Asymmetric impact of external environment on economic growth of Belarus

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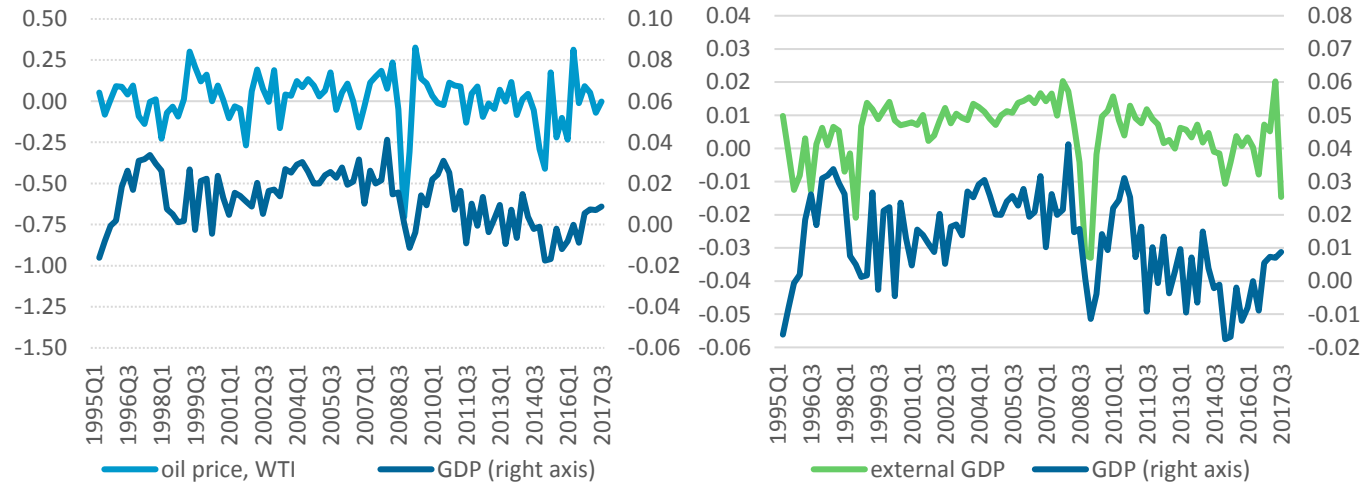
Oil price is one of key external factors that determine forecast of macroeconomic indicators of Belarus. The Ministry of Economy develops its forecast of socio-economic development of Belarus based on assumption of annual average oil price in upcoming year[1]. The Ministry of Finance takes into account pessimistic scenario of oil price development while elaborating annual budget[2]. Forecasts of macroeconomic trends done by independent research institutions also consider oil price as a key external determinant of Belarus economic growth (IPM Research Centre, 2018). Another important external factor for Belarus are growth rates of GDP of its main trade partners, namely Russia and the European Union.

Interrelation between oil price dynamics and economic growth in Belarus can be easily illustrated. Figure 1a presents seasonally adjusted quarterly growth rates of real GDP and oil price. It is obvious that significant changes in oil price are reflected in corresponding changes of Belarusian economic growth rates. Moreover, correlation between these variables is rather strong (26.8%). However, correlation of Belarusian GDP growth rates and average GDP growth rates of its trade partners, weighted by trade turnover (here after external GDP), is even stronger. Coefficient is equal to 42.7% for the period from the 2nd quarter of 1995 to 3rd quarter of 2017.

Despite correlation of the growth rates, stressing short-run dependence of the Belarusian economy on external factors, Engle-Granger tests reject hypothesis of long-run interrelation (cointegration) between oil price and external GDP on the one hand, and economic growth in Belarus on the other hand. It may imply that external factors have only short-term influence over Belarusian economy. Another explanation is that statistical tests fail to capture long-term relations between variables due to their non-linearity. For instance, response of dependent variable on a negative shock in explanatory variable may differ by magnitude from the response to a positive shock. Classical example of this kind of non-linearity is a reaction of employment on economic crisis that contradicts to Okun's law. Unemployment rate tends to be much higher after economic recovery than it was before the crisis, as employment falls much stronger due to economic downturn than it increases during the period of economic growth.

Figure 1. Seasonally adjusted quarterly growth rates of Belarusian real GDP, oil price and external GDP, logarithmic scale



Engle-Granger test: tau-statistics −3.267 [0.182]
(a) oil price, oil

Engle-Granger test: tau-statistics −3.284 [0.177]
(b) external GDP, xgdp

Note. Growth rates of external GDP are calculated as average weighted growth rates of main trade partners of Belarus (weighted by turnover). Total number of trade partners taken into account is 34, for details see Pelipas, I., Shymanovich, G. (2016).
Source: own estimates.

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[1] See resolution of the Ministry of Economy from January 30, 2018 #2 "On estimated balance indicators of the forecast of the social-economic development of Belarus in 2018", http://www.economy.gov.by/uploads/files/macro-prognoz/Post-2-30-01-2018.pdf.

[2] See note to the project of central government budget and estimated indicators of local government budgets for 2018, http://www.minfin.gov.by/upload/bp/project/project_151217_ps.pdf.

Such asymmetric behavior of variables implies that there are two different regimes of growth and contraction within which interdependence of variables should be examined. In this case, variables may be not cointegrated if entire time series is considered. However, separate negative or/and positive components of time series may be cointegrated. This situation is known as hidden cointegration (Granger, Yoon, 2002). Statistically its presence may be revealed by means of Nonlinear Autoregressive Distributed Lag (NARDL) models, developed in Shin, Yu, Greenwood-Nimmo (2014).

Asymmentry is often taken into account while studying impact of oil price and external environment on economic development of a country. A broad range of literature discusses non-linear interrelation between oil price and economic growth, in particular in oil-exporting countries. It is considered that consequences of negative oil price shock are much harsher for them than advantages related to positive price shock (see, for example, Moshiri, Banihashem, 2012). However, empirical studies do not always find support to this thesis. Some authors come to the opposite conclusions that impact of positive oil price shock has higher magnitude than impact of negative one (Elafif et al., 2017). Moreover, there are also evidences that reject hypothesis of non-linearity in interrelation of oil price and economic growth in general (Herrera, Lagalo, Wada, 2015).

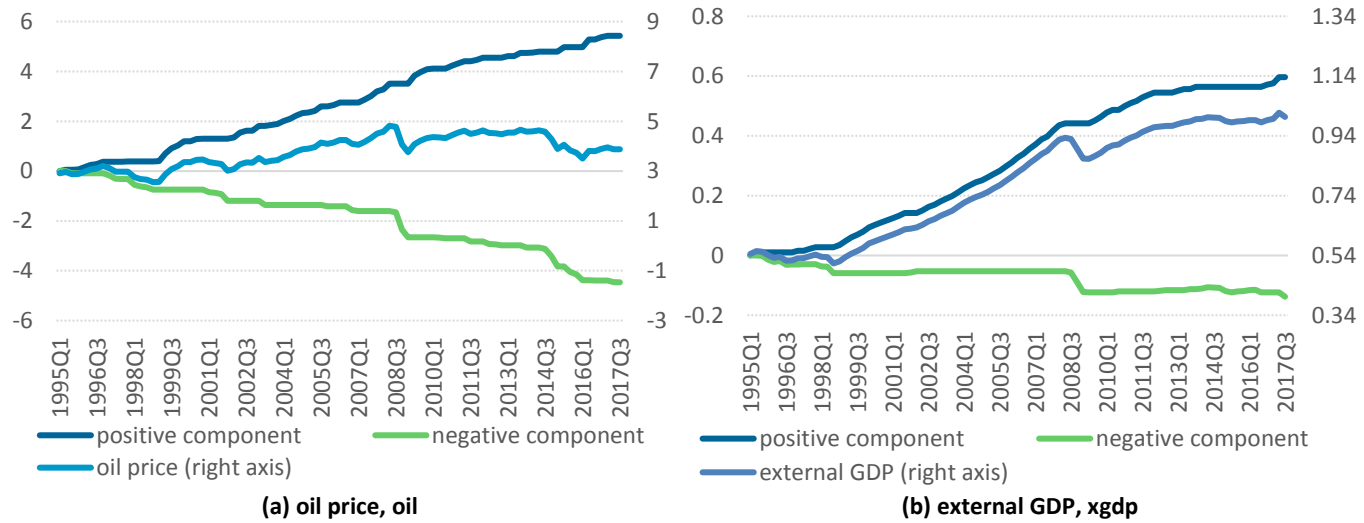
The key element of NARDL analysis is construction of time series containing only positive and only negative changes of variables. In case of oil price, it implies construction of two time series: one represents cumulative positive change of the price, another – cumulative negative change (Figure 2a). Division of Belarusian external GDP on negative and positive components is meaningless, as number of observations with negative GDP change is rather small. For this case, authors of NARDL methodology propose division of time series based on a threshold of average growth rate (Shin, Yu, Greenwood-Nimmo, 2014). Hence, positive component reflects cumulative growth of external GDP with the rates above average one (for the period of 1995–2017), and negative – cumulative growth with the rates below average. Summing up of these two time series gives an actual dynamics of Belarusian external GDP (Figure 2b).

Time series generated in accordance with described procedures are then introduced into the ARDL model as separate independent variables. Specification of the ARDL model aimed at assessment of oil price impact on Belarusian economy included unrestricted constant, three lags for explanatory variable (real GDP) and three lags for independent variables – positive and negative components of oil price dynamics and refinancing interest rate. Impact of external GDP on Belarusian economy was studied by similar equation that included four lags and restricted trend. Number of lags was determined by Akaike information criterion. Final specifications of estimated models (after exclusion of non-significant first differences of variables) are presented in Table 1.

Results of the modelling support hypothesis of long-run interrelation between oil price and external GDP and economic growth of Belarus. According to bounds F-tests (developed in Pesaran, Shin, Smith, 2001), there is cointegration between variables in the models at 1% significance level. Long-run coefficients at the control variable of refinancing interest rate (nirr) are statistically significant in both models. They have expected negative sign, stressing that increase of interest rates lead to economic growth slowdown. Residuals of the equations are normally distributed, without heteroscedasticity and serial correlation, which implies good quality of the models.

Obtained results reveal non-linear nature of oil price and external GDP impact on economic growth of Belarus. In case of oil price, there are both short- and long-run

Figure 2. Positive and negative components of oil price and external GDP time series, logarithmic scale



(a) oil price, oil **(b) external GDP, xgdp**

Note. Positive and negative components of external GDP dynamics are derived through comparison of actual growth rates with the threshold of average growth rate for the period of 1995–2017.
Source: own estimates.

asymmetry. Cumulative dynamic multipliers of positive (oil^+)and negative (oil^-) components of oil price intuitively illustrate this asymmetry (see Figure 3a). Such multipliers demonstrate how response of dependent variable to 1% shock of independent variable accumulates over time (Shin, Yu, Greenwood-Nimmo, 2014). When time horizon approaches to infinity the value of cumulative dynamic multiplier is equal to the long-run coefficient at the corresponding independent variable. Difference between dynamic multipliers of positive and negative components of initial time series is a display of asymmetry between them. In case of oil price, difference between multipliers is statistically significant within the first quarters after a shock and then later in the long-run (4 years after). Moreover, there is asymmetry between short- and long-run. Negative shock has a stronger impact over Belarusian economy in the short-run, while positive shock of oil price increase is more powerful in the long-run. Hence, in the short-run Belarusian economy is more sensitive to oil price reduction rather than its increase. However, long-run negative impact of oil price reduction accumulates with relatively slow pace, as economy gradually adapts to new price environment. In a similar way, adaptation of economy to higher prices ensures more rapid accumulation of related positive effect.

External GDP growth with the rates above and below average influences economy of Belarus in different ways as well. In this case, asymmetry is observed in the long-run and it is related to the fact that economic growth of Belarusian trade counterparts with the rate above average contributes to economic growth in Belarus, while slow growth in these countries does not have significant impact over Belarusian economy. It implies that Belarus benefits from acceleration of economic growth in its trade partners when it is a display of boom period, rather than a recovery from crisis.

These results imply that current external environment should not have significant influence on economic growth in Belarus. Oil price forecasts are largely based on assumption of its stability or very gradual price increase (Tochitskaya, 2018), which should not provide feasible benefits for Belarusian economy. Economic growth of Belarusian trade partners, Russia in particular, are not expected to accelerate as well (IPM Research Center, 2018). It implies no significant improve of external demand for Belarus and, consequently, key role of domestic demand in its economic growth prospects.

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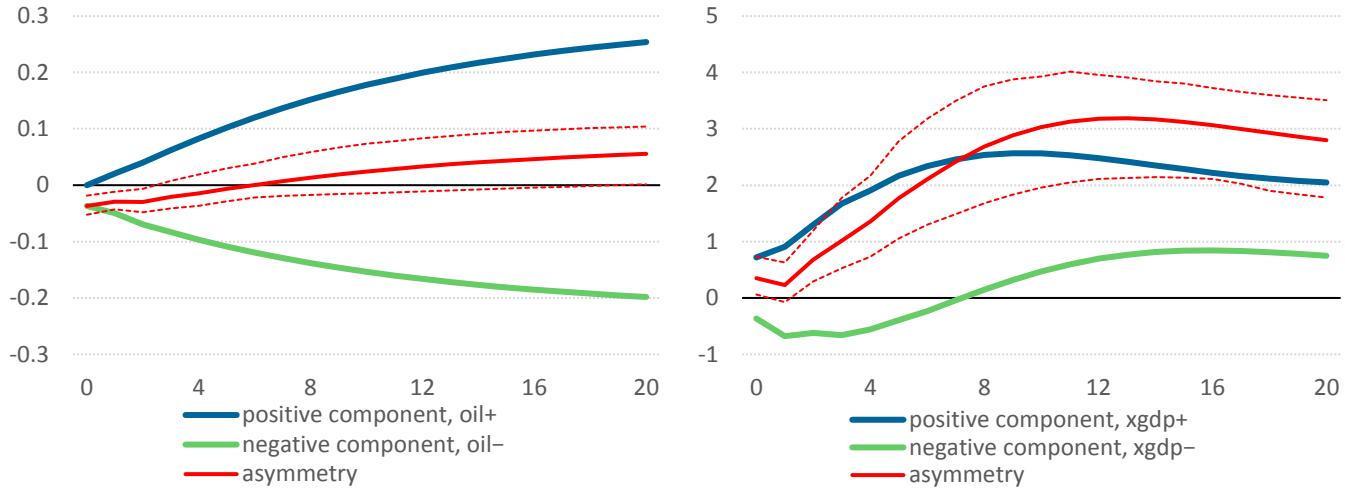
Figure 3. Dynamic multipliers for positive and negative components of oil and external GDP time series, scale of asymmetry between them with confidence intervals



(a) oil price, oil **(b) external GDP, xgdp**

Note. Dynamic multipliers for positive components are estimated for a positive 1% shock, while dynamic multipliers for negative components assume 1% negative shock. Asymmetry line represents a sum of positive shock for positive component and negative shock for a negative component. Confidence intervals for asymmetry (90%) are illustrated with dotted lines. They are estimated based on bootstrap procedure with 1000 replications, realized in Stata package for NARDL models, written by Marco Sunder.
Source: own estimates.

Table 1. Results of estimation of NARDL models describing impact of oil price and external GDP on Belarusian economic growth

Oil price				External GDP			
	coefficient	*t*-statistics	*p*-value		coefficient	*t*-statistics	*p*-value
gdp(−1)	−0.069	−3.900	0.000	gdp(−1)	−0.135	−4.840	0.000
$oil^{+}(-1)$	0.021	3.710	0.000	$xgdp^{+}(-1)$	0.285	4.700	0.000
$oil^{-}(-1)$	0.016	4.150	0.000	$xgdp^{-}(-1)$	−0.083	−1.330	0.188
nirr(−1)	−0.023	−4.460	0.000	nirr(−1)	−0.015	−3.080	0.003
d(gdp(−2))	0.210	2.170	0.033	d(gdp(−2))	0.319	3.700	0.000
$d(oil^{-})$	0.037	4.310	0.000	d(gdp(−3))	0.285	3.060	0.003
d(nirr(−2))	0.012	2.750	0.007	$d(xgdp^{+})$	0.719	4.190	0.000
constant	0.551	3.640	0.000	$d(xgdp^{-})$	0.367	2.340	0.022
				$d(xgdp^{-}(-1))$	0.443	2.800	0.006
				trend	−0.001	−3.150	0.002
				constant	1.165	4.680	0.000
Long-run coefficients	coefficient	*F*-statistics	*p*-value	Long-run coefficients	coefficient	*F*-statistics	*p*-value
oil^{+}	0.301	90.92	0.000	$xgdp^{+}$	2.104	124.1	0.000
oil^{-}	0.226	19.47	0.000	$xgdp^{-}$	−0.610	1.957	0.166
nirr	−0.331	13.02	0.001	nirr	−0.112	6.449	0.013
Tests		*F*(*t*)-statistics	*p*-value	Tests		*F*(*t*)-statistics	*p*-value
Cointegration	*t*-test Banerjee, Dolado, Mestre	−3.895		Cointegration	*t*-test Banerjee, Dolado, Mestre	−4.843	
	Bounds *F*-test	10.615			Bounds *F*-test	9.646	
Asymmetry	Short-run	6.077	0.016	Asymmetry	Short-run	0.099	0.753
	Long-run	18.56	0.000		Long-run	39.78	0.000

Note. Lag structure was chosen automatically in EViews. NARDL models were estimated in NARDL Stata package, written by Marco Sunder. Exclusion of insignificant lags of first differences of variables was performed automatically in OxMetrics. Tests prove good quality of the models: normal distribution of residuals, absence of heteroscedasticity and serial correlation of residuals, adequate choice of functional form.
Source: own estimates.