

International linkages and external shocks: A Global VAR perspective for Belarus.

Evidence from a small EAEU model

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1. Introduction

- In the global economy, individual economies are interrelated through many different channels in a complex way. But even after allowing for these effects, there may be residual interdependencies due to unobserved interactions and spillover effects not taken properly into account by using the common channels of interactions
- Taking into consideration these channels of interactions is a major challenge to modelling national economies as well as for conducting policy simulations in a global context
- The Global Vector Autoregressive (GVAR) approach is quite modern and a useful tool for such kind of modelling

Current empirical applications of GVAR models

- Global macroeconomic applications
 - Global inflation
 - Global imbalances and exchange rate misalignments
 - Role of the United States as a dominant economy
 - Business cycle synchronization and rising role of China in the world economy
 - Impact of Eurozone-membership
 - Commodity price models
 - Housing
 - Effects of fiscal and monetary policy
 - Labour market
 - Role of credit
 - Macroeconomic effects of weather shocks
- Forecasting applications
- Global finance applications
- Sectoral and regional applications

Some relevant literature

- The Global Vector Autoregression (GVAR) model originates from:

Pesaran, M.H., Schuermann, T., Weiner, S.M. (2004) Modelling regional interdependencies using a global error-correcting macroeconomic model, *Journal of Business and Economics Statistics*, 22, 129–162

- Comprehensive survey of GVAR modeling is presented in:

Chudik, A., Pesaran, M.H. (2016) Theory and practice of GVAR modelling, *Journal of Economic Surveys*, 30, 165–197

- Review of existing applications of GVAR for policy analysis:

di Mauro, F., Pesaran, M.H. (2013) *The GVAR Handbook: Structure and Applications of a Macro Model of the Global Economy for Policy Analysis*. Oxford University Press, Oxford.

2. Brief methodology

In general, the GVAR methodology involves two stages:

- Stage 1. Using the domestic macroeconomic, country-specific foreign and global variables, a Vector Autoregressive (VAR)/Vector Error Correction (VEC) model **for each country** involved in the analysis is **separately estimated**. It is assumed that external variables appearing in country-specific models are weakly exogenous and country-specific models are structurally stable
- Stage 2. Using the estimated country-specific models, a **global VAR is constructed**, which is used to **generate the impulse response functions, variance decompositions or forecasts**

Brief methodology

The main steps in the GVAR modeling:

- Data set creation
 - Defining the countries, regions and variables of interest
 - Importing variables and aggregation weights data
 - Importing cross-country trade flow data
 - Providing the weight matrix

- Defining the preliminary settings and selecting the weights for construction of the foreign variables
 - Selecting the weights for constructing the foreign variables
 - Defining the preliminary settings of the model

Brief methodology (cont'd)

- Specification of the individual VARX* models
 - Domestic variables
 - Foreign-specific variables
 - Global variables
 - Lag order selection
 - Saving the specification of the individual models
 - Checking the lag orders
- Determining the rank orders (cointegration)
- Imposing overidentifying restrictions on the cointegrating vectors (if necessary)
- Weak exogeneity test
- Defining the dominant unit settings and specification and estimation of the dominant unit model for global variables

Brief methodology (cont'd)

- Solving the GVAR model
- Structural stability tests
- Dynamic analysis
 - Defining forecast horizon
 - Bootstrapping for confidence intervals
 - Regional aggregation
 - Shock selection
 - Structural generalized impulse response functions (GIRF) and generalized forecast error variance decomposition (GFEVD), or orthogonalized IRFs and FEVD

3. GVARing Belarusian economy: Objectives of the analysis

The main aim of the study is to put the Belarusian economy into a global context and analyze the effect of various external shocks on the major macroeconomic variables (real GDP, inflation, exchange rate) and transmission channels of the shocks using a GVAR model

There are two possible options:

- Using a small Eurasian Economic Union (EAEU) data set (5 countries) and external variables of the EU, US and China and the oil price as well: The results from this approach will be presented in this Policy Briefing
- Using a large data set (35 countries): The results from this exercise will be presented in Policy Study 02/2016

GVARing Belarusian economy: Objectives of the analysis

To be more specific, we are conducting the following tasks:

- To analyze the impact of external shocks coming from Russia and the major world economies (EU, China) on the Belarusian economy
- To analyze interrelations within EAEU countries (if any)
- To compare small and large data sets results
- To compare the results of GVAR modeling with the comparable single country Structural VAR models for the Belarusian economy

4. GVAR specification: Variables and data sources (quarterly data, 1997q1–2016q2)

Endogenous	Weakly exogenous	Global
real GDP (gdp)	real GDP of ROW (gdp_row)	real GDP of Eurozone (eur)
consumer price index (cpi)	consumer price index of ROW (cpi_row)	real GDP of China (chn)
nominal exchange rate (ner)*	nominal exchange rate of ROW (ner_row)	short-term interest rate in the US (sr_us)
short-term interest rate (sr)**		oil price: WTI (oil)
broad money (m3)***		

* Bilateral nominal exchange rate vs. USD

** Market interest rate or deposit interest rate with maturity of 1 – 3 months

*** Broad money, or M3, or quasi-money plus money

Data sources: IMF (IFS), Eurostat, ECB, National statistical committees

Time series of money indicators, GDP, CPI, exchange rates were normalized to 2010 average, and transformed into logarithms. Data with seasonal pattern are seasonally adjusted using TRAMO/SEATS

GVAR specification: Weak exogeneity test

F-test on weak exogeneity

Country	gdp_row	cpi_row	ner_row	oil	eur	chn	sr_us
Armenia	2.186	0.599	0.073	2.231	2.152	--	3.487
Belarus	2.761	--	2.674	0.907	0.525	0.007	1.368
Kazakhstan	0.030	1.027	0.661	2.248	5.248	1.644	0.516
Kyrgyzstan	0.120	--	0.466	0.556	3.253	0.041	0.003
Russia	2.173	--	--	0.187	--	--	1.280

Critical value of *F*-test (1.57) at 5% significance level is equal to 4.0.

Missing cells represent variables rejected by the weak exogeneity test

GVAR specification: Contemporaneous effects of foreign variables on domestic counterparts

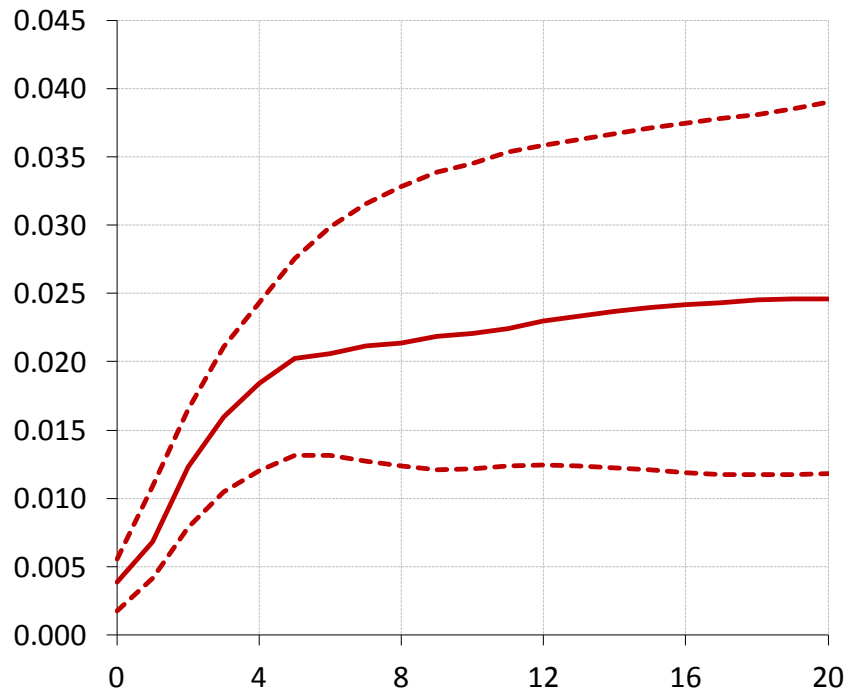
		gdp	cpi	ner
Armenia	coefficient	0.919	-0.134	0.205
	t-ratio_White	5.832	-1.136	3.453
Belarus	coefficient	0.296		0.905
	t-ratio_White	3.899		6.293
Kazakhstan	coefficient	0.923	-0.091	0.210
	t-ratio_White	4.082	-1.222	1.843
Kyrgyzstan	coefficient	0.110		0.620
	t-ratio_White	0.709		5.881
Russia	coefficient	0.747		
	t-ratio_White	3.488		

GVAR specification

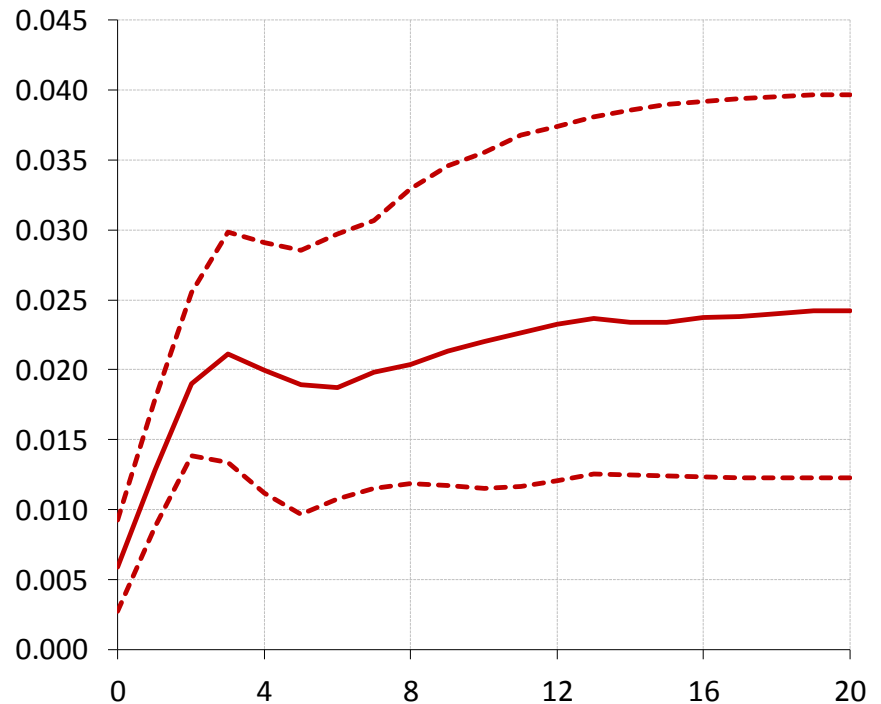
	Number of lags			VAR specification	Cointegration rank
	domestic variables	foreign variables	global		
Armenia	2	2	1	trend restricted, constant unrestricted	1
Belarus	2	2	1	trend restricted, constant unrestricted	1
Kazakhstan	2	2	1	trend restricted, constant unrestricted	1
Kyrgyzstan	2	2	1	trend restricted, constant unrestricted	1
Russia	2	2	1	trend restricted, constant unrestricted	1

5. Empirical results: Oil price shock on GDP (response to generalized one s.d. innovations ± 2 s.e.)

Belarus

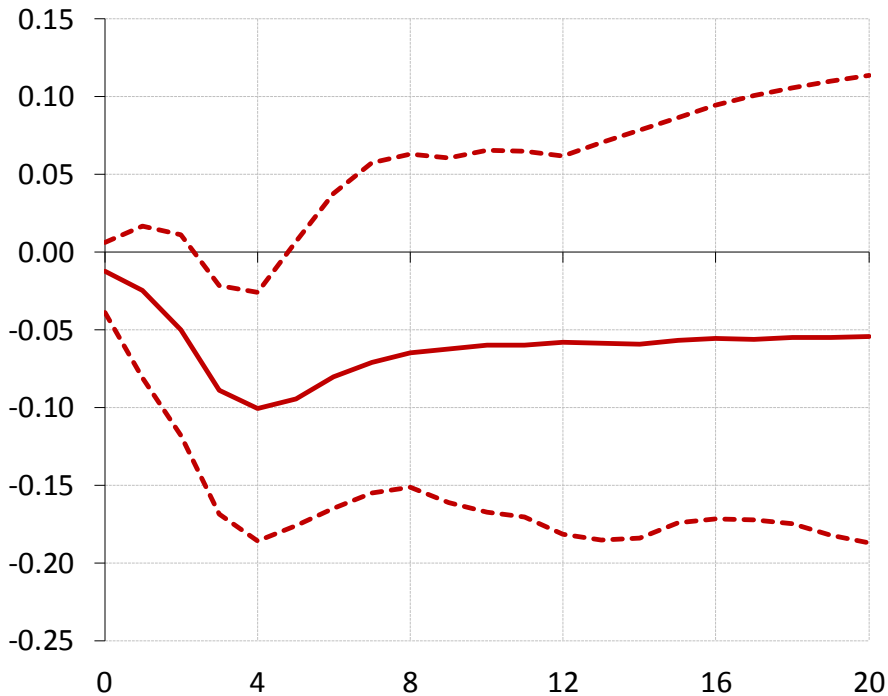


Russia

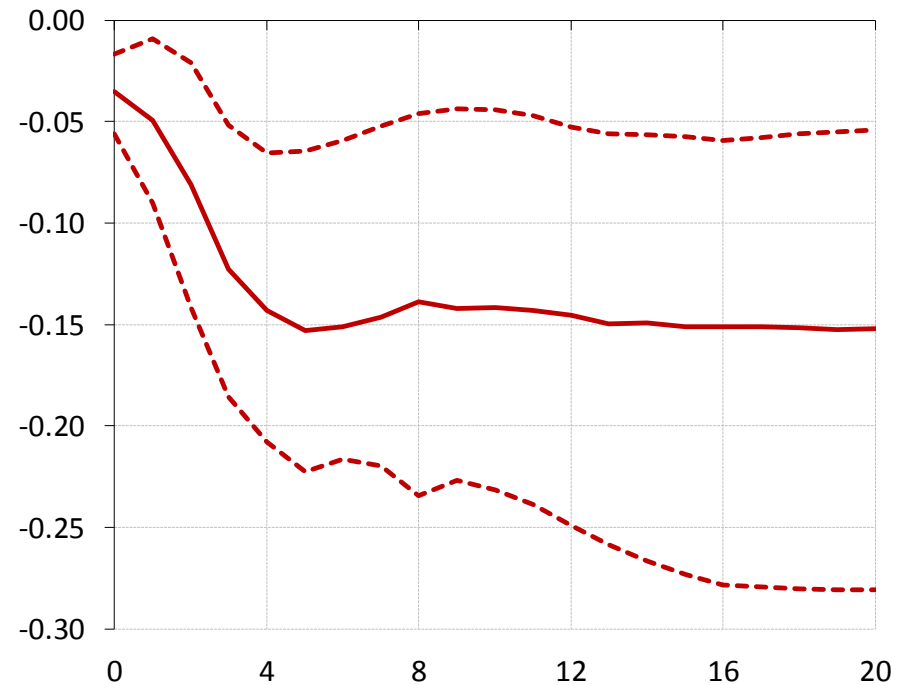


Empirical results: Oil price shock on exchange rate (response to generalized one s.d. innovations ± 2 s.e.)

Belarus

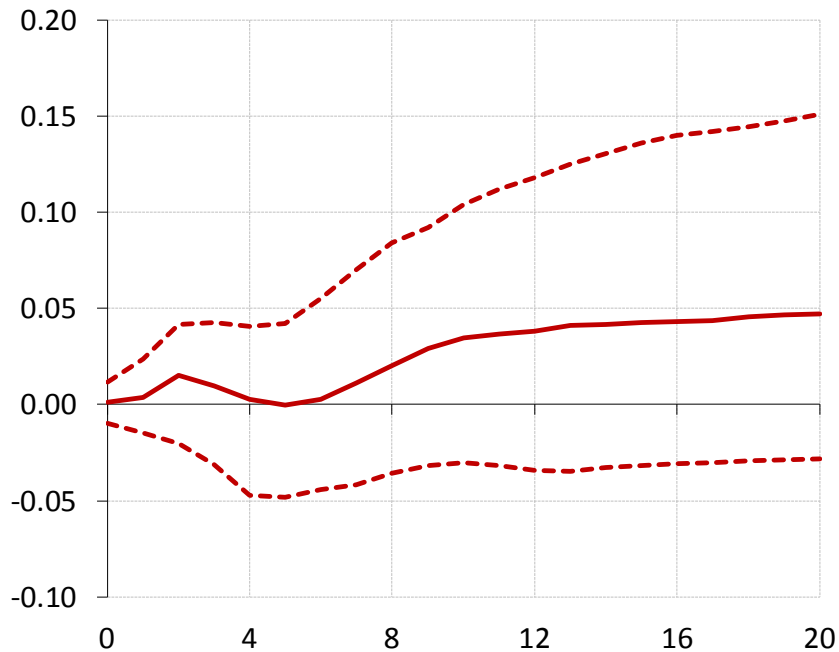


Russia

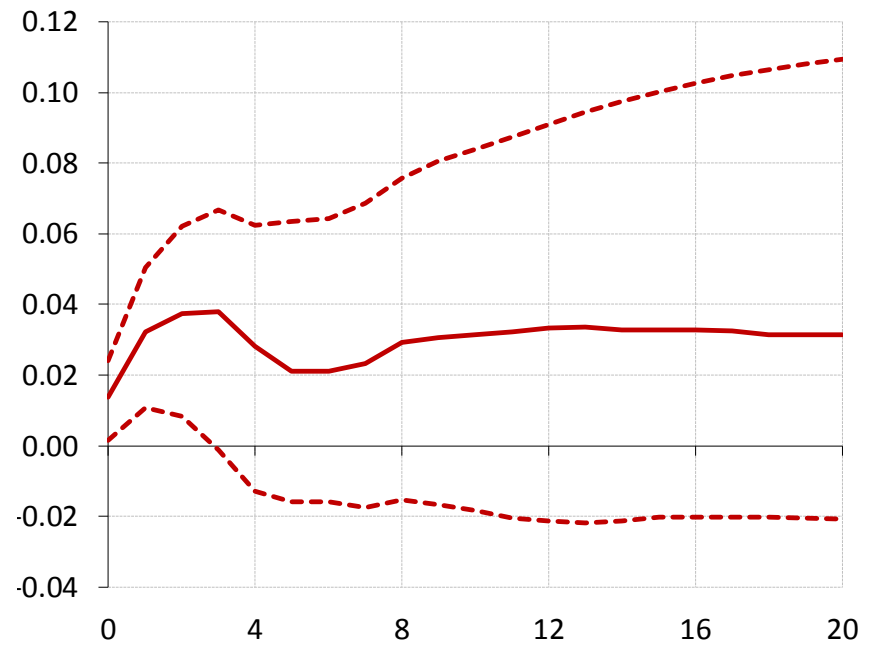


Empirical results: Oil price shock on broad money (response to generalized one s.d. innovations ± 2 s.e.)

Belarus

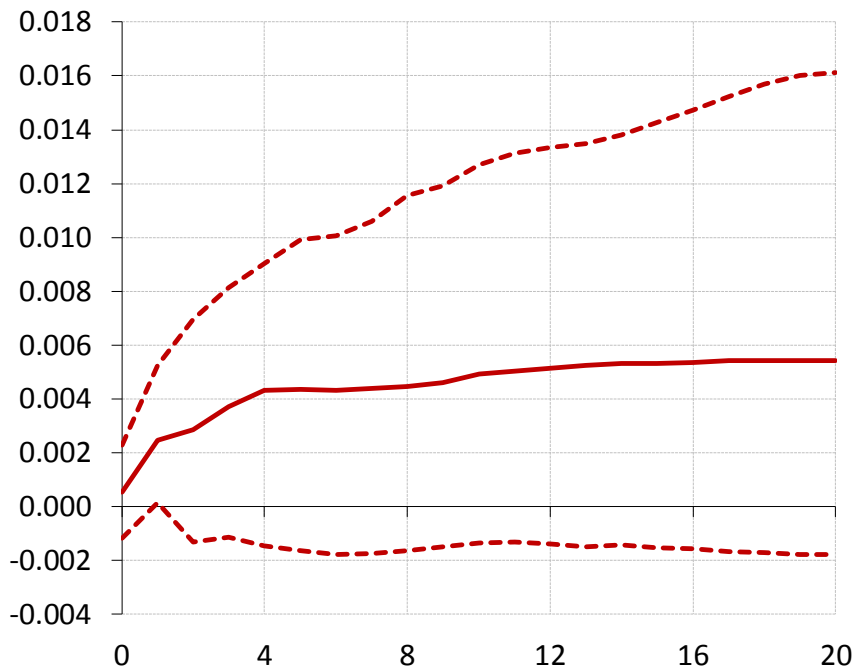


Russia

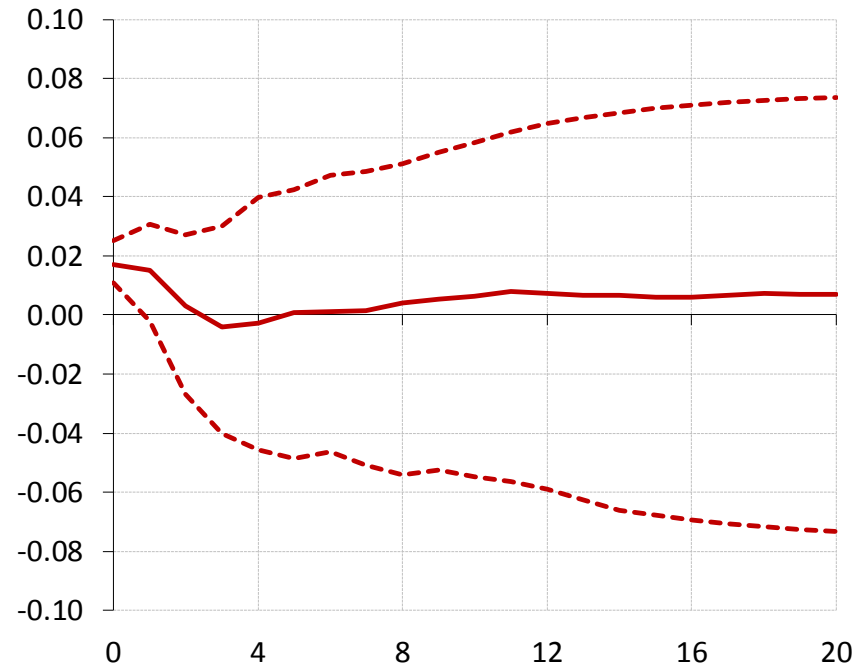


Empirical results: Shock of Russian GDP on Belarus (response to generalized one s.d. innovations ± 2 s.e.)

Belarus: GDP

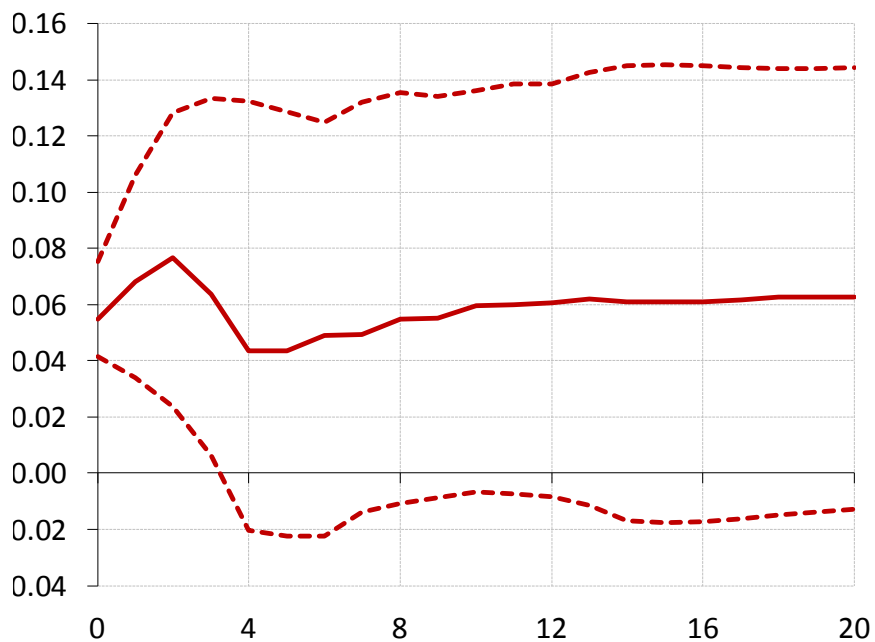


Belarus: CPI

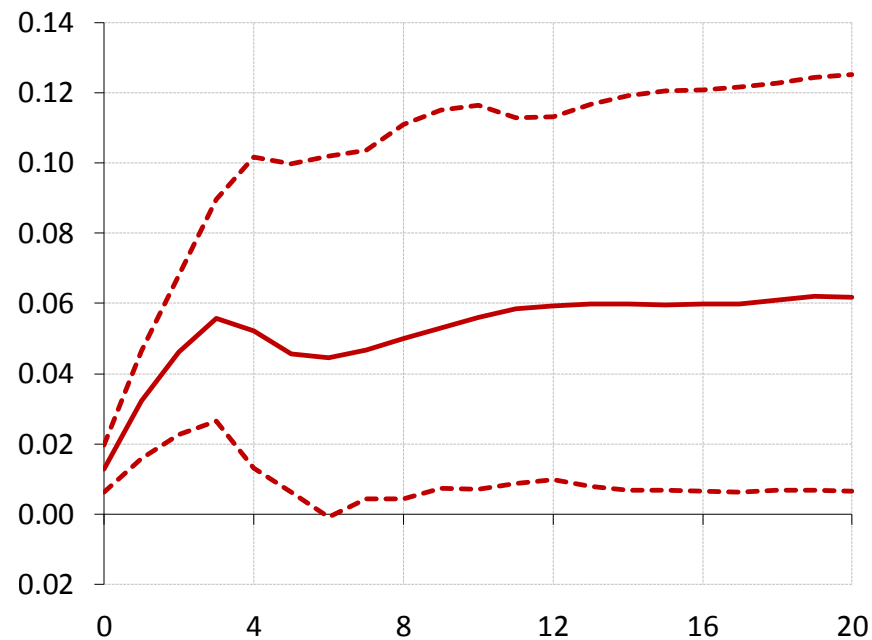


Empirical Results: Shock of Russian exchange rate on Belarus (response to generalized one s.d. innovations ± 2 s.e.)

Belarus: Exchange rate



Belarus: CPI



6. Summary and Conclusions

- An oil price increase leads in Belarus to GDP growth and the appreciation of the national currency. In case of Russia, it is also associated with a trade surplus and increasing money supply as a result of reserves accumulation, which creates inflationary pressure
- Russian GDP growth leads to increasing demand for Belarusian goods, which in the short-run results in inflation. After a quarter, production adjusts to the new situation, implying a GDP increase and price level stabilization
- Depreciation of the Russian ruble leads to depreciation of the Belarusian ruble and consecutive price increase
- Reaction of other EAEU countries on shocks in Russia is characterized by similar profiles, although with weaker reaction. Shocks in EAEU countries other than Russia do not affect regional development, with the exception of Kazakhstan having a measurable effect on Kyrgyzstan.

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