0.04
CE	Slovakia	0.09	0.09	0.09	0.09
SE	Romania	0.76	0.76	1.00	0.76
SE	Croatia	0.24	0.24	---	0.24
Russia	Russia	1	1	1	1
TUR	Turkey	1	1	---	1

Note : Weights are based on GDP at PPP price.

In the results that follow, we can see that the impulse responses settle down reasonably well. This is because the estimated GVAR model is stable: the modulus of every eigenvalue of the GVAR is on or within the unit circle (Figure 1). Some of them are complex, which result in oscillating features in the impulse responses. However, bootstrap simulation based on the estimated model generally points to rapidly widening bands for the IRF (not shown in the paper). Therefore, the mean results presented here are only indicative and results over 6-8 quarters should be treated with caution.

Figure 1. Modulus of the Eigenvalues of the Estimated GVAR model



1. Spillover of Real Shocks: Shocks to Real GDP Growth

A. Negative Shock to EURO-West Real GDP growth

The first experiment we implement is a 1 percentage point negative shock to the EURO-West group's real GDP growth which showed large responses in output across the region.[23] The generalized impulse response of real GDP growth to the shock is shown in Figure 2.[24] The negative shock in the EURO-west results in negative growth for all the countries and regions in the sample. The response generally follows the same profile: there is an immediate impact on growth, the impact then oscillates and dissipates in about 12 quarters. GDP growth in the CESEE countries drops by 0.65–1.25 percentage points (p.p.) in the same quarter.[25] This behavior is largely consistent with the GDP growth spillovers observed in 2011 and 2012. The Nordic countries also experience a fairly significant decline in growth rate in the same quarter (about 0.5 p.p.), while the ADV group also similarly impacted - the growth rate declines by about 0.5 p.p. in growth rate.

The GFEVD results are presented in Table 9. The table shows that shocks to variables in the EURO-West group together have the highest share of contribution to forecast error variance (over half of the rescaled total variance in the first four quarters). Among the EURO area variables, shock to real GDP growth is the dominant source of innovation, although oil price which is treated as an endogenous variable to the euro area is also an important source of shocks. Given that the oil price is the only explicit link of the region with the global economy in our model, it suggests that shocks from outside Europe are important.[26] Within each country or region, shock to real GDP growth is the main source of innovation compared to shocks to other variables in the same region, although contribution of shocks to other variables rises over time.

[23] The experiment is conducted differently from the conventional one s.d. shock in presenting the impulse response functions. In perspective, a one s.d. shock is equivalent to about 0.2 percentage points (p.p.) in annualized quarter on quarter growth rate for the EURO-West group on impact.

[24] The GIRF of other variables (credit, inflation, interest rates) to the shock to euro area GDP growth is not presented, and is available from the authors upon request. Similarly for the other shock experiments discussed below, the GIRF results that are not mentioned are available upon request.

[25] Individual country's responses vary quite widely. For example, Poland's response is a decline 0.4 p.p. while for smaller and more open economies like Slovakia and Lithuania, the responses are higher at around -1.5 to 1.6 p.p., see Figure A1.

[26] To fully explore the impact of the rest of the world on Europe will require a model that includes other important countries or regions like the US, Japan, and major emerging market countries as is done in DdPS.

B. Shock to Real GDP Growth in Nordic Countries

In contrast to strong region wide responses to output shocks in the Euro-West region, the shocks to real GDP growth in the Nordic region is less severe region wide, but is felt strongly in the Baltics. Given the very close relationship of the Nordic countries to the Baltic countries, we conduct the next experiment on a positive shock to real GDP growth in the Nordic countries. For the Nordic countries, there is a gradual decline in growth rate after the initial impact (see Figure 3).[27] As expected, the impact of growth shock from the Nordics to the Baltic countries is quite significant. In the same quarter, the growth rate in the Baltic increases by 1 p.p., and rises and reaches 1.5 p.p. in the third quarter before declining afterwards. While the Nordic economies are only about 10 percent of the size of the EURO-West group, with the close links between the two regions (recall Nordic is only about 15% of the weight for the EURO-West group), there is still some noticeable impact on EURO-West group's growth. There is an immediate effect of 0.2 p.p. increase in growth rate for the Euro-west group, which rises further to about 0.3 p.p. in the next quarter. The profile of response is similar in other CESEE countries. The same quarter impact to growth for central Europe, Russia, and Turkey ranges is around 0.15--0.2 p.p., and the effect rises further in the next 2-3 quarter before the impact diminishes. The shock to the Nordic region's GDP growth also has a small impact on the ADV group: the immediate effect is only 0.1 p.p. This reflects the relative distant linkages between the two groups: the Nordic group's weight is only 6% for the ADV group.

Table 10 presents the GFEVD results for this experiment. With shocks originating from real GDP growth in the NORD group, it follows that such innovation is one of the main source of influence for forecast error variance. Other important sources of influence are shocks to interest rate in the ADV group, oil price shocks, and shocks to output in the EURO-West group. These results suggest that real GDP growth in the Nordic group is sensitive to these external shocks given its close link to the EURO-West group, as well as to the other advanced economy.

C. Shock to Real GDP Growth in Central Europe

As the Central European economies grow in size and importance, a shock to their growth is likely to have a larger impact on its trading partners, including the western European countries. In particular, serving as a market for Western European countries, any shocks in domestic demand in Central Europe could have affected demand for Western European goods and services. In this section and the next, we experiment how shocks to CE countries (which include Czech R., Hungary, Poland, Slovakia, and Slovenia in this study) affect other countries in the region.

[27] A one s.d. shock is equivalent to 0.14 p.p. increase in growth rate on impact to the NORD group,

As shown in Figure 4, a one p.p. shock to CE group real GDP growth has some discernible impact on its trading partners. Its own real GDP growth declines gradually and settling down in about six quarters after the shock.[28] Among the other regions, the Euro-West group sees a 0.1 - 0.2 p.p. increase in growth in the first two quarters, with the impact dissipating quickly afterwards. For the Nordic countries, there is a rise in growth rate of 0.1 p.p. on impact which then declines and dissipates in the following periods. Similar profile is also evident for growth in ADV countries. The impact on CESEE countries is relatively larger and longer lasting. For example, the SE group countries will experience a rise of below 0.15 p.p. in growth rate on impact, and 0.25 p.p. in the second quarter. The impact on the Baltic countries is even more visible: GDP growth is expected to rise by 0.2 p.p. on impact, and over 0.4 p.p. in the second quarter before declining afterwards.

The GFEVD results (Table 11) suggest that CE real output growth is very sensitive to shocks to EURO-West group's output, oil price shocks, and shocks to ADV group output and interest rate. CE's domestic inflation and output are main source of domestic shocks.

D. Shock to Real GDP Growth in the Baltic countries

Although small in terms of size, the Baltic countries have experienced a cycle of boom, bust, and recovery since the late2000 s. Their experience have offered lessons of how foreign capital financed strong domestic demand boom, together with pro-cyclical policies before the crisis in 2007 may have amplified the subsequent crisis. Their rather strong recovery after the crisis is a tale of how structural reform, fiscal consolidation, and relatively strong growth in their trading partners including the Nordic countries and Russia have helped these economies quickly regain their footing despite a severe decline in output—as confirmed in the analysis above. For these reasons, we conduct the last experiment on the Baltic countries and to see how a shock to their real GDP growth affects them and other countries.

The shock to the Baltic countries real GDP growth has the largest impact on their own growth, while the impact on other countries or regions are generally muted, except for the Nordic countries and Russia, their two main trading partners. As shown in Figure 5, after a small dip in the second quarter, the growth rate increase in the following quarters are still significant, e.g. 0.6 p.p. in the third quarter, and 0.4 p.p. in the fourth quarter, and the impact stabilizes around 0.4 p.p. in about 6 quarters.[29] It is notable that the immediate bump in growth rate in the Nordic countries and Russia is 0.02 p.p. and 0.06 p.p. respectively, much more prominent than growth in other countries which see little initial impact, and average of first six quarters growth impact is around 0.01 - 0.05 p.p.

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[28] A one s.d. shock to CE real GDP growth is equivalent to 0.2 p.p. increase in its own GDP growth rate on impact.

[29] The one s.d. shock to Baltic GDP will result in a 0.67 p.p. increase in its real GDP growth rate on impact.

The GFEVD results (Table 12), on the other hand, show that the major sources of shocks to the Baltic countries real GDP growth outside the region are the EURO-West group's output and the oil price which is treated as an endogenous to the EURO-West group. ADV group is another source of important shocks (through interest rate shocks, credit, and output). Shocks from Nordic countries, CE, and SE group are smaller source of shocks, which generally are concentrated in output and inflation. Shocks from Russia are mainly from output.

2. Spillover of Financial Shocks

E. Shock to Euro-West Credit Growth

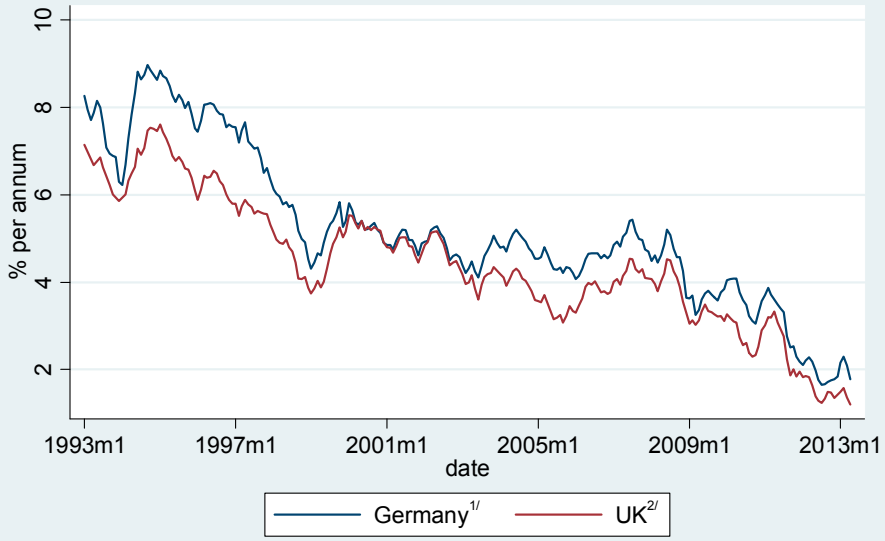
Credit growth shocks originating in the Euro-West area appear to have a limited impact on credit growth in other sub-regions of Europe. The results of a positive one percentage point p.p. shock to euro area credit growth are shown in Figure 6.[30] The credit shock's impact quickly diminishes in two to three quarters. This pattern is generally observed for other countries as well. For example, on impact, there is a decline in credit growth rate in ADV (below 0.6 p.p.), which fairly quickly dissipates. Among the CESEE countries, the impact is generally weaker, and the decline appeared with some lags. This result is consistent with the fact that credit growth in CESEE countries was most closely related to capital inflows from Western banks whose funding to their subsidiaries followed a different pattern than credit growth in home countries. Galesi and Sgherri (2009) also find that credit growth responses are more country specific and do not follow common international dynamics.

The GFEVD results (Table 13) show that innovations in the variables in the EURO-West group are the main source of forecast variance (close to 90 percent of the total forecast variance) to real credit growth, followed by innovations in variables in the ADV group. Among the EURO-West group variables, innovation in interest rate to real credit growth dominates in terms of impact, followed in importance by shocks to credit growth itself. Credit shock in the ADV group is also an important source of innovation. In other countries, innovation in output growth is generally the most important in contributing to forecast variance in credit growth among the domestic variables. These results indicate that domestically, impact to credit growth in mainly channeled through output growth, so volatility in output growth is the main driver for volatility in credit growth at the country level.

[30] For the euro area, the one s.d. shock is equivalent to about 0.26 p.p. increase in annualized quarter on quarter growth rate.

F. Shock to Interest Rate in ADV (the UK, Switzerland, Iceland, and Israel)

Figure. Interest rate on government securities in Germany and the U.K.



Note. 1. Germany: Central Government Securities: 9 to 10 years (Avg, % p.a.)
2. United Kingdom: Government Securities: 10-years (% p.a.)
Source: Haver Analytics.

An interest rate shock in the ADV group, however, generally elicits a strong response on interest rates in advanced Europe, but weak response in CESEE countries. The results of interest rate responses from a shock to interest rate in the UK, Switzerland, Iceland, and Israel group (the ADV group) are shown in Figure 7. There is a close link between interest rates in the UK and the Euro area as can be seen from the figure showing interest rates on government securities in Germany and the UK (see Figure). Given that the UK is the dominant country of this group (about 80% of the group's total GDP in PPP terms), the interest rate shock can be largely considered as originating from the UK. The experiment tried to analyze the impact to the rest of Europe when interest rate rises in the UK. It is perhaps worth emphasizing such an increase in UK's rate could be a result of interest rate shock to the United States to which the UK is very closely linked (see DdPS). For the ADV group, after a one percent (100 basis points) increase, interest rate declines slightly by 25bps by the fifth quarter, and continue to decline in the subsequent quarters.[31] The interest rate shock elicits a similar, though weaker, profile of response on interest rate in the EURO-West Group. There is an immediate increase of 10bps, followed by continuous rise to 60 bps by the end of the fourth quarter and the effect diminishes afterwards. These profiles suggest that the adjustment in long-term interest rates to a shock from one of the major international centers tends to be a gradual and prolonged process. This profile is also similar to what is reported in

[31] A one s.d. shock to interest rate is equivalent to 4.5 basis points (bps) rise in interest rate on impact,

DdPS on the reaction of euro area long-term rates to a shock in US (short-term) interest rates. Similar response profiles are also observed in the Nordic countries too. For the Nordic countries, the initial impact is a rise of 10bps in interest rates. The rise in interest rate continues and reaches 50 bps in the fourth quarter before diminishing afterwards. The interest rate response in CESEE is much muted, the movements are generally negligible.

The interest rate shock has a notable impact on output growth in the region, which is a clear example of financial shocks affecting real economic activities. Figure 8 shows the GIRF results of real GDP growth response to the shock on interest rate from the ADV group. The initial impact on real GDP growth is stronger compared to a one p.p. shock to EURO-West group GDP. And as the shock to interest rate takes hold over the following quarters, the impact on growth becomes much even more visible. By the 6th quarter, the growth effect has generally settled. And it is striking that the impact to real GDP growth in the EURO-West group is around 1.7 p.p., 1.9 p.p. in the ADV group, and 3 p.p. in the NORD group (q-o-q annualized rate). Equally significant is the impact on growth for countries in emerging Europe: the highest impact is seen in the Baltics (6 p.p.), followed by Russia (2 p.p.), SE (1.5 p.p.), Turkey and CE (around 1.2 p.p.) These results suggest that if either due to a very large change in the perception of long-term risks or because of credible switch in monetary policy cycles, a sudden increase in long-term interest rates will have significant output effect.

The forecast variance decomposition results are shown in Table 14. The main source of innovation is from shocks to interest rate in the ADV group (mainly the UK), followed by shocks to inflation in the ADV group. The latter may reflect, in addition to direct price impact on bonds from inflation shocks, impact of central bank's response to inflation shocks through monetary policy. Oil price shock is another important source of innovation to ADV interest rate.

G. Negative Shock to Real Credit Growth in Central Europe

Given the usual difficulty to disentangle effect of domestic demand and external demand on GDP growth, we further refine the experiment in the previous section by looking at the impact of a shock to real credit growth in Central Europe. Assuming that credit growth more closely related to domestic demand growth, this would give a better approximation of how a domestic demand driven shock in Central Europe propagates. The results of real GDP growth response to a negative shock in real credit growth are shown in Figure 9.

Clearly, the credit demand shock has a fairly significant shock to real GDP growth for the CE itself.[32] A negative one p.p. shock to real credit growth for CE, will result, on impact, a 0.2p.p. decline in real GDP growth rate in CE itself. The impact increases to -0.4 p.p. in the second quarter, and dissipates afterwards (with some oscillation).

[32] A negative one s.d. shock to real credit growth—which is equivalent to 0.69 p.p. decline in credit growth for CE.

The impact on GDP growth in other regions from a shock to credit growth in CE varies widely. For the Western European countries, the impact on real GDP growth is generally very small. For example, real GDP growth declines are less than 0.05 p.p. for the Euro-West group, ADV, and the Nordic countries. The decline increases in the second quarter but is offset in the following quarters. For the CESEE countries, the Baltic countries and the Southern European countries are negatively affected, with impact on real GDP growth average around 0.3p.p. in the first two quarters. It is somewhat puzzling that Russia and Turkey seem to experience a small bump in growth rate initially, although for Russia the growth rate decline in the second quarter.

In terms of major source of shocks to CE credit growth, its own innovation dominates in importance (Table 15). EURO-West group's output shocks, oil price shocks, and output shocks from the ADV group are other important source of external shocks. Perhaps reflecting the relatively synchronized capital flows to CESEE in the period studied, Baltic countries' credit and inflation also have notable influence to CE credit growth.

3. Shock to EURO-West Inflation

The inflationary impact on the rest of Europe of a shock to EURO-West inflation is much more muted than the response of output growth to EURO-West output shocks. Figure 10 presents the results of inflation responses to a one p.p. shock to EURO-West inflation.[33] For the EURO-West group, the inflationary impact declines sharply afterwards, with the effect diminishing in three to four quarters. The weak spillover of inflation may reflect market rigidities (including price regulation), differences in consumer baskets (CESEE countries tend to have a higher food component in the CPI), etc. that could reduce inflationary pass-through. Inflationary impact to non-EURO-West advanced economies is very small: on impact, inflation rate declines by 0.05 p.p. in the ADV group, and hardly changes for the Nordic countries. Impact of inflation for the CESEE economies is more varied. On impact, inflation increases by 0.4 p.p. for the Baltic countries, 0.5 p.p. for southeastern Europe, and 0.2 p.p. for central Europe, and it quickly diminishes afterwards.[34] The effect to inflation in Turkey is a small increase of less than 0.2 p.p. on impact, which gradually rises in the following quarters. For Russia, the inflation path is a bit surprising, an originally small but increasing decline in inflation in the following quarters—perhaps reflecting the possible strengthening of Russia currency if the inflation in EURO-West is driven by higher oil prices. Overall, the varied inflation response results concur with the findings of Galesi and

[33] The one s.d. shock to euro area inflation is equivalent to a higher inflation rate of 0.36 percentage points (p.p.) in the euro area on impact.

[34] Factors contributing to these varied responses (although statistically less significant) may require further study.

Lombardi (2009) where they note, under a different setting, that inflation response in emerging countries are generally smaller than in developed countries.

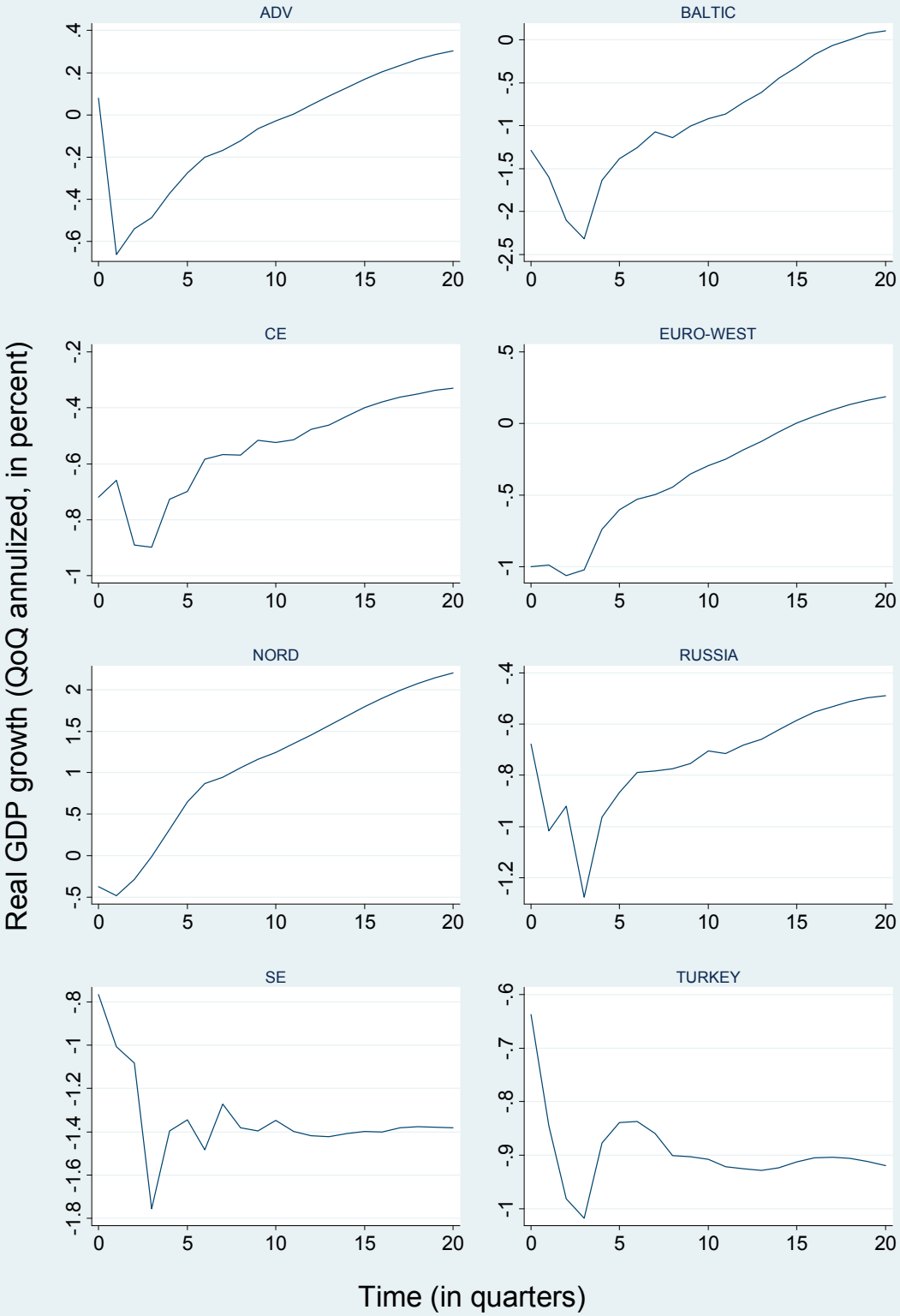
Similar to earlier variance decomposition results, shocks to EURO-West group inflation have a very high share of contribution in the forecast variance of inflation (Table 16). Oil price shocks and shocks to output for the EURO-West group are also important in contributing to the forecast error. EURO-West group inflation is also sensitive to ADV group output shocks.

V. CONCLUSIONS

We develop a Global VAR (GVAR) model to study the cross-border linkages among countries in Europe. The model's setup reflects the very close trade and financial linkages among European countries. This is achieved by using both trade and financial data as weights to construct relevant foreign variables. The model also has a strong focus on CESEE countries where 12 CESEE countries are included individually in the model. The model provides a good framework to study how shocks (both real and financial ones) are transmitted across regions.

The results show strong co-movement in domestic output growth and long-term interest rates with those in foreign partners, while co-movement in inflation and credit growth is weaker. There is clear evidence that the shocks to the EURO-West group's output growth are felt in strong ripples across Europe, with output growth in other regions significantly affected on impact. Shocks to EURO-West group's inflation have similar but more subdued impact on inflation in other countries suggesting smaller inflation pass-through across national borders. Shocks to long-term interest rate in one of Europe's major financial center, the UK, also have an effect on long-term interest rates in the rest of the Europe. The response of long-term interest rates is initially small, but gradually rises. In addition, shocks to long term interest rates will also have a rising and strong impact on growth, a clear indication that financial shocks will overtime affect real sector activities. The CESEE countries generally respond strongly to the shocks originated from advanced Europe. Nevertheless, shocks to credit growth in the EURO-West group appears to have relatively muted impact on credit growth in CESEE, reflecting a funding pattern that is mostly channeled through western European parent banks and less dependent on parent country's credit growth. Notwithstanding the EURO-West group's dominant influence, there are other economic clusters in the region too. The Nordic countries' enormous influence on the Baltic countries is evident. A shock to real GDP growth in the Nordic countries has a large impact to the Baltic countries. Interestingly, the impact is not contained only in the Baltic region, output in the EURO-West group and elsewhere is also affected reflecting strong interdependence among the countries in the region. As the economies in CESEE grow in size, their impact on the rest of the Europe is notable, though still small, and it is safe to predict that their influence will continue to grow in the future as these economies resume the income convergence process stalled by the latest crisis.

Figure 2. Generalized Impulse Response Function of Real GDP Growth to a Negative One p.p. Shock to Real GDP Growth in the Euro-West Group



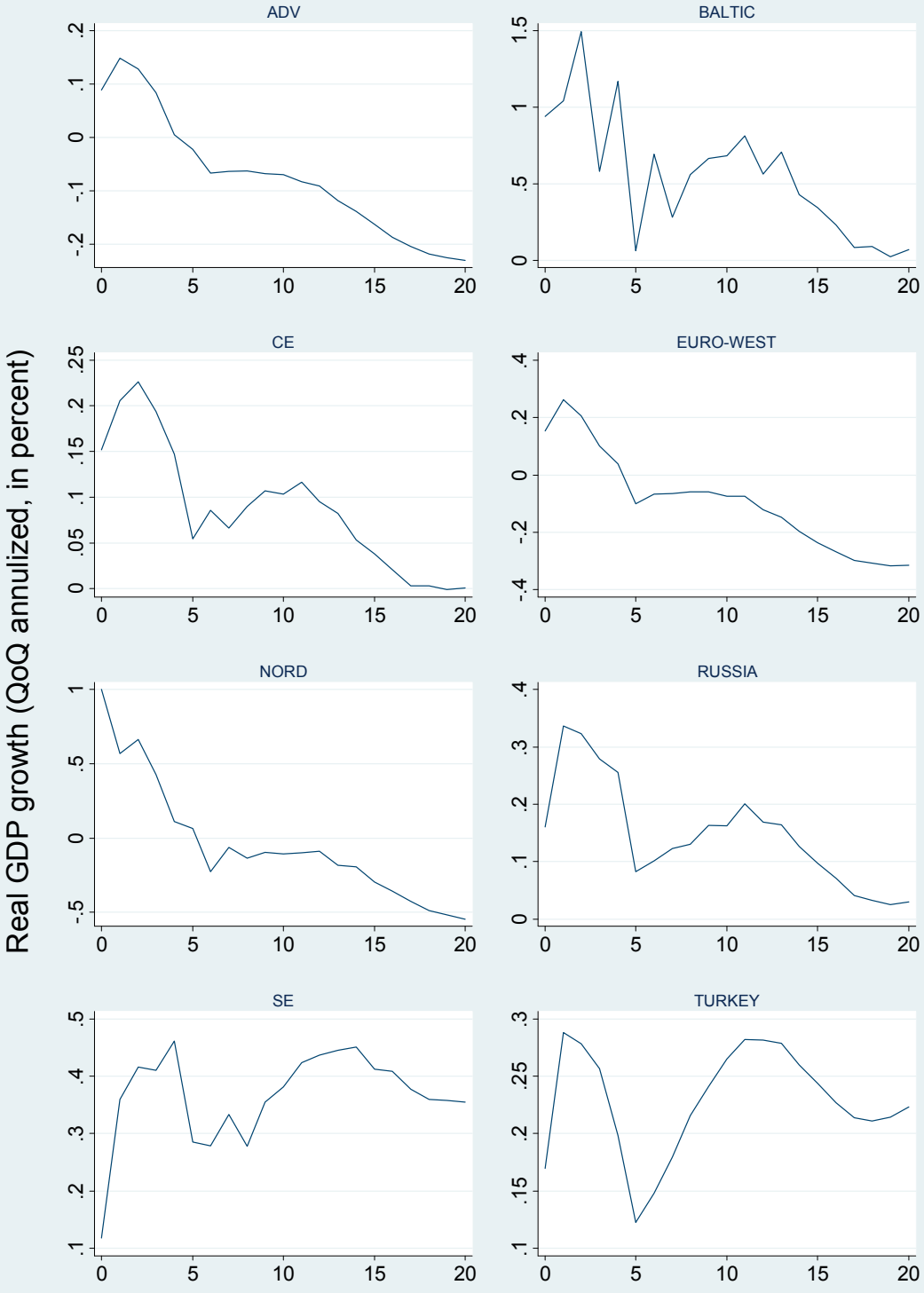
Notes: GIRF calculated based on the estimated GVAR model, see paper.
Source: Author's calculations.

Table 9. Generalized Forecast Error Variance Decompositions: a Negative One s.d. Shock to EURO-West real GDP Growth

	Quarters	0	1	2	3	4	5	6	7	8	9	10
Region/Country												
EURO-West	dy	62.3	53.7	27.0	23.5	21.7	20.5	19.6	18.7	17.8	17.0	16.3
	π	0.0	5.0	2.1	1.4	1.1	1.0	1.0	1.1	1.1	1.3	1.4
	r	0.4	2.3	1.3	2.2	2.8	4.4	5.7	6.6	7.2	8.1	8.9
	dCR	0.0	0.6	0.2	0.3	0.3	0.4	0.5	0.5	0.5	0.5	0.5
	p_{oil}	0.0	0.7	27.2	30.9	30.4	29.0	27.9	27.5	27.2	26.6	26.1
	EURO-West variance	**62.8**	**62.5**	**57.8**	**58.3**	**56.3**	**55.3**	**54.8**	**54.3**	**53.8**	**53.5**	**53.3**
NORD	dy	0.8	1.4	0.7	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.3
	π	0.3	0.5	0.3	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2
	r	0.1	0.1	0.4	0.6	0.7	0.7	0.7	0.7	0.6	0.6	0.6
	dCR	0.0	0.0	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	NORD variance	**1.2**	**2.1**	**1.5**	**1.5**	**1.6**	**1.6**	**1.6**	**1.5**	**1.4**	**1.3**	**1.4**
ADV	dy	19.3	11.3	4.1	4.7	5.3	5.2	4.8	4.4	4.2	4.0	3.8
	π	0.0	2.2	4.9	3.6	3.2	3.2	3.2	3.4	3.5	3.5	3.5
	r	10.3	8.9	16.1	20.4	22.1	23.9	25.2	26.5	27.5	28.1	28.4
	dCR	0.2	4.8	10.0	6.6	6.9	6.4	6.1	5.5	5.1	4.8	4.6
	ADV variance	**29.8**	**27.2**	**35.1**	**35.3**	**37.6**	**38.6**	**39.2**	**39.8**	**40.2**	**40.3**	**40.3**
BALTIC	dy	0.1	0.5	0.6	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3
	π	0.7	0.6	0.5	0.4	0.3	0.3	0.3	0.4	0.4	0.4	0.4
	dCR	1.8	1.2	1.4	1.3	1.1	1.1	1.1	1.1	1.1	1.1	1.1
	BALTIC variance	**2.6**	**2.3**	**2.5**	**2.1**	**1.8**	**1.8**	**1.8**	**1.8**	**1.8**	**1.8**	**1.8**
CE	dy	0.3	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
	π	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	r	1.0	1.3	0.7	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.1
	dCR	0.1	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5
	CE variance	**1.3**	**1.9**	**1.1**	**1.3**	**1.4**	**1.4**	**1.4**	**1.5**	**1.6**	**1.7**	**1.8**
SE	dy	0.9	1.2	0.5	0.4	0.3	0.3	0.3	0.2	0.3	0.3	0.4
	π	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	r	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	dCR	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	SE variance	**1.2**	**1.5**	**0.7**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**
Russia	dy	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	π	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	r	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	dCR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Russia variance	**0.1**	**0.2**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
Turkey	dy	0.8	1.6	0.7	0.5	0.4	0.4	0.4	0.3	0.4	0.4	0.4
	π	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	dCR	0.2	0.7	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Turkey variance	**1.0**	**2.4**	**1.2**	**0.9**	**0.8**	**0.7**	**0.6**	**0.6**	**0.6**	**0.7**	**0.8**

Note: Based on percentage of the k-step ahead forecast error variance of a one s.d. shock to the EURO group's real GDP growth. Original percentages do not sum to 100 due to non-zero covariance between the shocks, according to Pesaran and Shin (1998). Figures in the tables are rescaled to 100, as suggested by Wang (2002).

Figure 3. Generalized Impulse Response Function of Real GDP Growth to a One p.p. Shock to Real GDP Growth in the Nordic countries



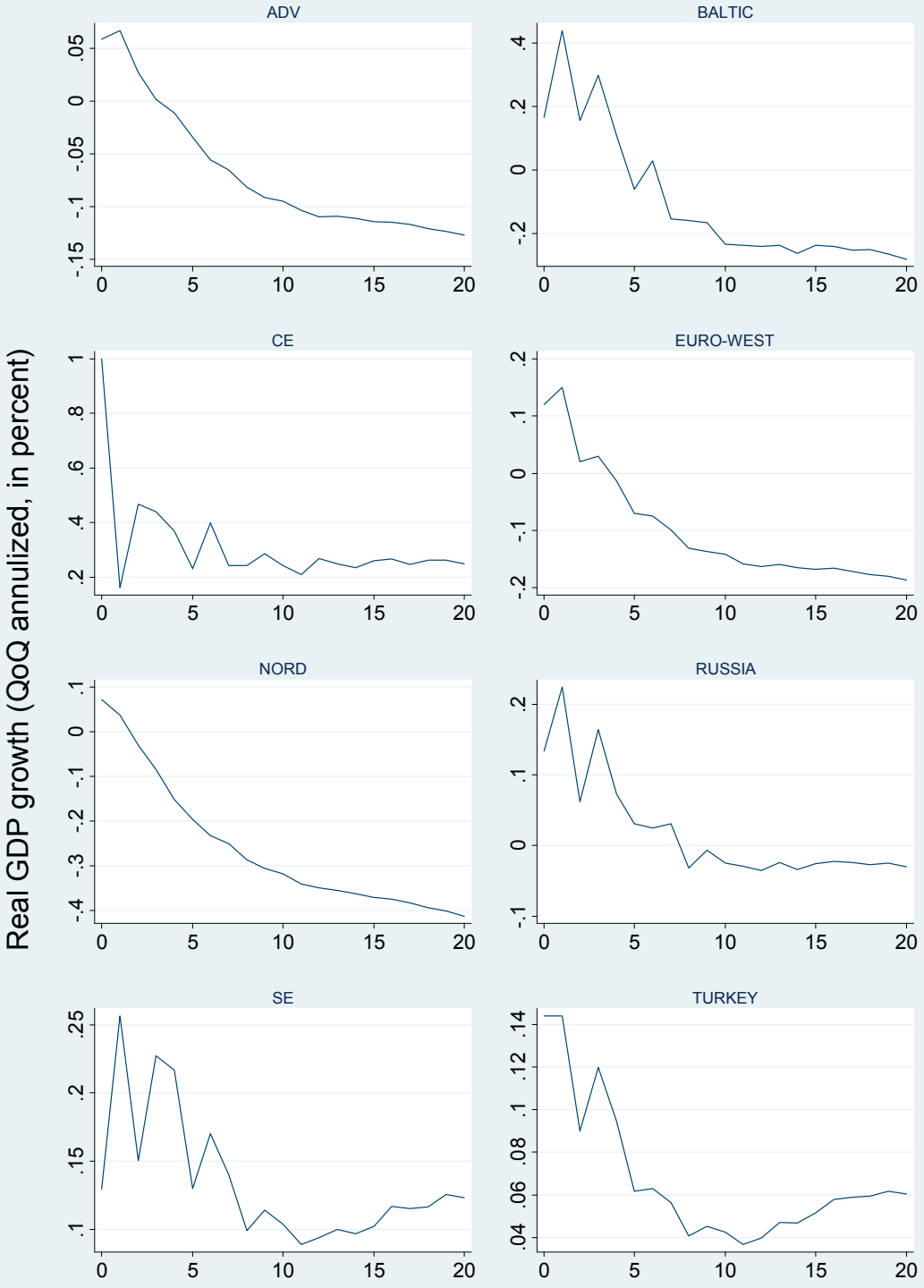
Notes: GIRF calculated based on the estimated GVAR model, see paper.
Source: Author's calculations.

Table 10. Generalized Forecast Error Variance Decomposition: a One s.d. Shock to Real GDP Growth in the Nordic countries

	Quarters	0	1	2	3	4	5	6	7	8	9	10
Region/Country												
EURO-West	dy	6.4	9.3	5.8	4.1	4.0	5.7	8.5	10.9	13.3	15.4	17.4
	π	0.0	0.1	0.1	0.9	2.4	4.6	7.5	10.0	12.2	13.9	15.4
	r	13.5	9.3	8.4	8.4	11.2	14.3	15.7	17.0	17.4	18.2	18.1
	dCR	1.5	1.1	1.1	0.8	0.7	0.7	0.6	0.5	0.4	0.4	0.3
	p_{oil}	1.3	20.5	34.8	34.0	30.1	25.2	21.2	18.0	15.4	13.2	11.5
	EURO-West variance	**22.8**	**40.2**	**50.2**	**48.2**	**48.4**	**50.5**	**53.5**	**56.5**	**58.8**	**61.1**	**62.7**
NORD	dy	26.4	18.7	12.8	10.0	8.0	6.6	5.7	4.8	4.1	3.5	3.1
	π	8.7	6.6	4.7	3.9	3.1	2.6	2.5	2.2	2.0	1.7	1.5
	r	0.6	2.4	2.3	3.8	3.6	3.4	3.3	3.2	3.0	2.6	2.2
	dCR	0.7	0.5	0.3	1.6	1.4	1.4	1.4	1.4	1.3	1.1	0.9
	NORD variance	**36.4**	**28.2**	**20.1**	**19.2**	**16.2**	**13.9**	**12.8**	**11.5**	**10.3**	**8.9**	**7.7**
ADV	dy	6.6	3.9	4.2	6.6	8.4	8.0	7.0	6.0	5.1	4.4	3.8
	π	2.7	3.3	3.4	2.8	2.3	1.9	1.6	1.4	1.3	1.1	1.0
	r	22.7	14.8	13.9	12.8	11.5	9.8	8.4	7.4	6.4	5.6	4.9
	dCR	6.2	7.1	5.7	7.7	9.5	10.8	9.9	8.8	7.6	6.5	5.7
	ADV variance	**38.2**	**29.0**	**27.2**	**29.8**	**31.7**	**30.6**	**27.0**	**23.6**	**20.4**	**17.6**	**15.3**
BALTIC	dy	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	π	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.5	0.6
	dCR	1.4	0.8	0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	BALTIC variance	**1.5**	**1.1**	**0.7**	**0.7**	**0.7**	**0.7**	**0.8**	**0.9**	**1.0**	**1.1**	**1.2**
CE	dy	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.4	0.5
	π	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	r	0.2	0.1	0.5	0.6	0.8	1.0	1.0	1.1	1.2	1.3	1.5
	dCR	0.2	0.4	0.6	0.7	0.7	0.7	0.6	0.6	0.5	0.5	0.4
	CE variance	**0.5**	**0.6**	**1.1**	**1.3**	**1.6**	**1.8**	**1.9**	**2.0**	**2.1**	**2.3**	**2.4**
SE	dy	0.3	0.2	0.1	0.2	0.5	0.9	1.5	2.1	2.8	3.4	4.0
	π	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
	r	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
	dCR	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
	SE variance	**0.4**	**0.5**	**0.4**	**0.4**	**0.7**	**1.1**	**1.7**	**2.3**	**3.1**	**3.7**	**4.3**
Russia	dy	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.3	0.4	0.5
	π	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
	r	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	dCR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
	Russia variance	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**
Turkey	dy	0.1	0.2	0.1	0.2	0.4	0.8	1.3	1.7	2.2	2.7	3.1
	π	0.0	0.0	0.0	0.0	0.1	0.3	0.5	0.8	1.1	1.4	1.7
	dCR	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.6	0.8
	Turkey variance	**0.2**	**0.3**	**0.2**	**0.3**	**0.6**	**1.2**	**2.0**	**2.9**	**3.8**	**4.7**	**5.5**

Note: Based on percentage of the k-step ahead forecast error variance of a one s.d. shock to the NORD group's real GDP growth. Original percentages do not sum to 100 due to non-zero covariance between the shocks, according to Pesaran and Shin (1998). Figures in the tables are rescaled to 100, as suggested by Wang (2002).

Figure 4. Generalized Impulse Response Function of Real GDP Growth to a One p.p. Shock to Real GDP Growth in the Central European countries (Czech R., Hungary, Poland, Slovakia, and Slovenia)



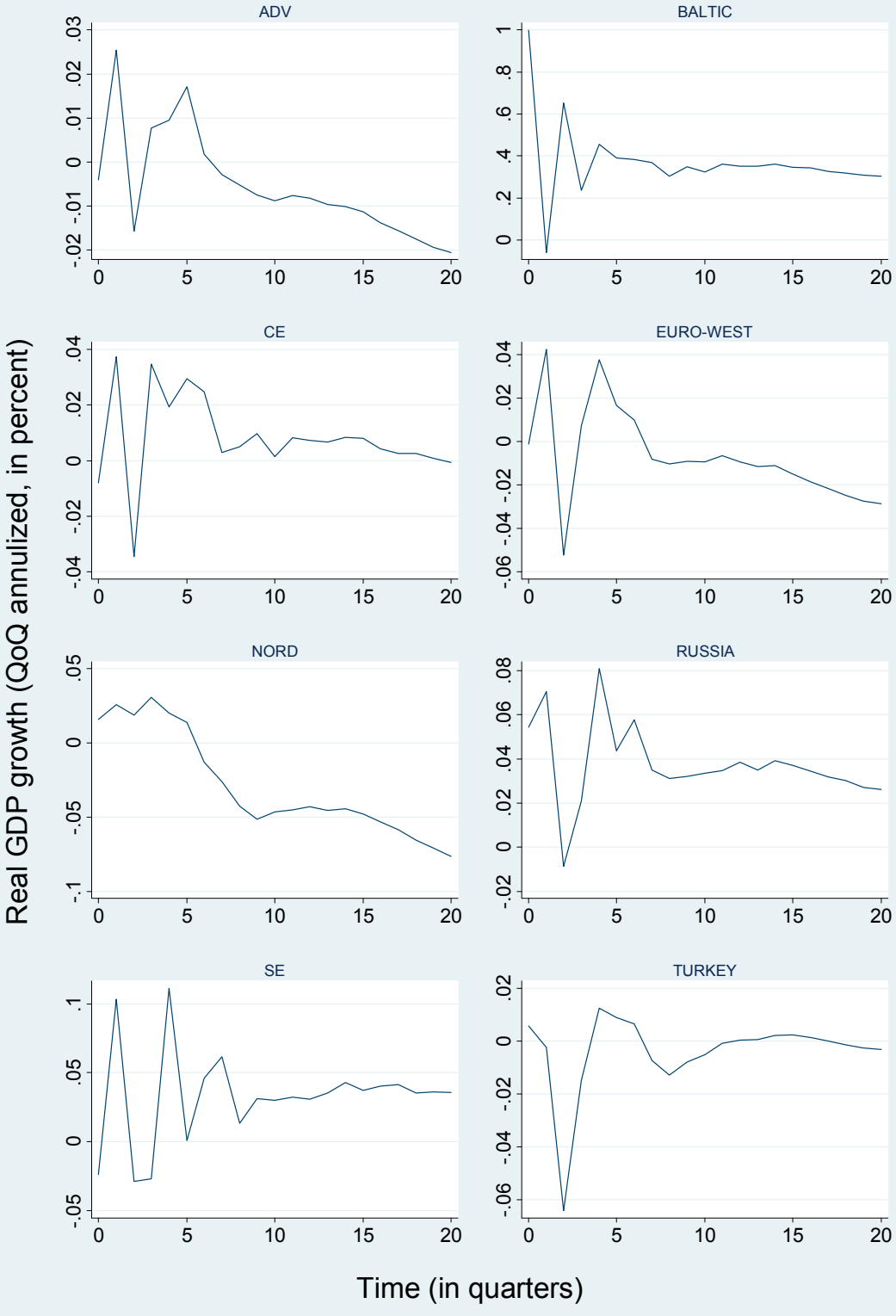
Notes: GIRF calculated based on the estimated GVAR model, see paper.
Source: Author's calculations.

Table 11. Generalized Forecast Error Variance Decomposition: a One p.p. Shock to to Real GDP Growth in the Central European countries (Czech R., Hungary, Poland, Slovakia, and Slovenia)

	Quarters	0	1	2	3	4	5	6	7	8	9	10
Region/Country												
EURO-West	dy	32.8	34.1	25.3	24.8	23.3	22.6	21.9	21.3	20.8	20.4	20.1
	π	0.1	4.5	2.9	2.3	1.9	1.7	1.5	1.3	1.2	1.1	1.1
	r	0.1	0.5	1.5	3.4	3.3	4.8	6.3	7.2	8.2	9.0	9.7
	dCR	0.1	0.3	0.4	0.7	0.6	0.7	0.8	0.8	0.9	0.9	0.9
	p_{oil}	1.6	1.2	11.9	13.8	16.5	15.7	14.4	13.9	13.3	12.8	12.4
	EURO-West variance	**34.7**	**40.5**	**41.9**	**45.1**	**45.6**	**45.5**	**44.9**	**44.6**	**44.4**	**44.2**	**44.1**
NORD	dy	0.8	1.3	1.0	0.9	0.8	0.6	0.6	0.5	0.5	0.5	0.5
	π	0.3	0.5	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1
	r	0.0	0.2	0.5	0.8	1.1	1.3	1.4	1.5	1.5	1.5	1.4
	dCR	0.0	0.0	0.1	0.2	0.4	0.5	0.5	0.5	0.5	0.5	0.5
	NORD variance	**1.2**	**2.0**	**1.9**	**2.2**	**2.4**	**2.6**	**2.7**	**2.7**	**2.7**	**2.6**	**2.5**
ADV	dy	16.2	10.9	4.5	3.4	3.4	3.3	3.0	2.7	2.5	2.4	2.2
	π	0.0	1.9	3.7	2.9	3.1	3.1	3.0	3.2	3.3	3.4	3.4
	r	5.2	4.8	14.1	17.2	19.9	22.3	23.3	24.8	26.0	26.9	27.8
	dCR	0.0	1.0	8.6	6.4	5.1	4.4	4.5	4.1	3.7	3.5	3.2
	ADV variance	**21.4**	**18.6**	**30.8**	**29.9**	**31.5**	**33.1**	**33.8**	**34.8**	**35.5**	**36.1**	**36.6**
BALTIC	dy	0.3	0.5	0.8	0.6	0.5	0.4	0.4	0.4	0.3	0.3	0.3
	π	1.2	1.0	1.3	0.9	0.7	0.7	0.6	0.7	0.8	0.8	0.8
	dCR	3.1	1.8	3.8	2.8	2.4	2.5	2.4	2.5	2.5	2.6	2.6
	BALTIC variance	**4.7**	**3.4**	**5.8**	**4.2**	**3.6**	**3.6**	**3.4**	**3.5**	**3.6**	**3.7**	**3.8**
CE	dy	23.2	14.6	7.1	6.2	5.4	4.8	4.8	4.4	4.2	4.1	4.0
	π	0.7	0.9	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.7
	r	5.7	7.0	4.7	4.7	4.5	4.2	4.3	4.1	3.9	3.8	3.7
	dCR	5.0	9.0	4.0	4.0	3.2	2.7	2.6	2.3	2.1	2.0	1.9
	CE variance	**34.6**	**31.5**	**16.2**	**15.5**	**13.7**	**12.3**	**12.2**	**11.5**	**10.9**	**10.6**	**10.3**
SE	dy	1.7	1.6	1.4	1.2	1.2	1.1	1.1	1.0	1.0	1.0	0.9
	π	0.3	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	r	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	dCR	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.4	0.4	0.4	0.4
	SE variance	**2.1**	**1.9**	**1.7**	**1.5**	**1.6**	**1.6**	**1.7**	**1.6**	**1.6**	**1.6**	**1.6**
Russia	dy	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
	π	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	r	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	dCR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Russia variance	**0.3**	**0.5**	**0.3**	**0.4**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**
Turkey	dy	0.8	1.1	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4
	π	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	dCR	0.2	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Turkey variance	**1.1**	**1.7**	**1.3**	**1.2**	**1.2**	**1.1**	**1.0**	**1.0**	**0.9**	**0.9**	**0.8**

Note: Based on percentage of the k-step ahead forecast error variance of a one s.d. shock to the NORD group's real GDP growth. Original percentages do not sum to 100 due to non-zero covariance between the shocks, according to Pesaran and Shin (1998). Figures in the tables are rescaled to 100, as suggested by Wang (2002).

Figure 5. Generalized Impulse Response Function of Real GDP Growth to a One p.p. Shock to Real GDP Growth in the Baltic countries (Estonia, Latvia, and Lithuania)



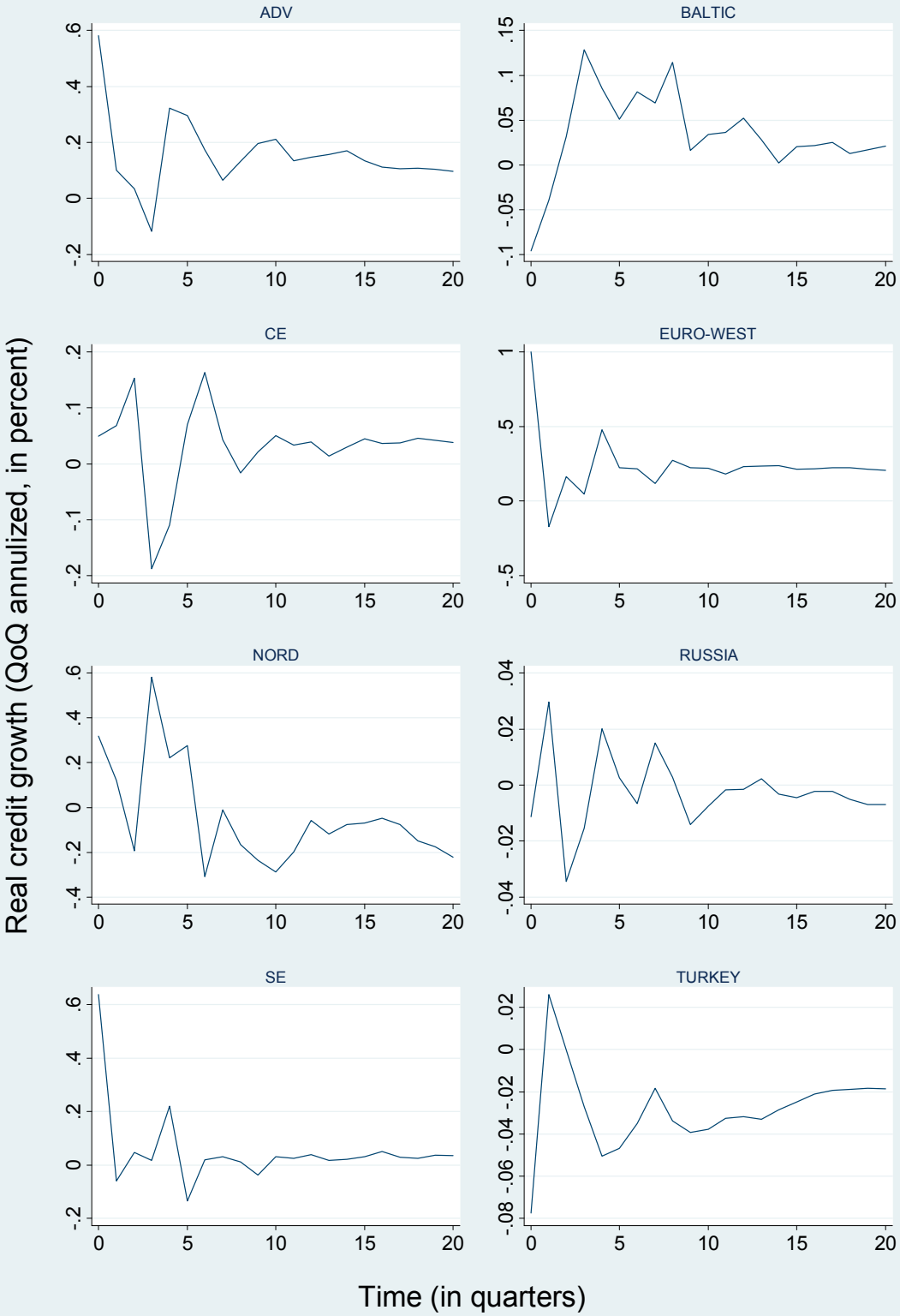
Notes: GIRF calculated based on the estimated GVAR model, see paper.
Source: Author's calculations.

Table 12. Generalized Forecast Error Variance Decomposition: a One s.d. Shock to Real GDP Growth in the Baltic countries (Estonia, Latvia, and Lithuania)

	Quarters	0	1	2	3	4	5	6	7	8	9	10
Region/Country												
EURO-West	dy	10.7	14.7	11.4	14.1	12.5	11.8	11.1	10.5	10.0	9.7	9.3
	π	0.0	0.6	1.1	0.9	0.7	0.6	0.6	0.7	0.7	0.7	0.8
	r	0.9	2.4	4.0	4.9	5.3	6.1	8.0	8.7	9.6	10.0	10.8
	dCR	0.0	0.4	0.7	0.7	0.7	0.6	0.8	0.8	0.8	0.8	0.9
	p_{oil}	1.5	17.3	17.7	18.1	19.0	17.6	15.5	14.6	13.9	13.4	12.9
	EURO-West variance	**13.1**	**35.4**	**35.0**	**38.6**	**38.2**	**36.7**	**36.1**	**35.3**	**35.0**	**34.6**	**34.6**
NORD	dy	3.3	3.9	3.2	2.6	2.5	2.1	2.0	1.8	1.7	1.7	1.7
	π	3.1	2.2	1.7	1.3	1.2	1.1	1.0	0.9	0.8	0.8	0.7
	r	0.2	1.1	1.9	2.7	3.2	4.3	4.7	5.2	5.1	5.2	5.0
	dCR	0.0	0.1	1.4	1.4	1.8	2.4	2.6	2.8	2.6	2.6	2.5
	NORD variance	**6.6**	**7.4**	**8.2**	**7.9**	**8.6**	**10.0**	**10.3**	**10.6**	**10.3**	**10.3**	**9.9**
ADV	dy	5.6	5.6	2.2	2.0	3.0	2.9	2.7	2.4	2.2	2.1	1.9
	π	3.2	1.8	6.5	5.3	5.2	4.9	4.6	4.8	4.8	4.9	4.9
	r	12.3	6.7	17.3	20.2	22.3	24.7	25.9	27.3	28.9	29.9	30.8
	dCR	6.5	8.1	7.2	5.6	4.6	3.9	4.1	3.7	3.4	3.1	2.9
	ADV variance	**27.6**	**22.2**	**33.1**	**33.1**	**35.1**	**36.5**	**37.4**	**38.2**	**39.3**	**40.0**	**40.5**
BALTIC	dy	29.1	16.4	10.1	8.1	6.8	6.3	5.9	5.7	5.4	5.2	5.1
	π	0.4	1.4	1.0	1.1	1.1	1.2	1.3	1.5	1.6	1.7	1.8
	dCR	5.2	3.4	3.9	3.5	3.2	3.2	3.2	3.2	3.3	3.3	3.4
	BALTIC variance	**34.7**	**21.2**	**15.1**	**12.8**	**11.1**	**10.6**	**10.4**	**10.4**	**10.3**	**10.2**	**10.3**
CE	dy	0.8	0.7	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2
	π	1.6	0.9	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2
	r	0.9	1.9	0.7	0.7	0.6	0.5	0.5	0.5	0.4	0.4	0.4
	dCR	2.5	1.5	0.7	0.6	0.5	0.4	0.4	0.4	0.4	0.4	0.5
	CE variance	**5.8**	**4.9**	**2.2**	**1.9**	**1.6**	**1.4**	**1.3**	**1.3**	**1.2**	**1.2**	**1.2**
SE	dy	7.5	4.7	3.7	3.1	2.8	2.5	2.4	2.2	2.0	1.9	1.8
	π	1.4	0.8	0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3
	r	1.3	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4
	dCR	0.0	0.0	0.1	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.1
	SE variance	**10.3**	**6.3**	**5.0**	**4.1**	**4.0**	**3.5**	**3.5**	**3.2**	**3.0**	**2.8**	**2.7**
Russia	dy	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	π	0.5	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	r	1.0	0.6	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1
	dCR	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Russia variance	**1.8**	**1.1**	**0.5**	**0.4**	**0.4**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**
Turkey	dy	0.1	0.8	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.3	0.3
	π	0.0	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
	dCR	0.0	0.6	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2
	Turkey variance	**0.2**	**1.5**	**1.0**	**1.1**	**0.9**	**0.8**	**0.7**	**0.6**	**0.6**	**0.6**	**0.5**

Note: Based on percentage of the k-step ahead forecast error variance of a one s.d. shock to the NORD group's real GDP growth. Original percentages do not sum to 100 due to non-zero covariance between the shocks, according to Pesaran and Shin (1998). Figures in the tables are rescaled to 100, as suggested by Wang (2002).

Figure 6. Generalized Impulse Response Function of Real Credit Growth to a One p.p. Shock to Real Credit Growth in the Euro-West Group



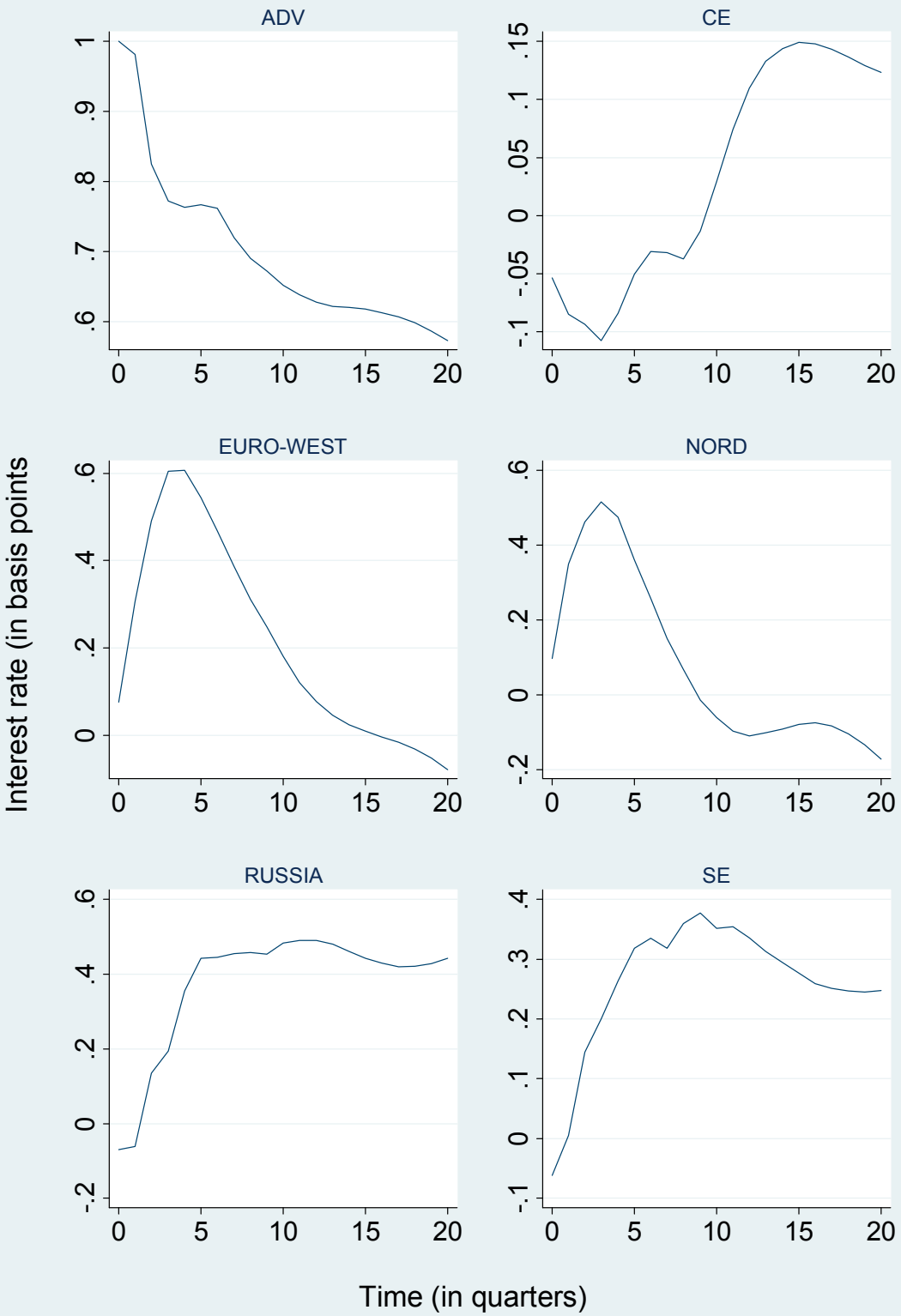
Notes: GIRF calculated based on the estimated GVAR model, see paper.
Source: Author's calculations.

Table 13. Generalized Forecast Error Variance Decomposition: a One s.d. Shock to Real Credit Growth in the Euro-West Group

	Quarters	0	1	2	3	4	5	6	7	8	9	10
Region/Country												
EURO-West	dy	0.1	0.1	0.4	0.7	0.6	0.5	0.5	0.4	0.4	0.4	0.4
	π	4.1	6.7	6.6	6.0	4.6	4.7	4.6	4.8	4.7	4.7	4.7
	r	60.6	52.5	53.8	53.4	57.5	60.0	61.7	62.0	62.4	63.2	64.0
	dCR	21.7	18.6	16.3	14.6	13.5	12.4	11.6	10.8	10.0	9.5	9.0
	p_{oil}	4.4	4.1	3.7	6.8	8.0	7.1	6.5	7.0	8.5	8.9	8.8
	EURO-West variance	**90.8**	**81.9**	**80.8**	**81.5**	**84.2**	**84.8**	**84.8**	**85.1**	**86.1**	**86.6**	**86.9**
NORD	dy	0.1	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1
	π	0.0	0.1	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2
	r	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.2
	dCR	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1
	NORD variance	**0.2**	**0.6**	**0.7**	**0.8**	**0.7**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
ADV	dy	1.6	1.4	1.2	1.2	0.9	0.8	0.8	1.0	0.9	0.8	0.8
	π	0.0	0.0	0.9	0.9	0.7	0.7	0.8	0.7	0.6	0.6	0.6
	r	0.2	2.1	2.5	2.3	2.1	2.2	2.7	2.5	2.4	2.3	2.4
	dCR	5.2	10.7	9.9	9.0	6.9	6.1	5.5	5.3	4.7	4.3	4.0
	ADV variance	**7.0**	**14.3**	**14.5**	**13.4**	**10.6**	**9.8**	**9.8**	**9.5**	**8.6**	**8.0**	**7.7**
BALTIC	dy	0.1	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2
	π	0.0	0.1	0.4	0.5	0.6	0.8	0.9	0.9	1.0	1.1	1.2
	dCR	1.7	1.8	1.9	1.9	2.0	2.0	2.0	1.9	1.8	1.8	1.8
	BALTIC variance	**1.8**	**2.3**	**2.8**	**2.7**	**3.0**	**3.1**	**3.1**	**3.0**	**3.1**	**3.2**	**3.2**
CE	dy	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	π	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	r	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
	dCR	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	CE variance	**0.1**	**0.2**	**0.3**	**0.3**	**0.3**	**0.4**	**0.5**	**0.5**	**0.5**	**0.4**	**0.5**
SE	dy	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	π	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	r	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	dCR	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	SE variance	**0.1**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**
Russia	dy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	π	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	r	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	dCR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Russia variance	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Turkey	dy	0.1	0.2	0.3	0.4	0.3	0.4	0.4	0.3	0.3	0.3	0.3
	π	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	dCR	0.0	0.2	0.4	0.5	0.5	0.5	0.6	0.6	0.5	0.5	0.5
	Turkey variance	**0.1**	**0.4**	**0.7**	**0.9**	**0.8**	**0.9**	**0.9**	**0.9**	**0.9**	**0.8**	**0.8**

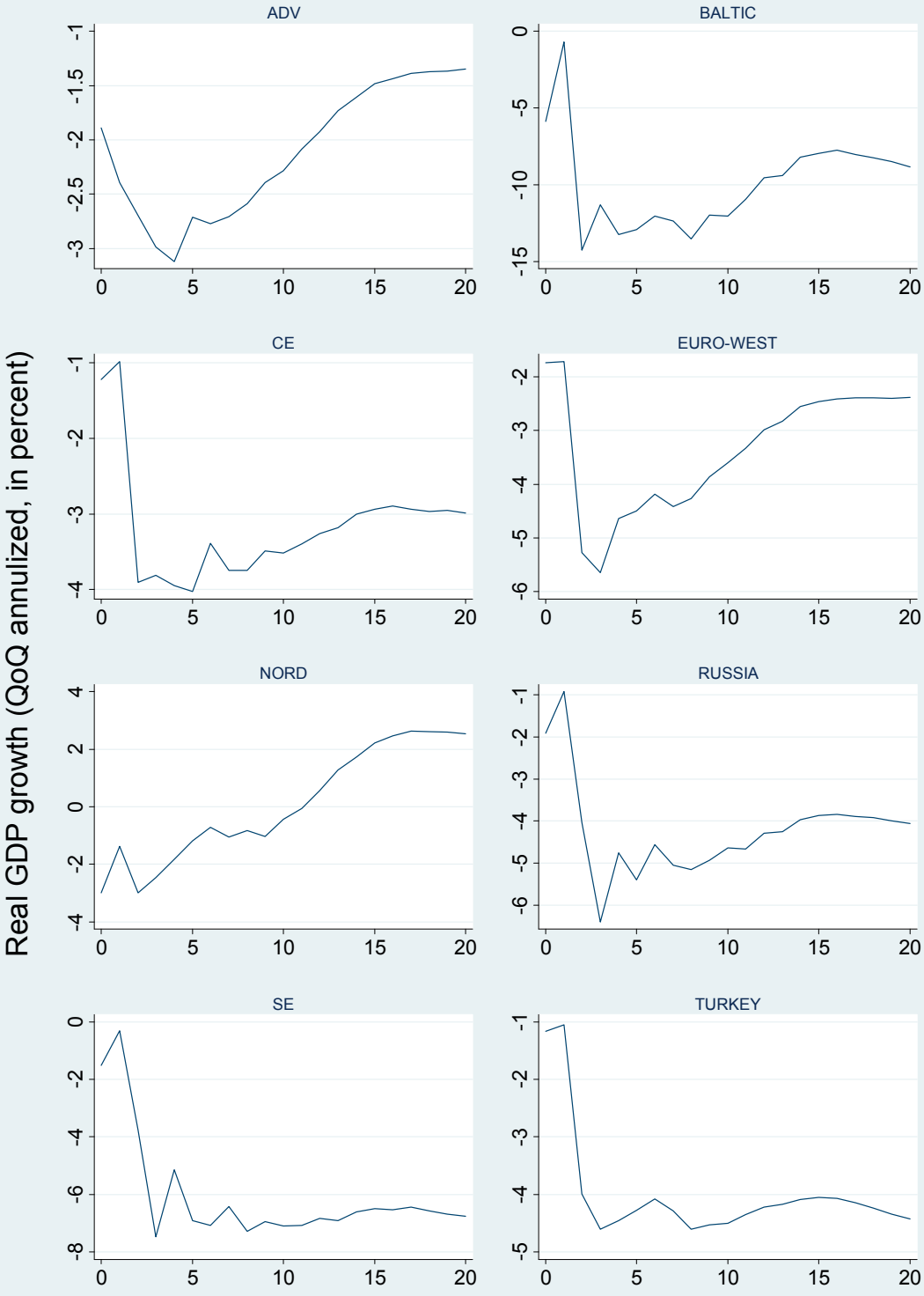
Note: Based on percentage of the k-step ahead forecast error variance of a one s.d. shock to the EURO group's real credit growth. Original percentages do not sum to 100 due to non-zero covariance between the shocks, according to Pesaran and Shin (1998). Figures in the tables are rescaled to 100, as suggested by Wang (2002).

Figure 7. Generalized Impulse Response Function of Interest Rate to a One Percent Shock to Interest Rate in the ADV Group (the UK, Switzerland, Iceland, and Israel)



Notes: GIRF calculated based on the estimated GVAR model, see paper.
Source: Author's calculations.

Figure 8. Generalized Impulse Response Function of Real GDP Growth to a One Percent Shock to Interest Rate in the ADV Group (the UK, Switzerland, Iceland, and Israel)



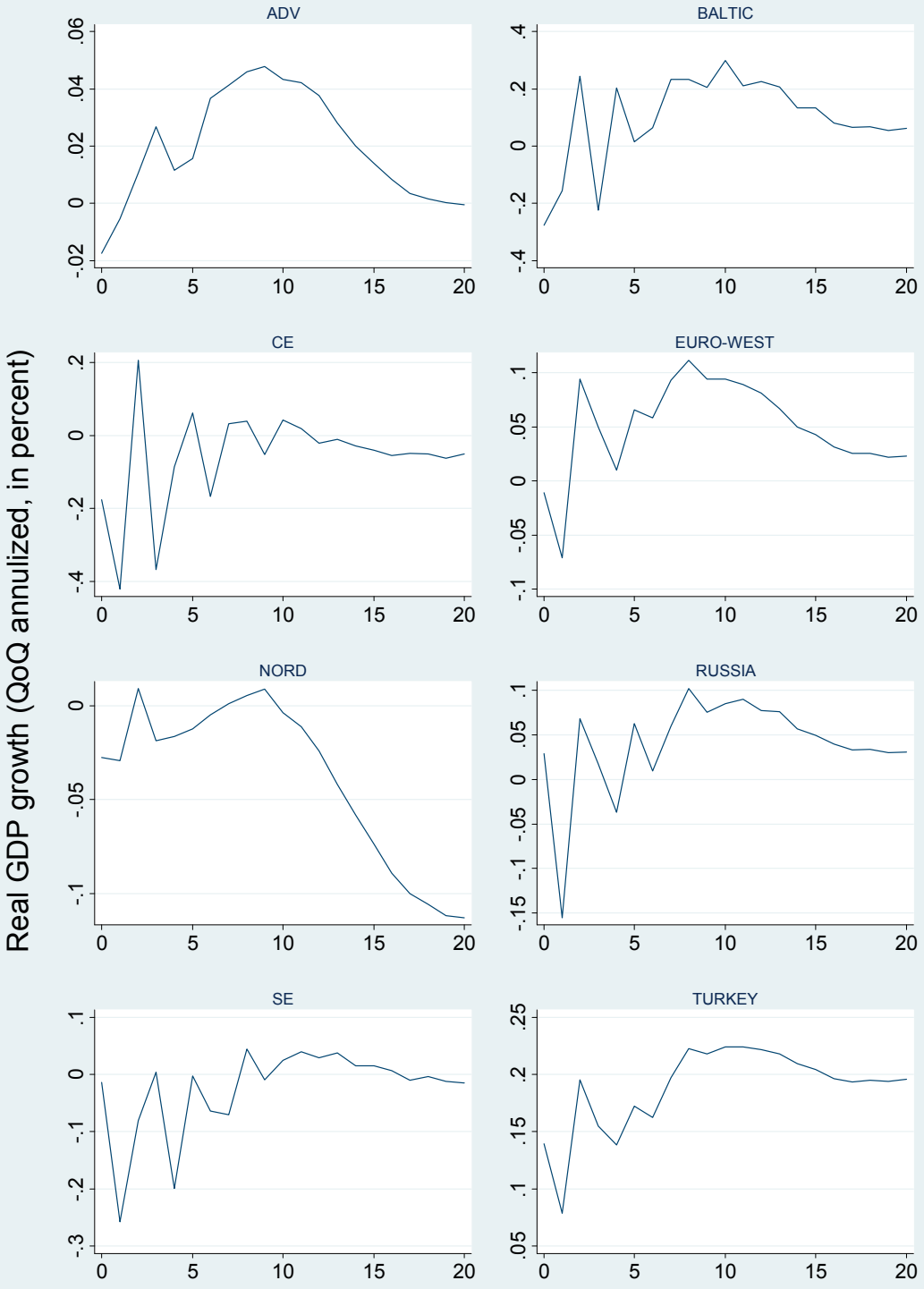
Notes: GIRF calculated based on the estimated GVAR model, see paper.
Source: Author's calculations.

Table 14. Generalized Forecast Error Variance Decomposition: a One s.d. Shock to Interest Rate in the ADV Group (the UK, Switzerland, Iceland, and Israel)

	Quarters	0	1	2	3	4	5	6	7	8	9	10
Region/Country												
EURO-West	dy	0.0	0.0	0.5	1.0	1.5	1.9	2.3	2.8	3.4	4.0	4.7
	π	0.0	0.2	0.5	0.7	0.9	1.2	1.4	1.6	1.8	2.1	2.3
	r	0.3	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9
	dCR	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	p_{oil}	10.9	12.0	9.8	8.2	7.0	6.2	5.7	5.2	4.7	4.3	4.0
	EURO-West variance	**11.2**	**13.2**	**12.1**	**11.2**	**10.6**	**10.6**	**10.7**	**11.0**	**11.3**	**11.7**	**12.3**
ADV	dy	0.5	0.4	0.3	0.4	0.7	0.9	0.9	0.9	1.1	1.2	1.3
	π	14.1	12.4	11.5	11.4	11.4	11.6	11.5	11.4	11.3	11.1	11.0
	r	71.4	70.9	71.5	71.7	71.3	70.4	69.4	68.3	66.9	65.4	63.9
	dCR	0.5	0.3	1.0	1.0	0.9	0.7	0.6	0.6	0.6	0.5	0.5
	ADV variance	**86.5**	**83.9**	**84.3**	**84.5**	**84.3**	**83.6**	**82.5**	**81.2**	**79.8**	**78.3**	**76.7**
NORD	dy	0.0	0.1	0.2	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.8
	π	0.0	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
	r	0.0	0.0	0.0	0.1	0.3	0.5	0.7	1.0	1.4	1.7	2.1
	dCR	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.5	0.7	0.8
	NORD variance	**0.1**	**0.2**	**0.4**	**0.7**	**1.0**	**1.3**	**1.7**	**2.1**	**2.6**	**3.2**	**3.7**
BALTIC	dy	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	π	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	dCR	0.5	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
	BALTIC variance	**0.5**	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**
CE	dy	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
	π	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	r	0.7	0.9	1.0	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.3
	dCR	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0
	CE variance	**1.5**	**1.9**	**2.0**	**2.0**	**2.0**	**2.1**	**2.2**	**2.2**	**2.3**	**2.4**	**2.4**
SE	dy	0.1	0.1	0.3	0.4	0.5	0.7	0.8	1.0	1.2	1.3	1.5
	π	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
	r	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	dCR	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2
	SE variance	**0.1**	**0.2**	**0.3**	**0.4**	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**
Russia	dy	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.2
	π	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	r	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	dCR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Russia variance	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.2**	**0.2**	**0.2**
Turkey	dy	0.0	0.2	0.3	0.5	0.6	0.7	0.8	1.0	1.1	1.2	1.3
	π	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.3	0.4	0.5	0.5
	dCR	0.0	0.1	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.6
	Turkey variance	**0.1**	**0.2**	**0.5**	**0.8**	**1.0**	**1.2**	**1.5**	**1.8**	**2.0**	**2.3**	**2.5**

Note: Based on percentage of the k-step ahead forecast error variance of a one s.d. shock to the ADV group's interest rate. Original percentages do not sum to 100 due to non-zero covariance between the shocks, according to Pesaran and Shin (1998). Figures in the tables are rescaled to 100, as suggested by Wang (2002).

Figure 9. Generalized Impulse Response Function of Real GDP Growth to a Negative One p.p. Shock to Real Credit Growth in the Central European countries (Czech R., Hungary, Poland, Slovakia, and Slovenia)



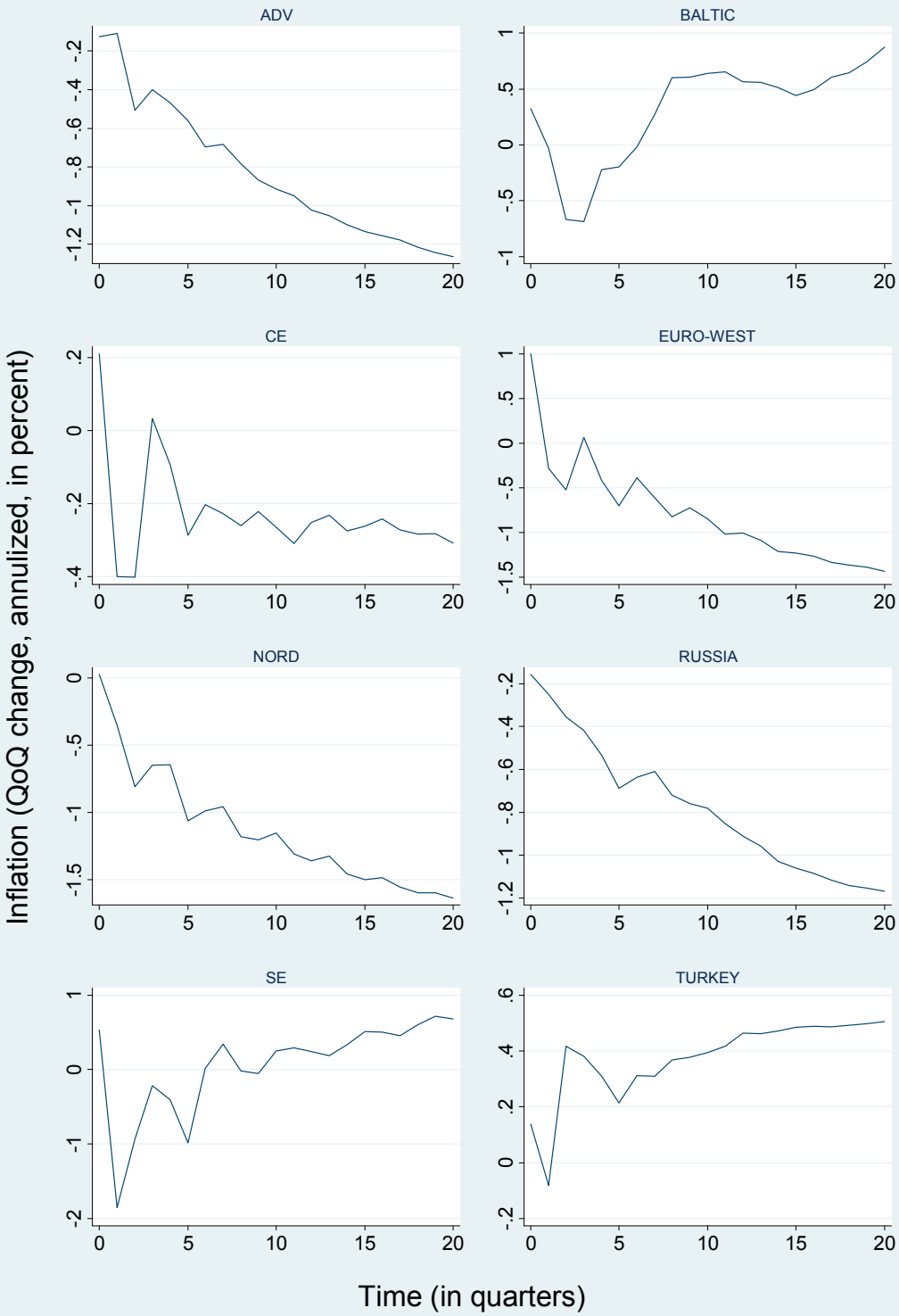
Notes: GIRF calculated based on the estimated GVAR model, see paper.
Source: Author's calculations.

Table 15. Generalized Forecast Error Variance Decomposition: a Negative One s.d. Shock to Real Credit Growth in the Central European countries (Czech R., Hungary, Poland, Slovakia, and Slovenia)

	Quarters	0	1	2	3	4	5	6	7	8	9	10
Region/Country												
EURO-West	dy	13.7	15.9	10.3	9.6	9.0	8.7	8.5	8.1	7.8	7.6	7.3
	π	0.1	1.8	1.1	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8
	r	0.2	0.4	0.8	1.0	1.1	1.0	1.1	1.1	1.0	1.0	1.0
	dCR	0.0	0.1	0.2	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.4
	p_{oil}	2.0	9.5	22.0	20.7	20.0	19.7	19.6	20.2	20.4	20.9	21.5
	EURO-West variance	**15.9**	**27.8**	**34.4**	**32.5**	**31.4**	**30.6**	**30.5**	**30.7**	**30.5**	**30.6**	**30.9**
NORD	dy	0.4	0.6	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
	π	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	r	0.0	0.0	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	dCR	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	NORD variance	**0.5**	**0.9**	**0.8**	**0.9**	**1.0**	**1.1**	**1.2**	**1.1**	**1.1**	**1.0**	**1.0**
ADV	dy	8.6	6.0	5.3	5.7	5.4	4.9	4.5	4.3	4.1	3.9	3.7
	π	0.0	2.1	2.3	1.9	1.7	1.8	1.8	1.9	1.8	1.7	1.8
	r	2.4	4.6	9.6	11.1	11.0	11.2	11.5	12.0	12.3	12.3	12.3
	dCR	0.0	0.5	7.8	6.9	8.8	7.9	7.3	7.0	6.6	6.3	5.9
	ADV variance	**11.0**	**13.2**	**25.0**	**25.5**	**26.9**	**25.8**	**25.1**	**25.2**	**24.8**	**24.3**	**23.7**
BALTIC	dy	0.4	0.5	0.9	0.8	0.8	0.8	0.9	1.0	1.0	1.0	1.0
	π	5.2	3.7	2.5	2.1	2.0	2.0	2.1	2.0	2.0	2.0	1.9
	dCR	7.6	5.6	3.7	3.4	3.1	3.0	2.8	2.6	2.6	2.4	2.3
	BALTIC variance	**13.2**	**9.7**	**7.1**	**6.3**	**5.9**	**5.8**	**5.7**	**5.6**	**5.5**	**5.4**	**5.2**
CE	dy	7.7	6.4	3.9	5.0	5.5	5.8	6.4	6.6	6.7	7.0	7.2
	π	3.8	3.7	3.4	3.6	3.8	4.6	5.2	5.3	5.6	5.9	6.0
	r	2.8	4.7	3.8	3.8	3.6	3.4	3.2	3.1	3.2	3.1	3.1
	dCR	41.6	30.4	19.7	20.5	20.2	21.2	21.2	20.9	21.2	21.2	21.2
	CE variance	**55.9**	**45.3**	**30.7**	**32.9**	**33.1**	**35.1**	**36.1**	**36.0**	**36.7**	**37.2**	**37.5**
SE	dy	0.5	0.5	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	π	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0
	r	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	dCR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SE variance	**0.9**	**0.7**	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.3**	**0.3**	**0.3**	**0.4**
Russia	dy	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	π	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	r	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	dCR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Russia variance	**0.4**	**0.4**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**
Turkey	dy	1.6	1.4	0.8	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.6
	π	0.0	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	dCR	0.5	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Turkey variance	**2.2**	**2.1**	**1.3**	**1.1**	**1.0**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**1.0**

Note : Based on percentage of the k-step ahead forecast error variance of a one s.d. shock to the NORD group's real GDP growth. Original percentages do not sum to 100 due to non-zero covariance between the shocks, according to Pesaran and Shin (1998). Figures in the tables are rescaled to 100, as suggested by Wang (2002).

Figure 10. Generalized Impulse Response Function of Inflation to a One p.p. Shock to Inflation in the Euro-West Group



Notes: GIRF calculated based on the estimated GVAR model, see paper.
Source: Author's calculations.

Table 16. Generalized Forecast Error Variance Decomposition: a One s.d. Shock to Inflation in the Euro-West Group

	Quarters	0	1	2	3	4	5	6	7	8	9	10
Region/Country												
EURO-West	dy	0.9	5.4	12.1	15.5	17.6	20.5	22.1	22.8	23.9	24.6	25.2
	π	25.1	10.9	8.9	6.9	5.7	5.8	5.1	4.7	4.8	4.6	4.5
	r	0.3	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1
	dCR	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
	p_{oil}	36.5	15.1	14.3	13.2	12.3	11.0	9.9	9.6	9.4	9.0	8.8
	EURO-West variance	**62.8**	**32.3**	**36.0**	**36.1**	**36.0**	**37.7**	**37.5**	**37.4**	**38.3**	**38.5**	**38.8**
NORD	dy	0.7	1.5	2.0	2.6	2.6	2.7	2.8	2.7	2.7	2.8	2.8
	π	0.3	0.6	0.6	0.7	0.6	0.5	0.5	0.4	0.3	0.3	0.2
	r	0.0	0.4	0.9	1.8	3.0	4.0	5.0	5.8	6.5	7.1	7.5
	dCR	0.0	0.1	0.2	0.5	1.1	1.5	1.8	2.2	2.4	2.6	2.7
	NORD variance	**1.0**	**2.5**	**3.8**	**5.6**	**7.3**	**8.6**	**10.1**	**11.0**	**12.0**	**12.8**	**13.3**
ADV	dy	29.0	33.5	22.8	17.8	13.9	10.9	8.9	7.2	5.8	4.8	4.0
	π	0.3	2.6	4.1	3.8	3.3	3.1	3.0	2.9	2.7	2.6	2.5
	r	0.0	5.9	10.4	12.9	15.4	16.3	16.7	17.6	18.0	18.3	18.6
	dCR	1.2	13.8	12.1	10.3	9.1	7.1	6.0	5.5	4.5	3.9	3.5
	ADV variance	**30.5**	**55.8**	**49.3**	**44.8**	**41.7**	**37.4**	**34.6**	**33.2**	**31.1**	**29.6**	**28.6**
BALTIC	dy	0.2	0.8	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.3	0.2
	π	2.0	1.3	0.8	0.8	0.7	0.5	0.5	0.5	0.4	0.3	0.3
	dCR	0.4	0.7	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8
	BALTIC variance	**2.6**	**2.7**	**2.1**	**2.1**	**1.9**	**1.8**	**1.7**	**1.6**	**1.5**	**1.4**	**1.4**
CE	dy	0.3	1.6	1.8	1.9	2.0	1.9	2.0	2.0	2.0	2.0	2.0
	π	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.5	0.5	0.5	0.5
	r	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
	dCR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CE variance	**0.5**	**1.9**	**2.2**	**2.4**	**2.6**	**2.6**	**2.6**	**2.7**	**2.6**	**2.6**	**2.7**
SE	dy	0.9	1.6	2.2	3.0	3.6	4.2	4.7	4.9	5.1	5.2	5.4
	π	0.2	0.1	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.5	0.5
	r	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
	dCR	0.1	0.0	0.1	0.2	0.2	0.3	0.5	0.5	0.5	0.6	0.6
	SE variance	**1.2**	**1.9**	**2.5**	**3.5**	**4.3**	**5.0**	**5.8**	**6.0**	**6.2**	**6.4**	**6.6**
Russia	dy	0.5	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
	π	0.1	0.1	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5
	r	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
	dCR	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
	Russia variance	**0.6**	**0.5**	**0.5**	**0.6**	**0.7**	**0.7**	**0.8**	**0.8**	**0.8**	**0.8**	**0.9**
Turkey	dy	0.7	1.8	2.5	3.1	3.4	3.7	4.0	4.1	4.1	4.2	4.2
	π	0.0	0.1	0.4	0.8	1.0	1.3	1.5	1.6	1.7	1.8	1.9
	dCR	0.2	0.4	0.7	1.0	1.1	1.3	1.5	1.6	1.6	1.7	1.7
	Turkey variance	**0.9**	**2.3**	**3.6**	**4.8**	**5.5**	**6.2**	**7.0**	**7.2**	**7.5**	**7.7**	**7.8**

Note: Based on percentage of the k-step ahead forecast error variance of a one s.d. shock to the EURO group's inflation. Original percentages do not sum to 100 due to non-zero covariance between the shocks, according to Pesaran and Shin (1998). Figures in the tables are rescaled to 100, as suggested by Wang (2002).

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APPENDIX I. GVAR MODEL STRUCTURE

Assume *N* number of countries are to be modeled, and data such as real GDP, inflation, interest rates etc. are collected in x_{it} (a k_i vector of country specific variables) where i=1,…,*N*, and t=1,2,…, *T*. For each x_{it}, the corresponding foreign variables x_{it}^* (a k_i^* vector of country specific foreign variables) can be constructed as follows: for i=1,…, *N*,[35]

$$x_{it}^* = \sum_{j=1}^{N} w_{ij} x_{jt}$$

$$\sum_{j=1}^{N} w_{ij} = 1, \text{and } w_{ii} = 0$$

Then assume that for country *i,* a VAR(2, 2) model with foreign variables, also called VARX or VARX* model, can be fitted to the data, allowing for deterministic trend, i.e.

$$x_{it} = \delta_{i0} + \delta_{i1} t + \mathbf{\Gamma}_{i1} x_{it-1} + \mathbf{\Gamma}_{i2} x_{it-2} + \mathbf{\Lambda}_{i0} x_{it}^* + \mathbf{\Lambda}_{i1} x_{it-1}^* + \mathbf{\Lambda}_{i2} x_{it-2}^* + \varepsilon_{it}$$

where δ, $\mathbf{\Gamma}$, and $\mathbf{\Lambda}$ are coefficients (matrices) to be estimated. This model is one of the key components of the GVAR model. Compared to a traditional domestic variable-only VAR structure, it captures the inter-country linkages, i.e. foreign country's influence, by explicitly including the foreign variables (which are treated as exogenous) in the VAR structure.

The model can also be rewritten in error correction terms as follows:

$$\Delta x_{it} = c_{i0} - \alpha_i \beta_i' \left[z_{i,t-1} - \gamma_i (t-1) \right] + \mathbf{\Lambda}_{i0} x_{it}^* + \mathbf{\Gamma}_i \Delta z_{i,t-1} + \varepsilon_{it}$$

where $z_{it} = (x_{it}', x_{it}^{*\prime})'$, and α, β, and γ again are coefficients to be estimated (including the relevant co-integration order rank). For example, if the co-integration rank order is r_i between
x_i and x_i^* for country i, then α_i is a $k_i \times r_i$ matrix of rank r_i and β_i is a matrix of rank $(k_i + k_i^*) \times r_i$. By partitioning β_i as $\beta_i = (\beta_{ix}', \beta_{ix^*}')'$, conformable to z_{it}, the r_i error correction terms defined by the above equation can be written as

$$\beta_i' (z_{it} - \gamma_i t) = \beta_{ix}' x_{it} + \beta_{ix^*}' x_{it}^* - (\beta_i' \gamma_i) t$$

The error terms
(ε_{it}) are assumed to be serially uncorrelated with a zero mean and a non − singular covariance matrix $\mathbf{\Sigma}_{ii} = (\sigma_{ls})$, where $\sigma_{ls} = cov(\varepsilon_{i,l}, \varepsilon_{i,s})$. In particular,

$$\varepsilon_{it} \sim i.i.d.(0, \mathbf{\Sigma}_{ii})$$

[35] The foreign variables generally also include some global variables such as oil prices.

The model also allows a cross-country correlation of idiosyncratic shocks, i.e.

$$E\left(\varepsilon_{it}\varepsilon'_{jt'}\right) = \begin{cases} \Sigma ij & if\ t = t' \\ 0 & if\ t \neq t' \end{cases}$$

The error structure, as reflected in
$\boldsymbol{\Sigma}_{ij}$, is another channel of cross −
country spillovers in addition to the VARX structure for an individual country as it governs how shocks
. Given that there is no need to impose uniform requirements on the set of variables
(domestic and foreign) to be included in individual country models, nor is there a need to
impose the same lag structure for the VARX(p, q), the GVAR model is a fairly flexible
structure to capture the inter-country relationships.

APPENDIX II. RESULTS OF UNIT ROOT TEST AND WEAK EXOGENEITY TESTS

Unit Root Tests

Following PSW and DdPS, we assume that the variables included in the country-specific models are integrated of order one (I(1)). This would permit the model to distinguish between short-run and long-run relations through co-integration relations. Therefore, we first carry out unit root tests for the domestic and foreign variables. The results are shown in Appendix Tables A2-A4. The results reported include both the conventional augmented Dickey-Fuller (ADF) test, and the unit-root *t*-statistic based on the weighted symmetric estimation of ADF type regressions introduced by Park and Fuller (1995) (WS). The latter tests are considered to have better power than the ADF test. The lag length employed in the tests is selected based on the Akaike Information Criterion (AIC) applied on standard ADF regressions.

The test results show that real GDP growth (*dy*) is mostly I(1) or borderline I(0)/I(1) (e.g. for ADV, EURO, Lithuania, NORD, Poland), except for Slovakia which is I(0). Inflation for Croatia, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia, and Turkey is I(1), while ADV, Estonia, EURO, Hungary, NORD appears to be I(0) (some with a trend). Interest rates are I(1) except for Hungary which is borderline I(0)/I(1). Credit growth (*dCR*) are mostly I(1) except for Hungary, Poland, and Slovakia which appears to be I(0). Results for foreign variables are mostly similar to domestic variables, but with some notable differences. For example, foreign inflation variables are I(0), except for Lithuania which is slightly more borderline I(0)/I(1). Interest rates for many countries (ADV, Croatia, the Czech Republic, Hungary, Poland, Romania, Russia, Slovakia, Slovenia, and Turkey) appear to be I(2), with the rest I(1). Credit growth is across the board I(1).

Weak Exogeneity Test

One of the key assumptions of the GVAR model, as explained in DdPS, is that foreign variables are weakly exogenous with respect to the long-run parameters of the error-correction model. A weakly exogenous variable can be defined as a variable whose value is independent of the contemporaneous values of the endogenous variables, but may depend on lagged values of these variables[36]. Formally, the weak exogeneity of $\boldsymbol{x}^*$ means that $\boldsymbol{x}$ does not affect $\boldsymbol{x}^*$ in the long-run, and $\boldsymbol{x}^*$ is said to be 'long-run forcing' for $\boldsymbol{x}$. This assumption allows proper identification of the co-integration relation as noted in Johansen (1992). The tests of weak exogeneity of foreign variables are show in Table A8. With the exception of real GDP growth, oil price for ADV, all foreign variables appear to be exogenous.

[36] In contrast, the notion of a strongly exogenous variable implies that it is independent of all endogenous variables in a model (including both current and lagged values of these variables);

APPENDIX TABLES

Table A1. Data Source

Country	Series Name			
	CPI	GDP	Interest Rate (RL)	Credit
Austria				
Source/code	H122H@EUDATA	J122GDPQ@EUDATA	I122R@EUDATA	C122DAP@IFS
Note	Austria: Harmonized Consumer Price Index (SA, 2005=100)	Austria: Gross Domestic Product (SWDA, 2005=100)	Austria: Long-term Interest Rate: Rolling 12 Month Average (%)	Austria: Bkg Insts: Claims on Oth Res Sectors in Cty (Mil.Euros)
Belgium				
Source/code	H124H@EUDATA	J124GDPQ@EUDATA	I124R@EUDATA	C124DAP@IFS
Note	Belgium: Harmonized Consumer Price Index (SA, 2005=100)	Belgium: Gross Domestic Product (SWDA, 2005=100)	Belgium: Long-term Interest Rate: Rolling 12 Month Average (%)	Belgium: Bkg Insts: Claims on Oth Res Sectors in Cty (Mil.Euros)
Cyprus				
Source/code	H423H@EUDATA	J423GDPQ@EUDATA	I423R@EUDATA	C423DAP@IFS
Note	Cyprus: Harmonized Consumer Price Index (SA, 2005=100)	Cyprus: Gross Domestic Product (SWDA, 2005=100)	Cyprus: Long-term Interest Rate: Rolling 12 Month Average (%)	Cyprus: Deposit Money Banks: Claims on Private Sector (Mil.Pounds)
Finland				
Source/code	H172H@EUDATA	J172GDPQ@EUDATA	I172R@EUDATA	C172DAP@IFS
Note	Finland: Harmonized Consumer Price Index (SA, 2005=100)	Finland: Gross Domestic Product (SWDA, 2005=100)	Finland: Long-term Interest Rate: Rolling 12 Month Average (%)	Finland: Bkg Insts: Claims on Oth Res Sectors in Cty (Mil.Euros)
France				
Source/code	H132H@EUDATA	J132GDPQ@EUDATA	I132R@EUDATA	C132DAP@IFS
Note	France: Harmonized Consumer Price Index (SA, 2005=100)	France: Gross Domestic Product (SWDA, 2005=100)	France: Long-term Interest Rate: Rolling 12 Month Average (%)	France: Bkg Insts: Claims on Oth Res Sectors in Cty (Mil.Euros)
Germany				
Source/code	H134H@EUDATA	J134GDPQ@EUDATA	I134R@EUDATA	C134DAP@IFS
Note	Germany: Harmonized Consumer Price Index (SA, 2005=100)	Germany: Gross Domestic Product (SWDA, 2005=100)	Germany: Long-term Interest Rate: Rolling 12 Month Average (%)	Germany: Bkg Insts: Claims on Oth Res Sectors in Cty (Mil.Euros)
Greece				
Source/code	H174H@EUDATA	J174GDPQ@EUDATA	I174R@EUDATA	C174DAP@IFS
Note	Greece: Harmonized Consumer Price Index (SA, 2005=100)	Greece: Gross Domestic Product (SWDA, 2005=100)	Greece: Long-term Interest Rate: Rolling 12 Month Average (%)	Greece: Bkg Insts: Claims on Other Resident Sectors in Country (NSA, Mil.Euros)
Ireland				
Source/code	H178H@EUDATA	J178GDPQ@EUDATA	I178R@EUDATA	C178DAP@IFS
Note	Ireland: Harmonized Consumer Price Index (SA, 2005=100)	Ireland: Gross Domestic Product (SWDA, 2005=100)	Ireland: Long-term Interest Rate: Rolling 12 Month Average (%)	Ireland: Bkg Insts: Claims on Oth Res Sectors in Cty (Mil.Euros)
Italy				
Source/code	H136H@EUDATA	J136GDPQ@EUDATA	I136R@EUDATA	C136DAP@IFS
Note	Italy: Harmonized Consumer Price Index (SA, 2005=100)	Italy: Gross Domestic Product (SWDA, 2005=100)	Italy: Long-term Interest Rate: Rolling 12 Month Average (%)	Italy: Bkg Insts: Claims on Oth Res Sectors in Cty (Bil.Euros)
Luxembourg				
Source/code	H137H@EUDATA	J137GDPQ@EUDATA	I137R@EUDATA	ActiveX VT_ERROR:
Note	Luxembourg: Harmonized Consumer Price Index (SA, 2005=100)	Luxembourg: Gross Domestic Product (SWDA, 2005=100)	Luxembourg: Long-term Interest Rate: Rolling 12 Month Average (%)	Italy: Bkg Insts: Claims on Oth Res Sectors in Cty (Bil.Euros)

Note: All data are sources from Haver Analytics, the serious codes and information are from Haver Analytics database.

Country	Series Name			
	CPI	GDP	Interest Rate (RL)	Credit
Malta				
Source/code	H181H@EUDATA	J181GDPQ@EUDATA	I181R@EUDATA	C181DAP@IFS
Note	Malta: HICP: Consumer Price Index (SA, 2005=100)	Malta: Gross Domestic Product (SWDA, 2005=100)	Malta: Long-term Interest Rate: Rolling 12 Month Average (%)	Malta: Deposit Money Banks: Claims on Private Sector (Mil.Liri)
Netherlands				
Source/code	H138H@EUDATA	J138GDPQ@EUDATA	I138R@EUDATA	C138DAP@IFS
Note	Netherlands: Harmonized Consumer Price Index (SA, 2005=100)	Netherlands: Gross Domestic Product (SWDA, 2005=100)	Netherlands: Long-term Interest Rate: Rolling 12 Month Average (%)	Netherlands: Bkg Insts: Claims on Oth Res Sectors in Cty (Bil.Euros)
Portugal				
Source/code	H182H@EUDATA	J182GDPQ@EUDATA	I182R@EUDATA	C182DAP@IFS
Note	Portugal: Harmonized Consumer Price Index (SA, 2005=100)	Portugal: Gross Domestic Product (SWDA, 2005=100)	Portugal: Long-term Interest Rate: Rolling 12 Month Average (%)	Portugal: Bkg Insts: Claims on Oth Res Sectors in Cty (Mil.Euros)
Spain				
Source/code	H184H@EUDATA	J184GDPQ@EUDATA	I184R@EUDATA	C184DAP@IFS
Note	Spain: Harmonized Consumer Price Index (SA, 2005=100)	Spain: Gross Domestic Product (SWDA, 2005=100)	Spain: Long-term Interest Rate: Rolling 12 Month Average (%)	Spain: Bkg Insts: Claims on Oth Res Sectors in Cty (Mil.Euros)
Denmark				
Source/code	H128H@EUDATA	J128GDPQ@EUDATA	I128R@EUDATA	C128DAP@IFS
Note	Denmark: Harmonized Consumer Price Index (SA, 2005=100)	Denmark: Gross Domestic Product (SWDA, 2005=100)	Denmark: Long-term Interest Rate: Rolling 12 Month Average (%)	Denmark: Banking Insts: Claims on Private Sector (Bil.Kroner)
Sweden				
Source/code	H144H@EUDATA	J144GDPQ@EUDATA	I144R@EUDATA	C144DAP@IFS
Note	Sweden: Harmonized Consumer Price Index (SA, 2005=100)	Sweden: Gross Domestic Product (SWDA, 2005=100)	Sweden: Long-term Interest Rate: Rolling 12 Month Average (%)	Sweden: Deposit Money Banks: Claims on Private Sector (Bil.Kronor)
United Kingdom				
Source/code	H112H@EUDATA	J112GDPQ@EUDATA	I112R@EUDATA	C112DAP@IFS
Note	UK: Harmonized Consumer Price Index (SA, 2005=100)	UK: Gross Domestic Product (SWDA, 2005=100)	UK: Long-term Interest Rate: Rolling 12 Month Average (%)	U.K.: Deposit Money Banks: Claims on Private Sector (Bil.Pounds)
Iceland				
Source/code	H176H@EUDATA	J176GDPQ@EUDATA		
Note	Iceland: Harmonized Consumer Price Index (SA, 2005=100)	Iceland: Gross Domestic Product (SWDA, 2005=100)		
Norway				
Source/code	H142H@EUDATA	J142GDPQ@EUDATA	NONRG10@NORDIC	NOSFC2@NORDIC
Note	Norway: Harmonized Consumer Price Index (SA, 2005=100)	Norway: Gross Domestic Product (SWDA, 2005=100)	Norway: 10-Year Government Bond Yield {Effective} (% per annum)	Norway: Domestic Credit: Total {C2} (SA,EOP, Mil.Kroner)
Switzerland				
Source/code	CHNPC@ALPMED	J146GDPQ@EUDATA	CHNRG10@ALPMED	
Note	Switzerland: Consumer Price Index (NSA, Dec-10=100)	Switzerland: Gross Domestic Product (SWDA, 2005=100)	Switzerland: Interest Rates for Confederation Bond: 10 Years (EOP, %)	
Israel				
Source/code	S436PC@EMERGEMA	S436NGPC@EMERGEMA	N436RGK5@EMERGEMA	C436DAP@IFS
Note	Israel: Consumer Price Index (SA, 2010=100)	Israel: Gross Domestic Product (SA, Mil.Chained.2005.NIS)	Israel: Yield on 5-Year Indexed Government Bonds (AVG, % p.a.)	Israel: Deposit Money Banks: Claims on Private Sector (Mil.NSheqalim)

Note : All data are sources from Haver Analytics, the serious codes and information are from Haver Analytics database.

Country	Series Name			
	CPI	GDP	Interest Rate (RL)	Credit
Czech Republic				
Source/code	H935H@EUDATA	J935GDPQ@EUDATA	I935R@EUDATA	C935DAP@IFS
Note	Czech Republic: Harmonized Consumer Price Index (SA, 2005=100)	Czech Rep: Gross Domestic Product (SWDA, 2005=100)	Czech Republic: Long-term Interest Rate: Rolling 12 Month Average (%)	Czech Rep: Dep Mon Banks: Claims on Private Sector (Bil.Koruny)
Hungary				
Source/code	H944H@EUDATA	J944GDPQ@EUDATA	I944R@EUDATA	C944DAP@IFS
Note	Hungary: Harmonized Consumer Price Index (SA, 2005=100)	Hungary: Gross Domestic Product (SWDA, 2005=100)	Hungary: Long-term Interest Rate: Rolling 12 Month Average (%)	Hungary: Banking Insts: Other Domestic Claims (Bil.Forint)
Poland				
Source/code	H964H@EUDATA	J964GDPQ@EUDATA	I964R@EUDATA	C964DAP@IFS
Note	Poland: Harmonized Consumer Price Index (SA, 2005=100)	Poland: Gross Domestic Product (SWDA, 2005=100)	Poland: Long-term Interest Rate: Rolling 12 Month Average (%)	Poland: Deposit Money Banks: Claims on Private Sector (Mil.Zlotys)
Slovak Republic				
Source/code	H936H@EUDATA	J936GDPQ@EUDATA	I936R@EUDATA	C936DAP@IFS
Note	Slovakia: Harmonized Consumer Price Index (SA, 2005=100)	Slovakia: Gross Domestic Product (SWDA, 2005=100)	Slovakia: Long-term Interest Rate: Rolling 12 Month Average (%)	Slovak Rep: Dep Mon Banks: Claims on Private Sector (Mil.Koruny)
Slovenia				
Source/code	H961H@EUDATA	J961GDPQ@EUDATA	I961R@EUDATA	C961DAP@IFS
Note	Slovenia: Harmonized Consumer Price Index (SA, 2005=100)	Slovenia: Gross Domestic Product (SWDA, 2005=100)	Slovenia: Long-term Interest Rate: Rolling 12 Month Average (%)	Slovenia: Deposit Money Banks: Claims on Private Sector (Bil.Tolars)
Estonia				
Source/code	H939H@EUDATA	J939GDPQ@EUDATA	I939R@EUDATA	C939DAP@IFS
Note	Estonia: Harmonized Consumer Price Index (SA, 2005=100)	Estonia: Gross Domestic Product (SWDA, 2005=100)	Estonia: Long-term Interest Rate: Rolling 12 Month Average (%)	Estonia: Banking Insts: Claims on the Private Sector (Mil.Krooni)
Latvia				
Source/code	H941H@EUDATA	J941GDPQ@EUDATA	I941R@EUDATA	C941DAP@IFS
Note	Latvia: Harmonized Consumer Price Index (SA, 2005=100)	Latvia: Gross Domestic Product (SWDA, 2005=100)	Latvia: Long-term Interest Rate: Rolling 12 Month Average (%)	Latvia: Banking Insts: Claims on Private Sector (Mil.Lats)
Lithuania				
Source/code	H946H@EUDATA	J946GDPQ@EUDATA	I946R@EUDATA	C946DAP@IFS
Note	Lithuania: Harmonized Consumer Price Index (SA, 2005=100)	Lithuania: Gross Domestic Product (SWDA, 2005=100)	Lithuania: Long-term Interest Rate: Rolling 12 Month Average (%)	Lithuania: Banking Insts: Claims on Private Sector (Mil.Litai)
Croatia				
Source/code	F960PC@EMERGECW	J960GDPQ@EUDATA		C960SAPK@IFS
Note	Croatia: Consumer Price Index (SA, 2005=100)	Croatia: Gross Domestic Product(SWDA, 2005=100)		Croatia: Dep Corps {MFSM}: Claims on Private Sector (Mil.Kuna)
Romania				
Source/code	H968H@EUDATA	J968GDPQ@EUDATA	N968RGR@EMERGECW	C968DAP@IFS
Note	Romania: Harmonized Consumer Price Index (SA, 2005=100)	Romania: Gross Domestic Product (SWDA, 2005=100)	Romania: Interest-Bearing Government Bonds: Interest Rate (Avg, %)	Romania: Deposit Money Banks: Claims on Private Sector (Bil.Lei)
Russia				
Source/code	F922PC@EMERGECW	H922NGPC@EMERGECW	N922G10@EMERGECW	C922SAPK@IFS
Note	Russia: Consumer Price Index (SA, 2005=100)	Russia: Gross Domestic Product (SA, Bil.Chn.2008.Rubles)	Russia: Zero Coupon Yield Curve: 10-Year (AVG, %)	Russia: Dep Corps {MFSM}: Claims on Private Sector (Bil.Rubles)
Turkey				
Source/code	H186H@EUDATA	S186NGPC@EMERGEMA	N186RT1@EMERGEMA	C186SAPK@IFS
Note	Turkey: HICP: Monetary Union Index: Consumer Prices(SA, 2005=100)	Turkey: Gross Domestic Product (SWDA, Thous.98.TL)	Turkey: Interest Rates: 12 Month Time Deposits (% p.a.)	Turkey: Dep Corps {MFSM}: Claims on Private Sector (Mil.New Liras)

Note: All data are sources from Haver Analytics, the serious codes and information are from Haver Analytics database.

Table A2a. Weight Matrix (average of weights for the period 2000-2004) 1/

Country	ADV	Czech Rep.	Estonia	EURO	Croatia	Hungary	Lithuania	Latvia	NORD	Poland	Romania	Russia	Slovakia	Slovenia	Turkey
ADV	0.00	0.05	0.03	0.63	0.03	0.05	0.07	0.07	0.22	0.05	0.07	0.13	0.03	0.04	0.18
Czech Rep.	0.00	0.00	0.01	0.03	0.01	0.02	0.01	0.01	0.01	0.03	0.01	0.02	0.13	0.02	0.01
Estonia	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.01	0.00	0.00	0.01	0.00	0.00	0.00
EURO	0.92	0.79	0.20	0.00	0.84	0.80	0.35	0.31	0.70	0.77	0.74	0.61	0.68	0.78	0.68
Croatia	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
Hungary	0.00	0.02	0.01	0.03	0.01	0.00	0.01	0.00	0.00	0.01	0.04	0.02	0.03	0.02	0.01
Lithuania	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.07	0.00	0.01	0.00	0.02	0.00	0.00	0.00
Latvia	0.00	0.00	0.03	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
NORD	0.06	0.02	0.62	0.16	0.02	0.03	0.28	0.39	0.00	0.06	0.02	0.07	0.02	0.02	0.04
Poland	0.00	0.03	0.01	0.03	0.01	0.02	0.04	0.03	0.02	0.00	0.02	0.04	0.04	0.02	0.01
Romania	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.02
Russia	0.00	0.02	0.07	0.04	0.03	0.03	0.15	0.06	0.03	0.04	0.05	0.00	0.06	0.02	0.07
Slovakia	0.00	0.05	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.02	0.00	0.01	0.00
Slovenia	0.00	0.00	0.00	0.01	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Turkey	0.01	0.00	0.00	0.03	0.00	0.01	0.01	0.00	0.01	0.01	0.04	0.04	0.00	0.01	0.00

1/ Bilateal weights are shown in columns and sum up to one. Weights are average annual weights for the period of 2000-2004. Weights for specific year are calculated based on the total of trade flow and BIS reporting banks' external position between countries for that year. See paper for detail.

Table A2b. Changes in Weight Matrix from 2000-2004 to 2005-2011 2/

Country	ADV	Czech Rep.	Estonia	EURO	Croatia	Hungary	Lithuania	Latvia	NORD	Poland	Romania	Russia	Slovakia	Slovenia	Turkey
ADV	0.00	**-0.01**	**-0.01**	**-0.03**	**-0.01**	**-0.02**	**-0.04**	**-0.04**	**-0.01**	0.00	**-0.02**	**-0.02**	0.00	**-0.01**	**-0.01**
Czech Rep.	0.00	0.00	0.00	**0.01**	0.00	**0.01**	0.00	0.00	0.00	**0.01**	0.00	0.00	**-0.02**	0.00	0.00
Estonia	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00
EURO	**-0.01**	**-0.01**	**-0.05**	0.00	**0.05**	**-0.03**	**-0.10**	**-0.08**	**-0.02**	**-0.02**	**0.06**	**0.03**	0.00	**0.01**	**-0.03**
Croatia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**-0.01**	0.00
Hungary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.02**	0.00	0.00
Lithuania	0.00	0.00	**0.01**	0.00	0.00	0.00	**0.00**	**0.01**	0.00	0.00	0.00	**-0.01**	0.00	0.00	0.00
Latvia	0.00	0.00	**0.02**	0.00	0.00	0.00	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NORD	**0.01**	0.00	**0.05**	**-0.01**	**-0.01**	**-0.01**	**0.11**	**0.11**	0.00	0.00	**-0.01**	**0.01**	0.00	**-0.01**	**-0.01**
Poland	0.00	**0.01**	**0.01**	**0.01**	0.00	**0.01**	**0.01**	0.00	**0.01**	0.00	0.00	0.00	**0.01**	0.00	0.00
Romania	0.00	0.00	0.00	0.00	0.00	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**
Russia	0.00	0.00	**-0.02**	**0.02**	0.00	**0.01**	**0.01**	0.00	**0.01**	0.00	**-0.02**	0.00	**-0.01**	0.00	**0.03**
Slovakia	0.00	0.00	0.00	0.00	0.00	**0.02**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Slovenia	0.00	0.00	0.00	0.00	**-0.02**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**-0.01**	**0.01**	0.00	**0.01**	0.00

2/ Changes larger than 1% (in absolute terms) are highlighted in bold.

Table A3. Unit Root Tests for the Domestic Variables at the 5% Significance Level

Domestic Variables	Statistic	Critical Value	ADV	Czech Rep.	Estonia	EURO-West	Croatia	Hungary	Lithuania	Latvia	NORD	Poland	Romania	Russia	Slovakia	Slovenia	Turkey
dy (with trend)	ADF	-3.5	-3.0	-2.7	-2.6	-3.1	-2.8	-1.6	-3.3	-2.8	-3.4	-2.9	-2.3	-2.9	-4.4	-3.5	-2.6
dy (with trend)	WS	-3.2	-3.1	-2.9	-2.8	-3.3	-2.3	-2.1	-3.5	-3.1	-3.5	-2.7	-2.5	-3.0	-4.6	-3.7	-2.3
dy (no trend)	ADF	-2.9	-3.0	-2.5	-2.4	-3.1	-2.1	-1.7	-3.1	-2.5	-2.5	-3.0	-1.9	-2.0	-4.3	-3.1	-1.7
dy (no trend)	WS	-2.6	-3.1	-2.7	-2.7	-3.3	-2.4	-1.8	-3.3	-2.8	-2.7	-2.6	-2.2	-2.3	-4.5	-3.4	-1.8
Δdy	ADF	-2.9	-6.5	-5.1	-3.9	-5.5	-5.6	-6.0	-7.3	-4.7	-3.6	-3.2	-9.6	-5.9	-7.7	-6.2	-5.2
Δdy	WS	-2.6	-6.7	-5.4	-4.2	-5.8	-5.8	-6.5	-7.6	-5.0	-3.8	-3.4	-10.0	-6.2	-8.2	-6.5	-5.6
Δ^2dy	ADF	-2.9	-5.5	-6.3	-5.2	-8.5	-4.8	-6.0	-6.1	-10.6	-6.0	-15.0	-7.9	-6.4	-11.1	-5.8	-5.0
Δ^2dy	WS	-2.6	-5.9	-6.7	-5.7	-8.9	-5.2	-7.0	-6.6	-11.0	-6.2	-15.4	-8.4	-6.9	-11.8	-6.3	-5.7
π (with trend)	ADF	-3.5	-4.3	-3.5	-4.0	-3.7	-6.8	-4.6	-2.3	-2.3	-4.7	-3.9	-2.3	-3.0	-3.5	-2.7	-3.3
π (with trend)	WS	-3.2	-4.7	-3.7	-4.3	-4.0	-4.3	-4.7	-2.4	-2.6	-5.0	-3.5	-2.5	-3.2	-3.7	-2.8	-2.2
π (no trend)	ADF	-2.9	-4.4	-3.4	-4.0	-3.8	-6.9	-4.6	-2.1	-2.3	-4.5	-3.1	-2.3	-3.1	-2.9	-2.5	-2.6
π (no trend)	WS	-2.6	-4.7	-3.7	-4.4	-4.0	-4.5	-4.6	-2.4	-2.6	-4.7	-3.2	-2.5	-3.4	-2.8	-2.0	0.4
$\Delta\pi$	ADF	-2.9	-4.7	-6.1	-4.0	-6.2	-6.8	-6.3	-4.7	-4.1	-5.4	-6.4	-3.4	-7.0	-4.9	-5.6	-4.2
$\Delta\pi$	WS	-2.6	-5.7	-6.1	-4.4	-6.1	-7.2	-6.4	-4.8	-4.3	-5.9	-6.0	-3.7	-6.7	-4.4	-5.7	-4.0
$\Delta^2\pi$	ADF	-2.9	-5.2	-10.2	-10.4	-9.8	-5.8	-6.5	-6.0	-5.3	-9.3	-9.4	-11.6	-11.4	-6.3	-5.1	-12.1
$\Delta^2\pi$	WS	-2.6	-5.3	-10.7	-10.8	-9.2	-5.9	-6.6	-6.4	-5.8	-9.3	-8.9	-10.5	-11.1	-6.4	-5.3	-12.2
lr (with trend)	ADF	-3.5	-2.1	-3.0		-2.4		-3.5			-3.2	-4.6	-2.5	-2.1	-3.9		
lr (with trend)	WS	-3.2	-2.3	-2.8		-1.9		-3.7			-3.4	-1.6	-2.1	-2.5	-4.2		
lr (no trend)	ADF	-2.9	-0.8	-2.8		-3.0		-3.3			-1.5	-4.8	-2.6	-2.4	-1.7		
lr (no trend)	WS	-2.6	0.1	-2.5		-1.5		-3.2			-0.3	-0.5	-2.1	-2.3	-0.7		
Δlr	ADF	-2.9	-4.6	-2.7		-1.8		-3.8			-3.7	-2.8	-4.0	-3.8	-4.8		
Δlr	WS	-2.6	-4.9	-3.0		-2.1		-3.9			-3.9	-1.6	-3.3	-3.3	-5.1		
Δ^2lr	ADF	-2.9	-6.2	-9.7		-4.9		-5.6			-4.2	-5.7	-6.6	-6.3	-7.1		
Δ^2lr	WS	-2.6	-6.5	-4.2		-5.2		-5.8			-4.6	-5.4	-7.0	-4.3	-7.6		
dcredit (with trend)	ADF	-3.5	-3.8	-5.8	-2.3	-0.5	-2.5	-5.5	-2.5	-1.7	-0.5	-3.6	-3.2	-3.2	-4.8	-0.8	-3.4
dcredit (with trend)	WS	-3.2	-4.1	-1.4	-1.5	-1.0	-2.7	-5.7	-1.2	-1.6	-0.5	-3.9	-2.7	-3.5	-4.8	-0.8	-2.9
dcredit (no trend)	ADF	-2.9	-2.2	-6.4	-0.3	-0.8	-1.6	-4.3	-0.9	-0.5	1.0	-3.6	-1.9	-2.1	-4.9	-1.4	-1.0
dcredit (no trend)	WS	-2.6	-2.5	-1.3	-0.9	-1.2	-2.0	-4.6	-1.3	-0.8	0.1	-3.8	-2.2	-2.1	-4.8	-1.7	-1.4
Δdcredit	ADF	-2.9	-8.7	-3.6	-4.5	-7.3	-6.0	-5.7	-7.7	-6.3	-5.6	-7.8	-3.2	-6.2	-8.2	-2.4	-6.0
Δdcredit	WS	-2.6	-9.1	-4.0	-4.8	-7.7	-6.2	-6.5	-7.0	-6.2	-6.0	-8.1	-3.6	-6.5	-8.4	-2.6	-6.0
Δ^2dcredit	ADF	-2.9	-6.1	-7.7	-5.3	-8.8	-6.9	-7.0	-7.9	-5.1	-6.8	-6.0	-6.0	-9.7	-5.7	-6.7	-6.4
Δ^2dcredit	WS	-2.6	-6.6	-5.5	-5.4	-9.2	-6.6	-7.8	-8.1	-5.8	-7.3	-6.3	-5.5	-9.8	-6.2	-6.2	-6.3

Note. WS statistic are weighted symmetric estimation of ADF type regressions introduced by Park and Fuller (1995).

Table A4. Unit Root Tests for the Foreign Variables at the 5% Significance Level

Foreign Variables	Statistic	Critical Value	ADV	Czech Rep.	Estonia	EURO-West	Croatia	Hungary	Lithuania	Latvia	NORD	Poland	Romania	Russia	Slovakia	Slovenia	Turkey
dy* (with trend)	ADF	-3.5	-3.1	-3.1	-3.3	-2.6	-3.1	-3.1	-3.1	-2.7	-3.0	-3.1	-3.1	-2.9	-3.1	-3.1	-3.1
dy* (with trend)	WS	-3.2	-3.3	-3.3	-3.5	-2.7	-3.3	-3.3	-3.3	-2.9	-3.2	-3.2	-3.3	-3.1	-3.2	-3.2	-3.2
dy* (no trend)	ADF	-2.9	-3.0	-3.0	-2.7	-2.4	-3.1	-3.0	-2.6	-2.5	-3.0	-2.9	-3.0	-2.8	-2.9	-2.8	-2.9
dy* (no trend)	WS	-2.6	-3.3	-3.3	-3.1	-2.6	-3.3	-3.2	-2.9	-2.7	-3.2	-3.2	-3.2	-3.1	-3.2	-3.0	-3.2
Δdy*	ADF	-2.9	-5.3	-5.7	-3.4	-4.9	-5.5	-5.8	-3.7	-4.7	-5.2	-5.4	-5.3	-5.0	-5.2	-5.5	-5.5
Δdy*	WS	-2.6	-5.6	-6.0	-3.7	-5.2	-5.8	-6.1	-3.9	-4.9	-5.5	-5.7	-5.6	-5.3	-5.5	-5.8	-5.8
Δ^2dy*	ADF	-2.9	-8.3	-8.6	-6.0	-7.8	-8.4	-8.8	-6.0	-5.8	-7.9	-8.3	-8.2	-7.9	-7.9	-8.7	-8.3
Δ^2dy*	WS	-2.6	-8.7	-9.1	-6.2	-8.2	-8.8	-9.2	-6.3	-6.2	-8.3	-8.7	-8.6	-8.3	-8.3	-9.1	-8.7
π* (with trend)	ADF	-3.5	-3.8	-3.6	-3.6	-3.9	-3.8	-3.9	-3.9	-3.9	-3.8	-3.9	-3.8	-3.9	-3.9	-3.9	-3.8
π* (with trend)	WS	-3.2	-4.1	-3.7	-3.8	-4.1	-4.1	-4.1	-4.2	-4.1	-3.9	-4.2	-4.0	-4.0	-4.1	-4.0	-4.0
π* (no trend)	ADF	-2.9	-3.9	-3.6	-3.5	-4.0	-3.9	-4.0	-3.9	-3.3	-3.8	-4.0	-3.9	-4.0	-4.0	-4.0	-3.8
π* (no trend)	WS	-2.6	-4.1	-3.7	-3.8	-4.1	-4.0	-4.1	-4.2	-3.5	-4.0	-4.2	-3.7	-3.8	-4.1	-3.9	-4.0
Δπ*	ADF	-2.9	-6.3	-6.4	-6.1	-5.7	-6.3	-6.3	-6.1	-5.8	-6.3	-6.2	-6.4	-6.3	-6.3	-6.4	-6.6
Δπ*	WS	-2.6	-6.1	-6.2	-6.0	-6.0	-6.1	-6.3	-5.8	-5.7	-6.1	-6.0	-6.1	-6.1	-6.1	-6.3	-6.5
Δ^2π*	ADF	-2.9	-9.8	-9.4	-9.3	-8.1	-9.9	-9.8	-10.0	-9.1	-9.0	-9.6	-9.7	-9.4	-10.1	-9.7	-9.7
Δ^2π*	WS	-2.6	-9.3	-9.0	-9.0	-7.9	-9.3	-9.4	-9.5	-8.8	-8.4	-9.2	-9.3	-9.0	-9.7	-9.1	-9.1
lr* (with trend)	ADF	-3.5	-2.5	-2.6	-3.7	-2.1	-2.7	-2.9	-4.3	-3.8	-2.8	-3.0	-2.6	-2.4	-2.5	-2.6	-3.6
lr* (with trend)	WS	-3.2	-2.0	-1.6	-3.1	-2.1	-1.9	-1.7	-1.9	-2.7	-2.1	-2.0	-1.8	-1.9	-1.6	-1.8	-2.1
lr* (no trend)	ADF	-2.9	-3.1	-3.3	-2.5	-1.1	-3.3	-3.7	-4.6	-3.1	-3.0	-3.6	-3.2	-2.7	-3.3	-3.3	-4.0
lr* (no trend)	WS	-2.6	-1.4	-0.9	-0.2	0.4	-0.9	-1.0	-0.1	-0.2	-0.4	-0.7	-1.2	-0.4	-0.9	-1.2	-0.4
Δlr*	ADF	-2.9	-1.9	-2.8	-3.7	-4.2	-1.8	-2.8	-3.9	-3.7	-2.8	-2.0	-2.7	-3.1	-3.0	-2.7	-2.9
Δlr*	WS	-2.6	-2.2	-3.0	-4.1	-4.4	-2.2	-3.2	-4.1	-4.1	-3.2	-2.4	-3.0	-3.2	-3.3	-3.0	-3.5
Δ^2lr*	ADF	-2.9	-4.8	-4.3	-4.1	-5.9	-4.7	-4.1	-3.8	-4.0	-5.0	-4.3	-4.4	-4.2	-4.4	-4.4	-3.2
Δ^2lr*	WS	-2.6	-5.1	-4.5	-4.4	-6.3	-5.0	-4.5	-4.3	-4.4	-5.1	-4.7	-4.8	-4.6	-4.7	-4.8	-3.5
dcredit* (with trend)	ADF	-3.5	-0.8	-1.1	-0.7	-2.1	-0.6	-1.0	-1.1	-1.3	-2.9	-1.0	-0.8	-1.2	-1.4	-1.0	-2.7
dcredit* (with trend)	WS	-3.2	-1.1	-1.2	-0.6	-2.2	-1.0	-1.0	-0.9	-0.7	-3.0	-0.9	-1.0	-1.1	-1.1	-1.1	-2.7
dcredit* (no trend)	ADF	-2.9	-0.4	-0.7	0.5	-1.6	-0.6	-0.5	0.5	0.4	-1.5	-0.3	-0.6	-0.4	-1.0	-0.5	-2.0
dcredit* (no trend)	WS	-2.6	-0.9	-1.1	-0.3	-1.9	-1.1	-0.9	-0.3	-0.3	-1.9	-0.7	-1.1	-0.9	-1.0	-1.0	-2.3
Δdcredit*	ADF	-2.9	-7.1	-6.8	-6.1	-8.1	-7.1	-6.8	-5.9	-5.9	-2.8	-6.8	-6.6	-5.9	-6.0	-6.6	-6.3
Δdcredit*	WS	-2.6	-7.6	-7.2	-6.5	-8.5	-7.5	-7.2	-6.4	-6.3	-3.1	-7.2	-7.0	-6.3	-6.3	-7.0	-6.7
Δ^2dcredit	ADF	-2.9	-8.2	-7.0	-6.4	-5.7	-8.7	-7.7	-6.6	-6.0	-9.1	-7.9	-8.5	-7.7	-7.8	-7.8	-8.9
Δ^2dcredit	WS	-2.6	-8.5	-7.4	-7.0	-6.3	-9.1	-8.2	-6.9	-6.8	-9.7	-8.3	-8.8	-8.1	-8.2	-8.2	-9.5

Note. WS statistic are weighted symmetric estimation of ADF type regressions introduced by Park and Fuller (1995).

Table A5. Unit Root Tests for the Global Variables at the 5% Significance Level

Global Variables	Test	Critical Value	Statistic
poil (with trend)	ADF	-3.45	-2.3
poil (with trend)	WS	-3.24	-2.6
poil (no trend)	ADF	-2.89	-1.5
poil (no trend)	WS	-2.55	-0.3
Δpoil	ADF	-2.89	-6.2
Δpoil	WS	-2.55	-6.2
Δ^2poil	ADF	-2.89	-7.4
Δ^2poil	WS	-2.55	-7.7

Note. WS statistic are weighted symmetric estimation of ADF type regressions introduced by Park and Fuller (1995).

Table A6. VARX Order of Individual Models and Selected Number of Co-integration Relations

	p	q	# Co-integrating relations
ADV	1	1	3
Czech Rep.	3	2	2
Estonia	3	2	1
EURO-West	3	2	2
Croatia	1	1	1
Hungary	3	2	2
Lithuania	3	2	1
Latvia	3	2	1
NORD	3	2	3
Poland	3	1	2
Romania	3	2	2
Russia	3	2	1
Slovakia	1	1	2
Slovenia	1	1	1
Turkey	1	1	1

Note. p and q are the orders of domestic and foreign variables respectively.

Table A7. Cointegration Results for the Trace Statistic at the 5% Significance Level

Country	ADV	Czech Rep.	Estonia	EURO-West	Croatia	Hungary	Lithuania	Latvia	NORD	Poland	Romania	Russia	Slovakia	Slovenia	Turkey
# endogenous variables	4	4	3	5	3	4	3	3	4	4	4	4	4	3	3
# foreign (star) variables	3	3	4	3	3	3	5	4	4	3	3	3	3	3	3
r=0	137.4*	129.8*	74.8*	197.0*	71.8*	122.1*	117.5*	83.6*	159.2*	131.7*	137.2*	150.3*	130.6*	77.1*	70.4*
r=1	81.3*	70.9*	36.3	117.1*	29.1	67.7*	46.9*	30.2	88.8*	82.2*	65.3*	49.3	62.9*	35.3*	41.8*
r=2	35.3*	34.8*	7.7	60.5*	9.8	29.5	21.1	9.0	39.2*	46.1*	26.2	28.8	25.7	15.8	19.7*
r=3	5.0	11.1		31.0		11.4			12.4	21.1*	9.1	9.2	8.9		
r=4				13.7											

Note: * means rejection at 5% critical value level. The 5% significance level is based on MacKinnon, Haug, and Michelis (1999).

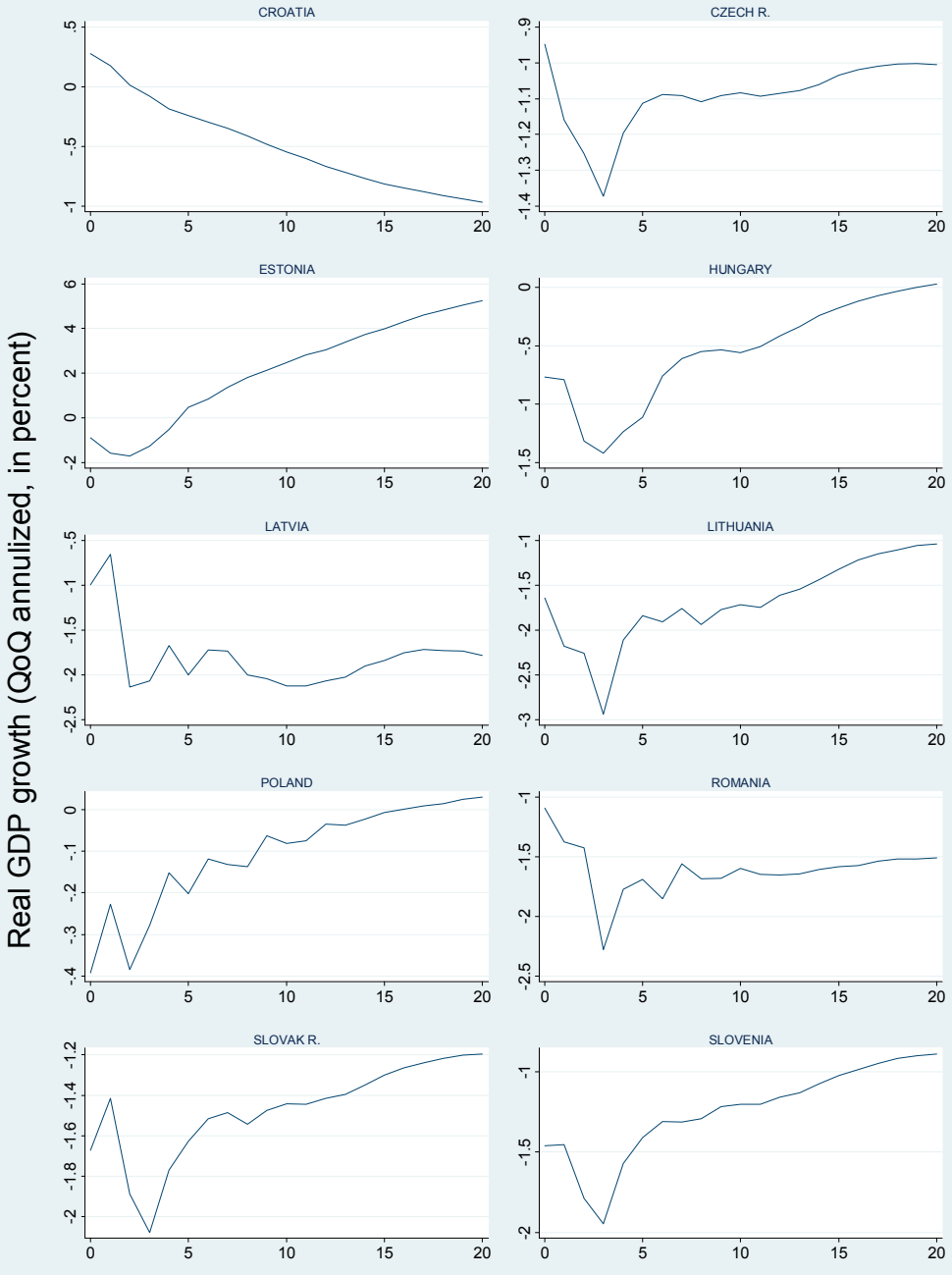
Table A8. Test for Weak Exogeneity of Foreign Variables at the 5% Significance Level

Country	F test	Fcrit_0.05§	dy^*	π^*	r^*	dCR^*	p_{oil}
ADV	F(3,28)	2.95	3.97			1.47	4.51
Czech Rep.	F(2,14)	3.74	2.09			2.07	0.39
Estonia	F(1,17)	4.45	0.44		1.62	0.94	1.05
EURO-West	F(2,10)	4.10	0.33		0.31	0.48	
Croatia	F(1,31)	4.16	2.63			0.05	0.62
Hungary	F(2,14)	3.74	2.83			1.86	0.52
Lithuania	F(1,15)	4.54	0.75	1.85	0.01	1.35	4.56
Latvia	F(1,17)	4.45	0.19		0.02	0.41	0.92
NORD	F(3,11)	3.59	0.03		0.57	0.10	1.02
Poland	F(2,17)	3.59	1.42			3.62	1.23
Romania	F(2,14)	3.74	0.44			0.10	0.80
Russia	F(1,15)	4.54	3.93			0.02	0.00
Slovakia	F(2,29)	3.33	0.05			0.05	0.03
Slovenia	F(1,31)	4.16	0.07			0.25	2.92
Turkey	F(1,31)	4.16	0.12			0.01	1.19

Note: § denotes statistical significance at the 5% level.

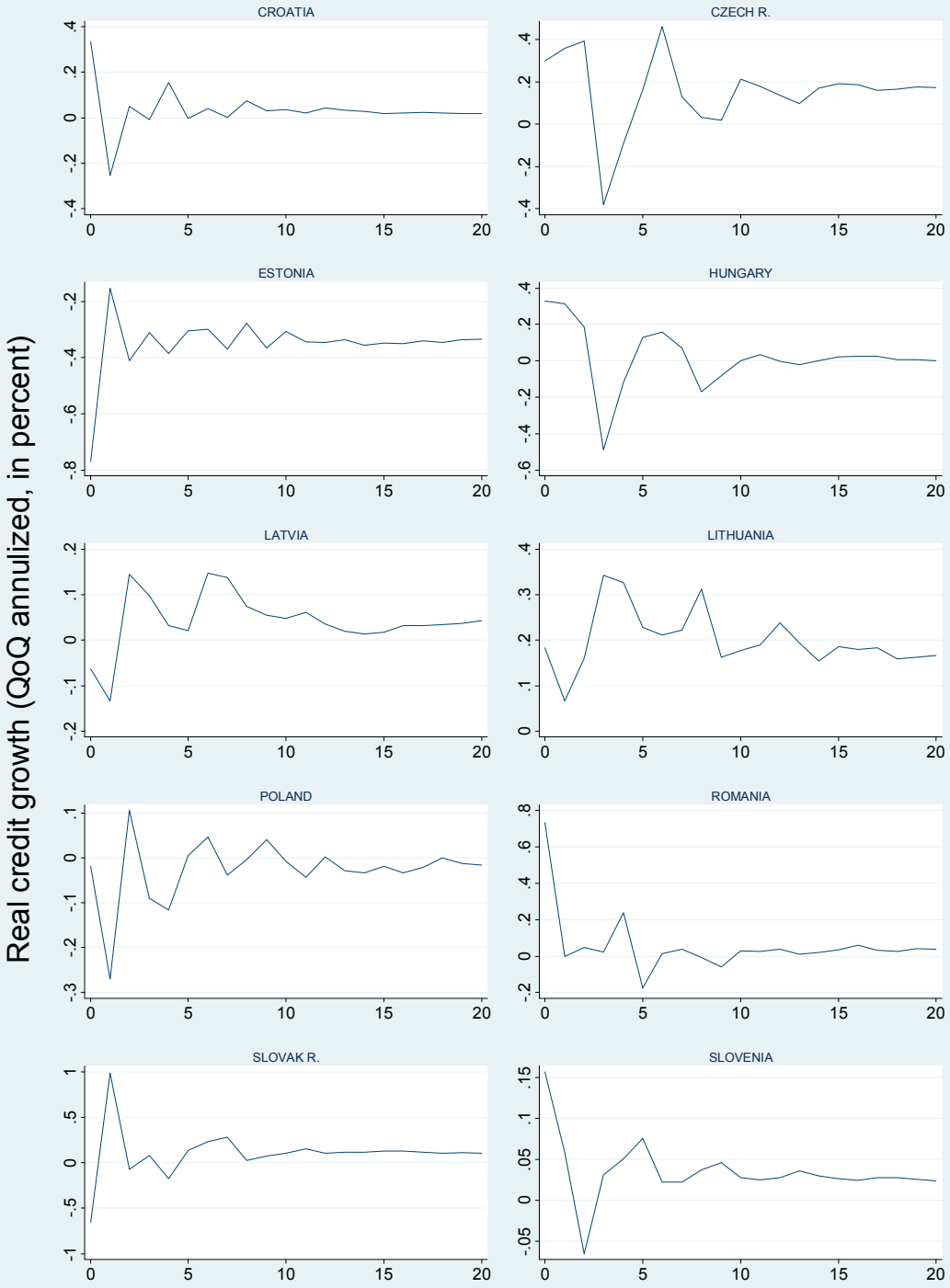
APPENDIX FIGURES

Figure A1. Generalized Impulse Response Function of Real GDP Growth to a Negative One p.p. Shock to Real GDP Growth in the Euro-West Group



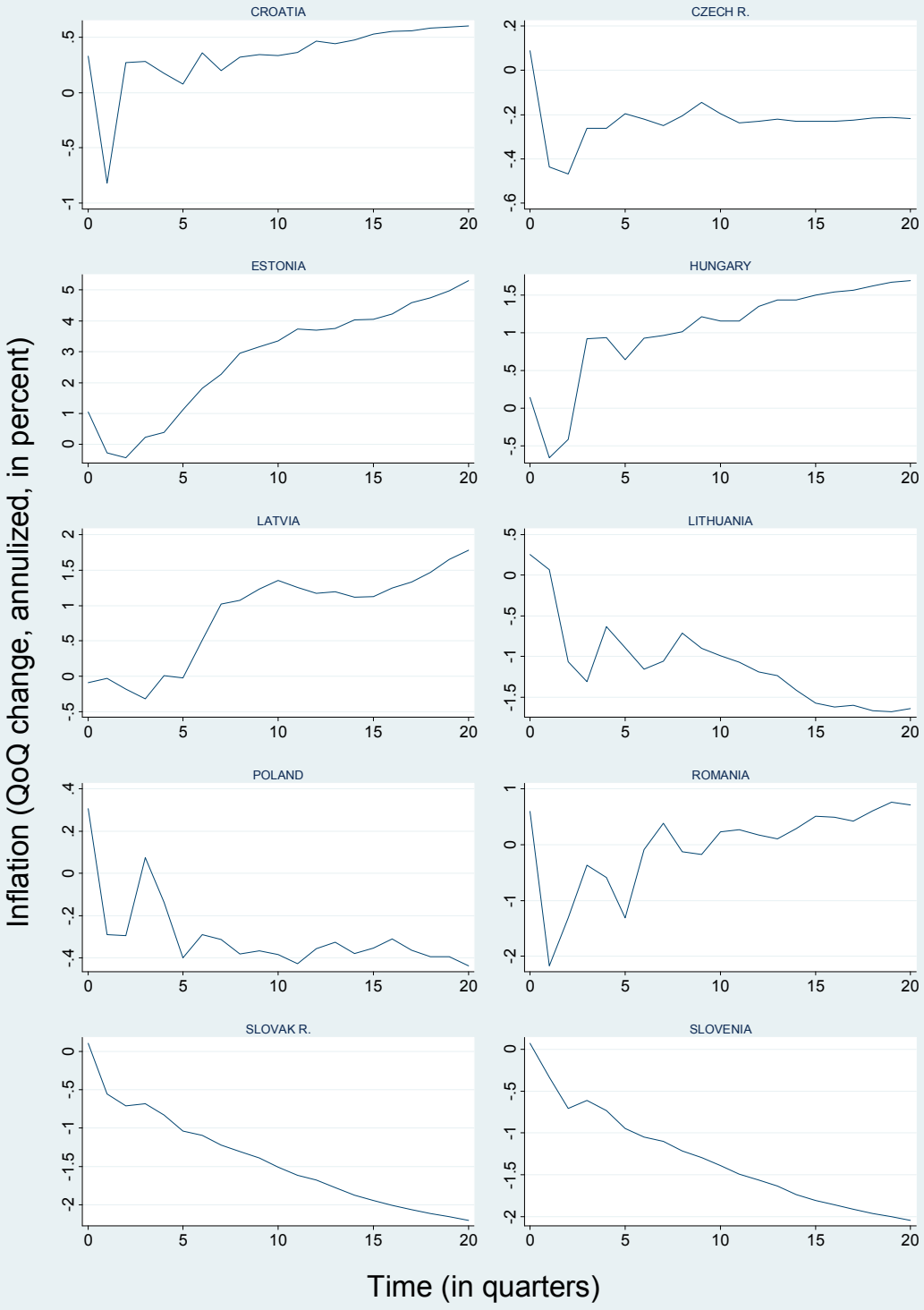
Notes: GIRF calculated based on the estimated GVAR model, see paper.
One s.d. shock to Euro group real GDP growth is equivalent to about -0.2 percentage points in annualized quarter on quarter
growth rate for the EURO group.
Source: Author's calculations.

Figure A2. Generalized Impulse Response Function of Real Credit Growth to a One p.p Shock to Real Credit Growth in the EURO-West Group



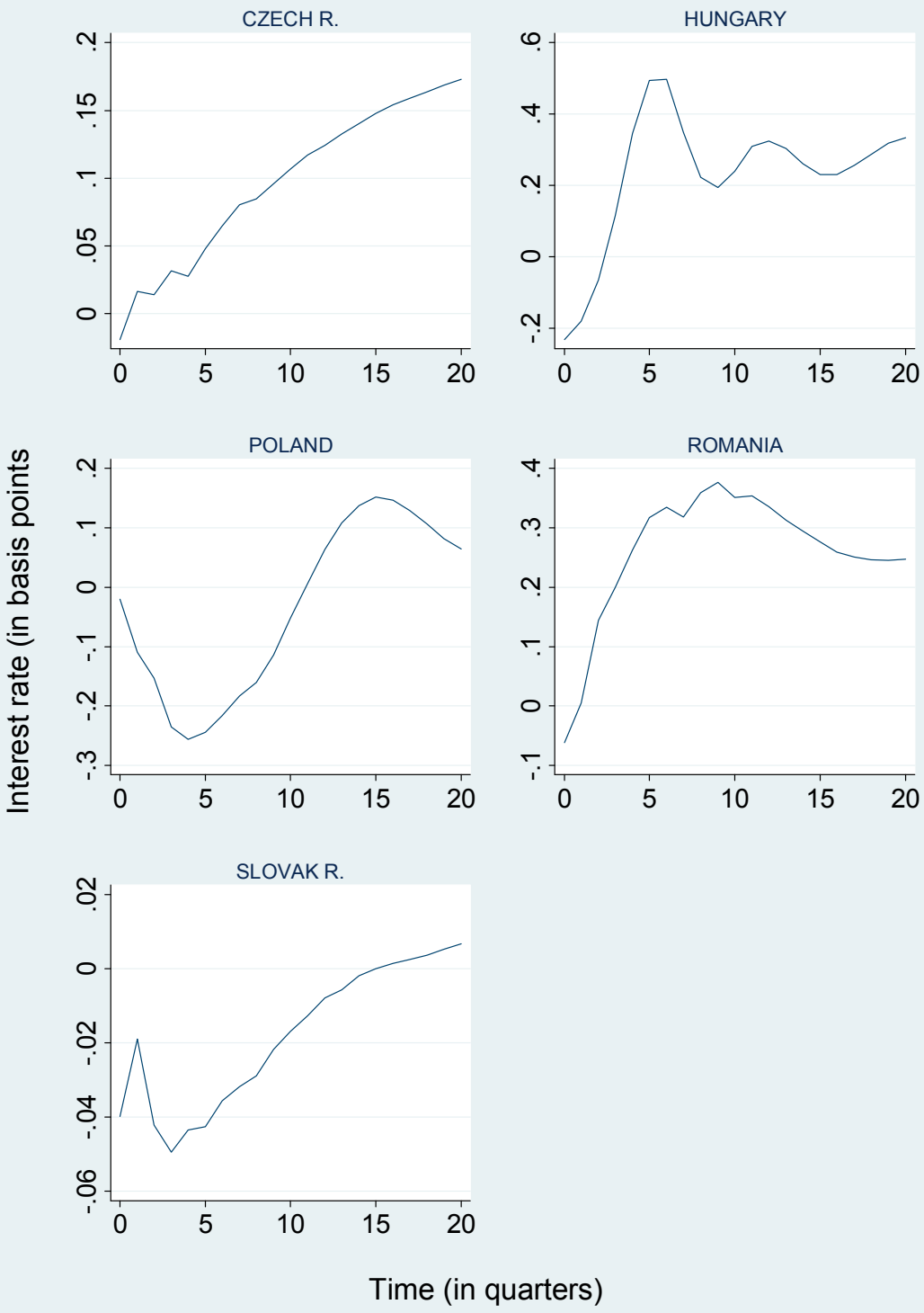
Notes: GIRF calculated based on the estimated GVAR model, see paper.
One s.d. shock to Euro group credit growth is equivalent to about 0.3 percentage points in annualized quarter on quarter growth rate for the Euro group.
Source: Author's calculations.

Figure A3. Generalized Impulse Response Function of Inflation to a One p.p. Shock to Inflation in the EURO-West Group



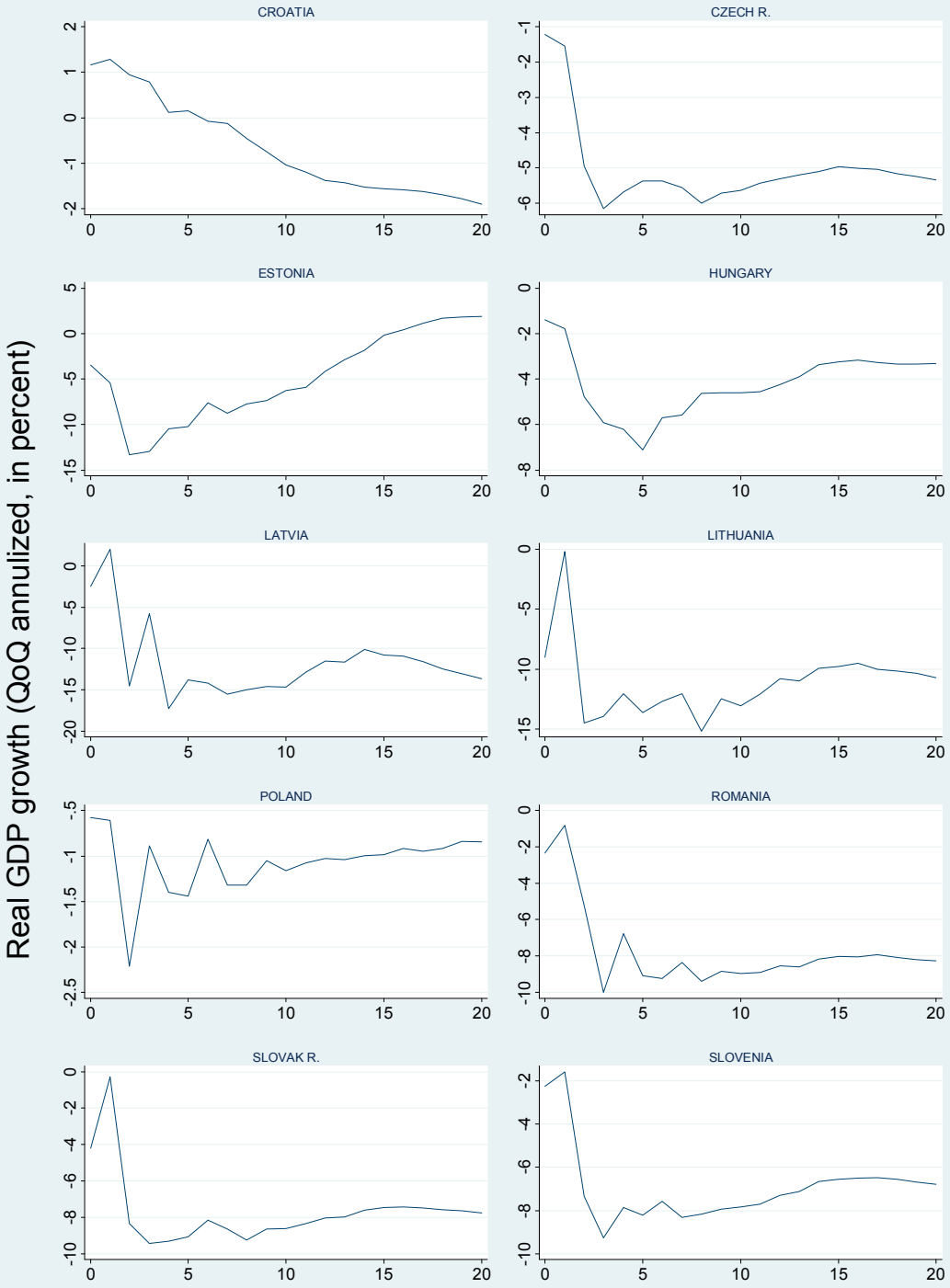
Notes: GIRF calculated based on the estimated GVAR model, see paper.
One s.d. shock to EURO group inflation is equivalent to a higher inflation rate of 0.4 percentage points in the EURO group.
Source: Author's calculations.

Figure A4. Generalized Impulse Response Function of Interest Rate to a One Percent Shock to Interest Rate in the ADV Group (the UK, Switzerland, Iceland, and Israel)



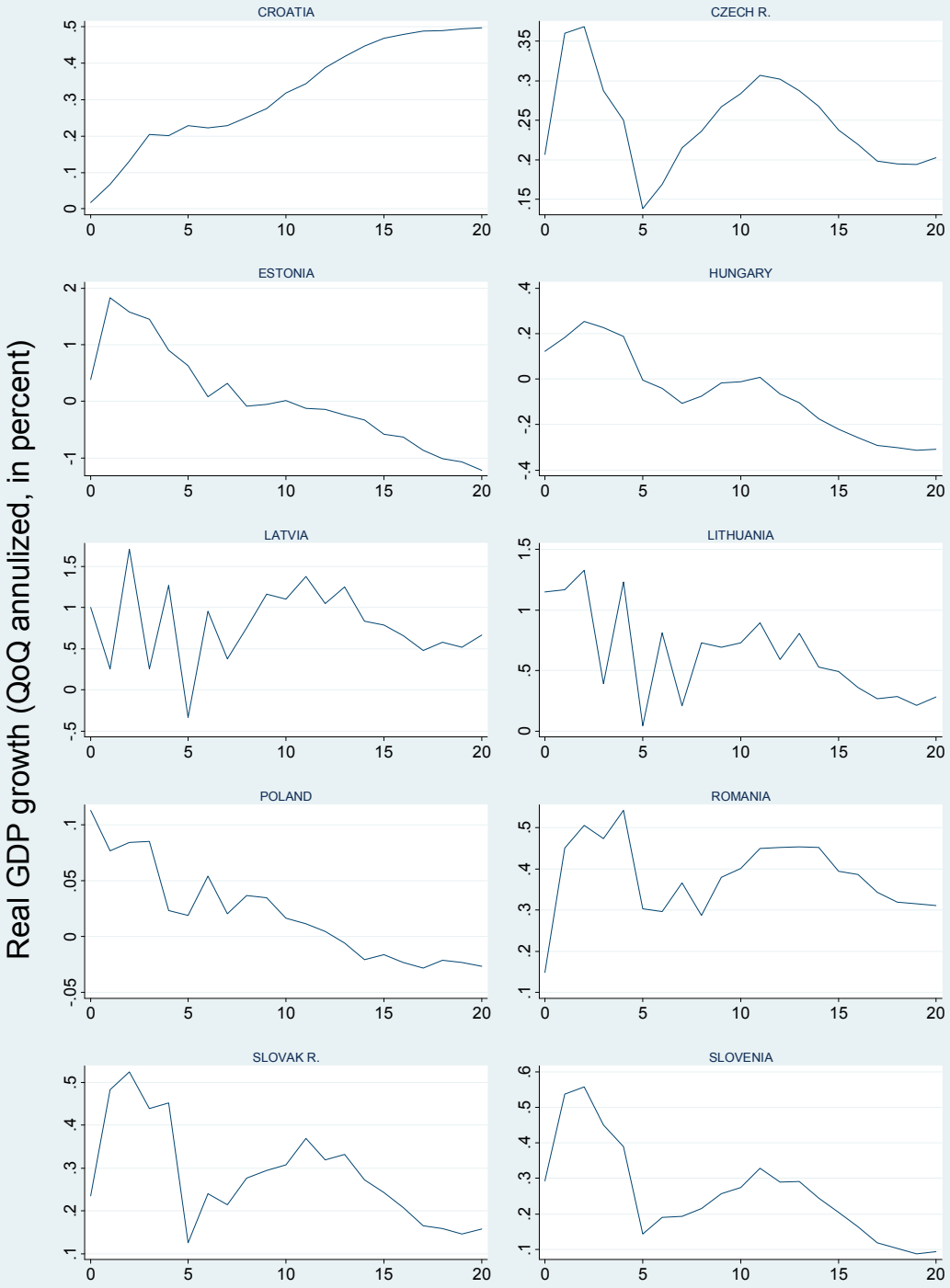
Notes: GIRF calculated based on the estimated GVAR model, see paper.
A one s.d. shock to interest rate in the ADV group is equivalent to 0.0 basis points (bps) rise in interest rate.
Source: Author's calculations.

Figure A5. Generalized Impulse Response Function of Real GDP Growth to a One Percent Shock to Interest Rate in the ADV Group (the UK, Switzerland, Iceland, and Israel)



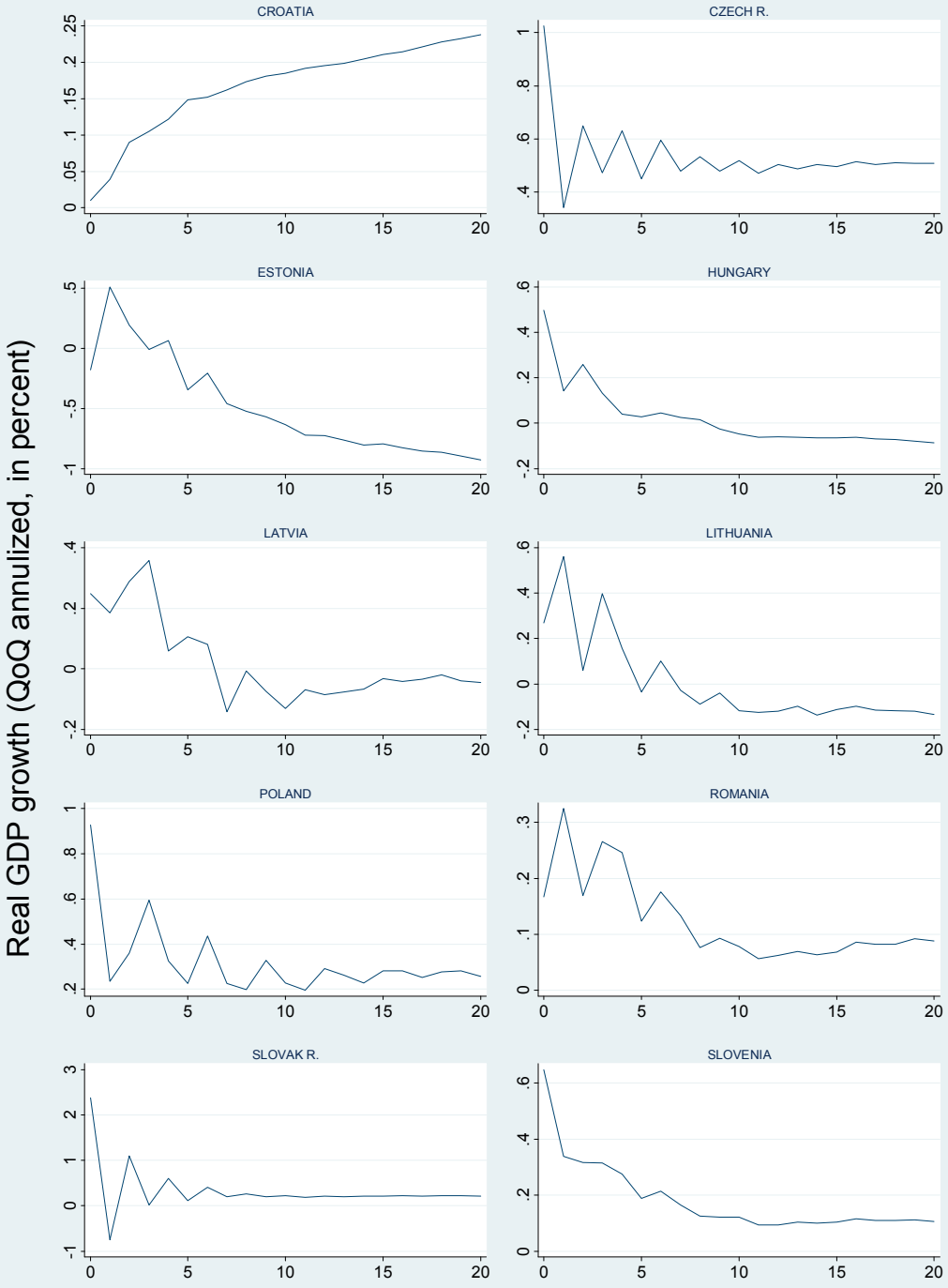
Notes: GIRF calculated based on the estimated GVAR model, see paper.
A one s.d. shock to interest rate in the ADV group is equivalent to 0.0 basis points (bps) rise in interest rate.
Source: Author's calculations.

Figure A6. Generalized Impulse Response Function of Real GDP Growth to a One p.p. Shock to Real GDP Growth in the Nordic countries



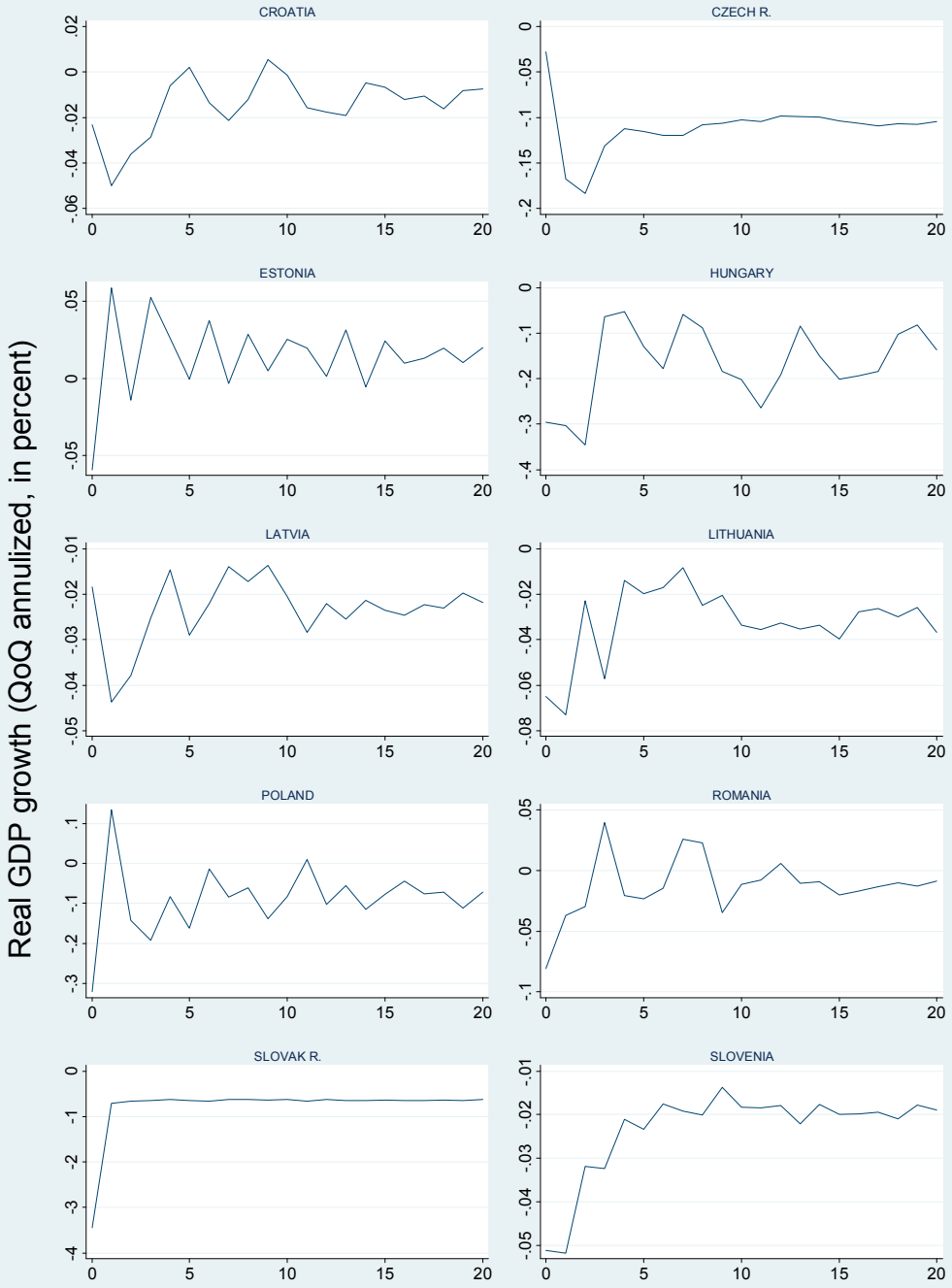
Notes: GIRF calculated based on the estimated GVAR model, see paper.
One s.d. shock to Nordic group real GDP growth is equivalent to 0.1 percentage points in quarater on quarter annualized growth rate.
Source: Author's calculations.

Figure A7. Generalized Impulse Response Function of Real GDP Growth to a One p.p. Shock to Real GDP Growth in the Central European countries (Czech R., Hungary, Poland, Slovakia, and Slovenia)



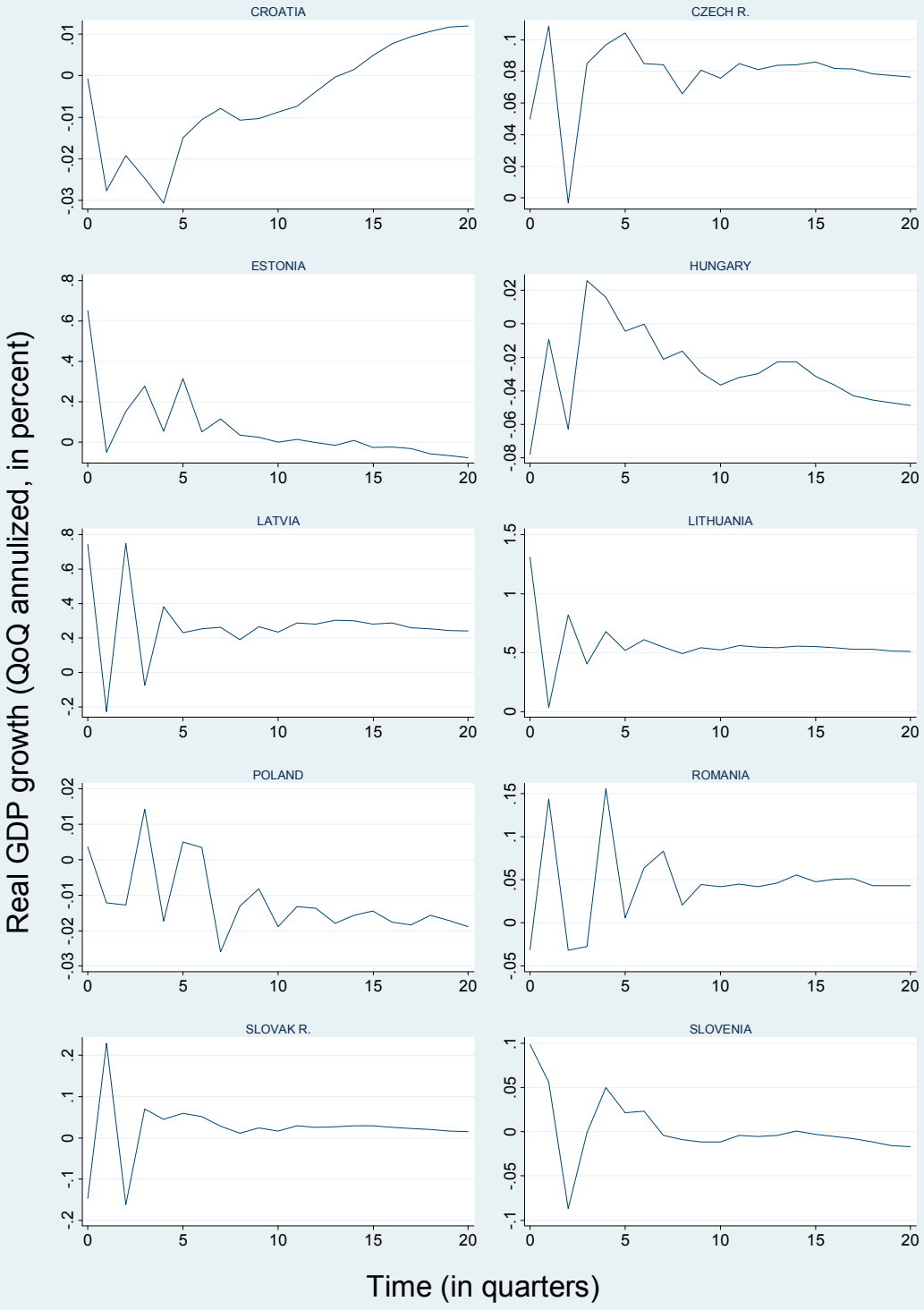
Notes: GIRF calculated based on the estimated GVAR model, see paper.
One s.d. shock to CE group real GDP growth is equivalent to 0.2 percentage points in quarater on quarter annualized growth rate.
Source: Author's calculations.

Figure A8. Generalized Impulse Response Function of Real GDP Growth to a Negative One p.p Shock to Real Credit Growth in the Central European countries (Czech R., Hungary, Poland, Slovakia, and Slovenia)



Notes: GIRF calculated based on the estimated GVAR model, see paper.
One s.d. shock to CE group real CREDIT growth is equivalent to -0.5 percentage points in quarater on quarter annualized growth rate.
Source: Author's calculations.

Figure A9. Generalized Impulse Response Function of Real GDP Growth to a One p.p. Shock to Real GDP Growth in the Baltic countries (Estonia, Latvia, and Lithuania)



Notes: GIRF calculated based on the estimated GVAR model, see paper.
One s.d. shock to BALTICS group real GDP growth is equivalent to 0.7 percentage points in quarater on quarter annualized growth rate.
Source: Author's calculations.