PRICE AND NON-PRICE COMPETITIVENESS FACTORS AND ECONOMIC DEVELOPMENT. A PVAR APPROACH

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Abstract

The present study aims at identifying the link between economic growth and a wide variety of external competitiveness indicators, related to both price and non-price factors. Using data for European Union, we estimate a series of panel Vector Autoregression (PVAR) models and find that non-price indicators have a higher contribution in explaining GDP developments compared to traditional price and cost based measures of competitiveness. On the other hand, the results underline the broadness of competitiveness concept, as economic growth alone is found not to determine significant effects on the competitive capacity of economies.

Keywords: PVAR, price competitiveness, global competitiveness, causality

Introduction and state of art

Competitiveness is a multidimensional concept with direct implications on economies' ability to compete on external markets and increase domestic living standards. However, as most macroeconomic phenomena, competiveness and economic development are interrelated, and thus the direction of causality might be difficult to track, the intensity of the relation being affected by multiple factors. As such, the most appropriate manner to analyse the nature of the relation between different competitiveness aspects and economic development of nations would be using VAR models, which treat the variables as endogenous and interdependent. This approach has been frequently used in analysing the link between external sector performance and indicators of economic growth.

Sanchez and Varoudaki (2013), using data from 1975 to 2011 for 13 Eurozone countries, analyse external balance dynamics and find that economic growth changes seem to be the key determinant of current account fluctuations, while the price competitiveness factors (such as REER and real interest rates shocks) have only a limited role in explaining external imbalances. At the same time, Dimitris (2012) show that different sub-components of the global competitiveness indicator developed by World Economic Forum do indeed influence economic growth, as shown by Granger causality test in a VAR framework for four Euro Area states. Kersan-Skabic (2012) shows for a group of 10 CEE countries that both FDI and external debt cause GDP growth.

Gabrisch and Staehr (2014), by means of Granger causality tests and VAR models, assess the link between current account balance and unit labor costs and conclude that changes in external balance affects relative ULC, although no significant effect in the opposite direction is identified.

Data and methodology

The annual data used in the empirical process of testing the link and direction of causality between economic growth and competitiveness refers to 28 European Union countries during 2006-2013.

We use two categories of variables related to economic development (GDP level and GDP per capita in current prices provided by International Monetary Fund and World Bank and expressed in USD) and indicators of external competitiveness:

- Goods exports market share, as an indicator of domestic producers' performance on international markets. The source providing the data for European countries shares in world exports is Eurostat.
- Gross value of goods exports, expressed in euros (as provided by Eurostat) but transformed in USD based on annual average values for EUR/USD exchange rate.
- Different indicators for real effective exchange rate (REER based either on CPI or ULC with 37 or 42 partners), provided by Eurostat.
- Global competitiveness indicator and sub-components (for example 1st pillar related to institutions, 2nd pillar to infrastructure etc.), computed by World Economic Forum. It is expressed in units from 1 to 7 and aims at offering a holistic measure of competitiveness capturing different non-price aspects.

The methodology for assessing the causal relationship between economic growth and competitiveness variables is a panel-data VAR (PVAR). The estimations were done in Stata.

PVAR models have similar structures with VAR models, the variables being considered endogenous and interdependent. Nevertheless, unlike in VAR models, a cross-sectional dimension is added, which generally leads to a series of problems the econometrician is confronted with when estimating PVARs: short time series (short history for each cross section, as it is recorded in the present case, for each country having 8 observations available) and heterogeneity among units. This makes traditional methods of VAR estimation on panel data to be inadequate (Holtz-Eakin et al., 1988).

According to Canova și Ciccarelli (2013), a PVAR model can be formalized as:

$$Y_t = A_0(t) + A(l)Y_{t-1} + u_t \quad (1)$$

where Y_t is a $(Gx1)$ vector of endogenous variables for each country i $(i = \overline{1:N})$, i.e. $Y_t = (y_{1t}{}', y_{2t}{}' \ldots y_{Nt}{}')'$, $t = \overline{1:T}$, $A(l)$ is a lag polynomial and u_t=$Y_t = (u_{1t}{}', u_{2t}{}' \ldots u_{Nt}{}')'$ is iid vector of errors.

As mentioned, in the present study, we estimate a series of models with 2 categories of variables: indicating the level of economic development (GDP level and GDP per capita) and external competitiveness (Global Competitiveness Indicator and sub-components, REER, goods exports market shares etc.).

Prior to the estimations, the data are Helmert transformed. Using a panel data-set with x_{it} as variable, where i denotes the group variables (in this case countries) and t indicates the time dimension ($t = \overline{1:T}$), x_{it}^H is called Helmert transformation of x_{it}:

$$x_{it}^H = \sqrt{\frac{T-t}{T-t+1}}(x_{it} - \frac{1}{T-t}\sum_{n=t+1}^{T} x_{in}) \quad (2)$$

Thus, Helmert observation at t moment is the original variable at t moment, out of which the average of observations from t+1 to T average of all future observations) is deducted. The abovementioned equation allocates a higher weight to observations closer to the beginning of the time series (Decker, 2014).

The time series are stationary as indicated by panel unit root tests (Table 1, Appendix) and thus the PVAR models can be estimated. Based on information criteria and in order to have a larger number of degrees of freedom, we estimate a one lag PVAR model.

The main results PVAR offers are impulse response functions and forecast error variance decomposition, the estimated coefficients being interpreted as the average dynamics of unit due to the shocks (Gravier-Rymaszewska, 2012). The impulse response functions highlight the trajectory of variables as an answer to a shock in the system variables, while the variance decomposition indicates the amount of information each variable contributes to the other variables.

The abovementioned tools are complemented by Granger causality test. This states that if a variable x affects another variable z, than x should lead to a better prediction of z. If Ω_t is the set of relevant information until period t and $z_t(h|\Omega_t)$ a predictor at step h (which minimises the mean squared error) of z_t process at moment t based on the information from Ω_t

and $\Sigma_z(h|\Omega_t)$ is the mean squared error of the prognosis, x_t causes in Granger sense z_t if:

$$\Sigma_z(h|\Omega_t) < \Sigma_z(h|\Omega_t \backslash \{x_s|s \leq t\}), \text{ for at least one h=1,2,....} \qquad (3)$$

where $\Omega_t \backslash \{x_s|s \leq t\}$ is the set that contains all relevant information in the universe except for the information about the past and current values of x_t process. In other words, one can say that x_t causes in Granger sense z_t if a forecast of z_t, based on a set of information which includes x_t history is better that a forecast that ignores x_t history. Thus, Granger causality can be used for answering to questions as "what variables can reveal, with anticipation, a change in other variables?"

Results

In the series of Charts in the Appendix, we plot the impulse response functions of economic development indicators and competitiveness pillars, respectively, to a shock in analysed variables. The main conclusions that can be formulated based on the responses' time trajectory and amplitude reflects that an improvement in global competitiveness leads to economic growth. The impact of gains in overall competitiveness of the economy is more important to improving economic development than simple increases in exports' volume or exports market shares. At the same time, advances in competitiveness, for example in the quality of nations' institutions, leads to real currency appreciation in both short and long term. These relations also hold when using GDP per capita instead of GDP levels.

On longer term, the accumulated responses of GDP levels to positive shocks in global competitiveness are higher than in case of increases of exports market shares of export sales volume. At the same, a positive shock in global competitiveness has a positive effect on long term on export performance. On the other hand, intensification in exports activity does not seem to have a significant impact on overall competitive position of the economy, suggesting that for sustained gains in competitiveness, an economy has to record improvements in many indicators, most probably, related to non-price factors, not only in international sales. This conclusion is also supported by the insignificant effect of REER appreciation (the confidence interval includes level 0) on global competitiveness.

The results from impulse response functions are supported by variance decomposition and Granger causality test (Tables 2-3, Appendix).

For example, after 5 years from shock production, global competitiveness indicator explains over 10 percent of GDP variation, compared to below 1 percent of output variation explained by exports' market share. Also, global competitiveness explains approximately 7 percent of GDP per capita evolution, compared to 1 percent due to REER evolution. GDP per capita evolution also seems to be explained to a higher extent by non-price factors captured by the pillars related to institutions and infrastructure (as computed by World Economic Forum), compared to REER.

The higher importance of global competitiveness indicators in explaining GDP evolution is also confirmed by Granger causality. World Economic index causes GDP, in Granger sense, at a significance of 1 percent. At the same time, global competiveness also causes exports market share evolution and REER. Out of price competitiveness factors, REER is significant in explaining the variation of GDP and global competitiveness.

Conclusion

In this paper, we have identified a positive and significant impact of competitiveness factors (both price and non-price) on economic developments of a panel of 28 EU countries. Regarding price indicators, the one with the highest impact on economic growth or on GDP per capita are ULC-based REER indicators, as indicated by impulse response functions, forecast error variance decomposition and Granger causality test. Nevertheless, non-price factor seem to have a greater influence not only on GDP evolution but also on external performance (captured by exports' volumes, market shares etc.). Results of different PVAR specifications indicate that out of the most important pillar of global competitiveness, measured by World Economic Forum, the most significant are those related to institutions and infrastructure.

On the other hand, economic growth alone does not guarantee a significant improvement of the competitive position of nations, although the effects of improved living standards or economic growth on competitiveness are positive.

Appendix

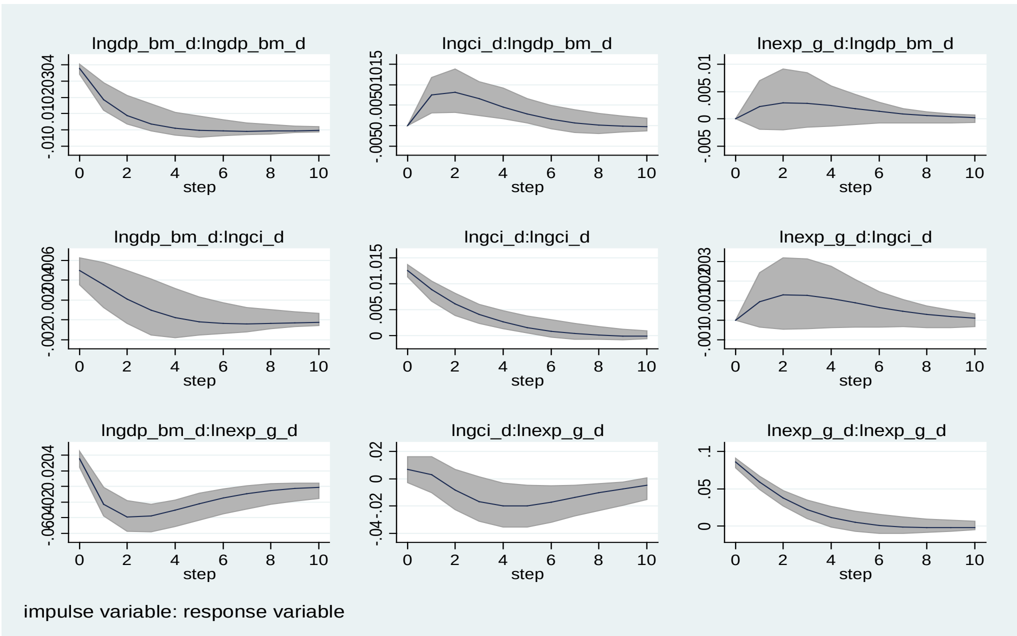
Table 1.Unit-root test for PVAR variables

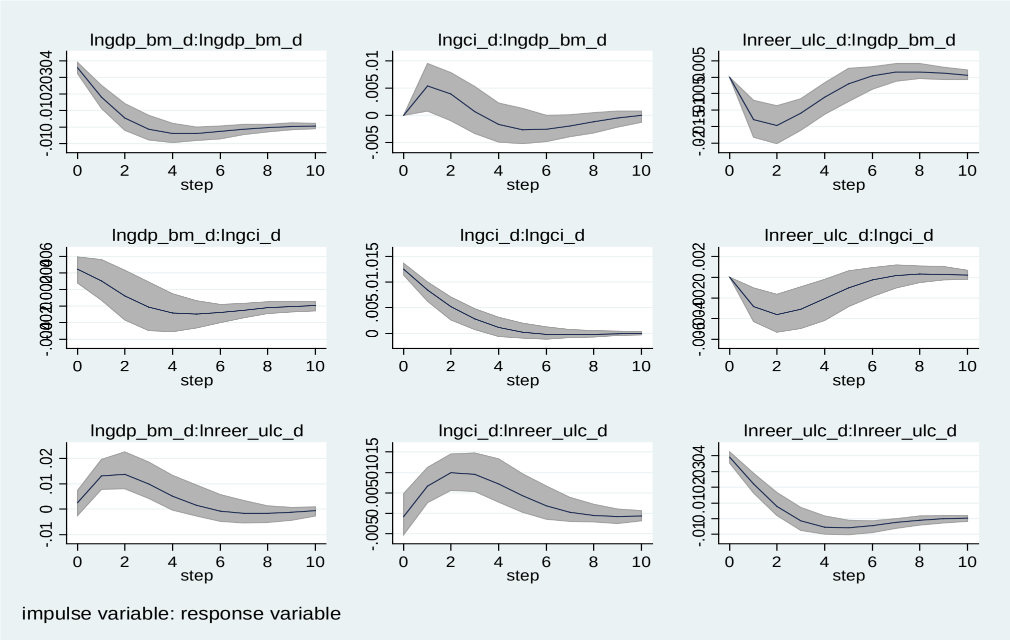
Levin-Lin-Chu unit-root test for gdpcpu	Levin-Lin-Chu unit-root test for reer_cpi37
Ho: Panels contain unit roots Number of panels = 28	Ho: Panels contain unit roots Number of panels = 28
Ha: Panels are stationary Number of periods = 10	Ha: Panels are stationary Number of periods = 10
AR parameter: Common Asymptotics: N/T -> 0	AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included	Panel means: Included
Time trend: Not included	Time trend: Not included
ADF regressions: 0.11 lags average (chosen by AIC)	ADF regressions: 0.18 lags average (chosen by AIC)
LR variance: Bartlett kernel, 6.00 lags	LR variance: Bartlett kernel, 6.00 lags

average (chosen by LLC) Statistic p-value Unadjusted t -10.6007 Adjusted t* -7.0570 0.0000 --- Levin-Lin-Chu unit-root test for gdp_bm Ho: Panels contain unit roots Number of panels = 28 Ha: Panels are stationary Number of periods = 10 AR parameter: Common Asymptotics: N/T -> 0 Panel means: Included Time trend: Not included ADF regressions: 0.39 lags average (chosen by AIC) LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC) Statistic p-value Unadjusted t -8.9612 Adjusted t* -6.2369 0.0000 --- Levin-Lin-Chu unit-root test for ms_g Ho: Panels contain unit roots Number of panels = 28 Ha: Panels are stationary Number of periods = 10 AR parameter: Common Asymptotics: N/T -> 0 Panel means: Included Time trend: Not included ADF regressions: 0.21 lags average (chosen by AIC) LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC) Statistic p-value Unadjusted t -7.1303 Adjusted t* -4.8073 0.0000 --	average (chosen by LLC) Statistic p-value Unadjusted t -9.1638 Adjusted t* -5.9640 0.0000 --- Levin-Lin-Chu unit-root test for reer_ulc Ho: Panels contain unit roots Number of panels = 28 Ha: Panels are stationary Number of periods = 10 AR parameter: Common Asymptotics: N/T -> 0 Panel means: Included Time trend: Not included ADF regressions: 0.25 lags average (chosen by AIC) LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC) Statistic p-value Unadjusted t -8.3335 Adjusted t* -4.8662 0.0000 --- Levin-Lin-Chu unit-root test for reer_cpi42 Ho: Panels contain unit roots Number of panels = 28 Ha: Panels are stationary Number of periods = 10 AR parameter: Common Asymptotics: N/T -> 0 Panel means: Included Time trend: Not included ADF regressions: 0.18 lags average (chosen by AIC) LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC) Statistic p-value Unadjusted t -9.4005 Adjusted t* -5.7066 0.0000 --

------------------------ Levin-Lin-Chu unit-root test for exp_g Ho: Panels contain unit roots Number of panels = 28 Ha: Panels are stationary Number of periods = 10 AR parameter: Common Asymptotics: N/T -> 0 Panel means: Included Time trend: Not included ADF regressions: 0.21 lags average (chosen by AIC) LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC) Statistic p-value Unadjusted t -7.2383 Adjusted t* -3.2846 0.0005	------------------------ Levin-Lin-Chu unit-root test for gci Ho: Panels contain unit roots Number of panels = 28 Ha: Panels are stationary Number of periods = 8 AR parameter: Common Asymptotics: N/T -> 0 Panel means: Included Time trend: Not included ADF regressions: 0.46 lags average (chosen by AIC) LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC) Statistic p-value Unadjusted t -6.6055 Adjusted t* -4.9007 0.0000

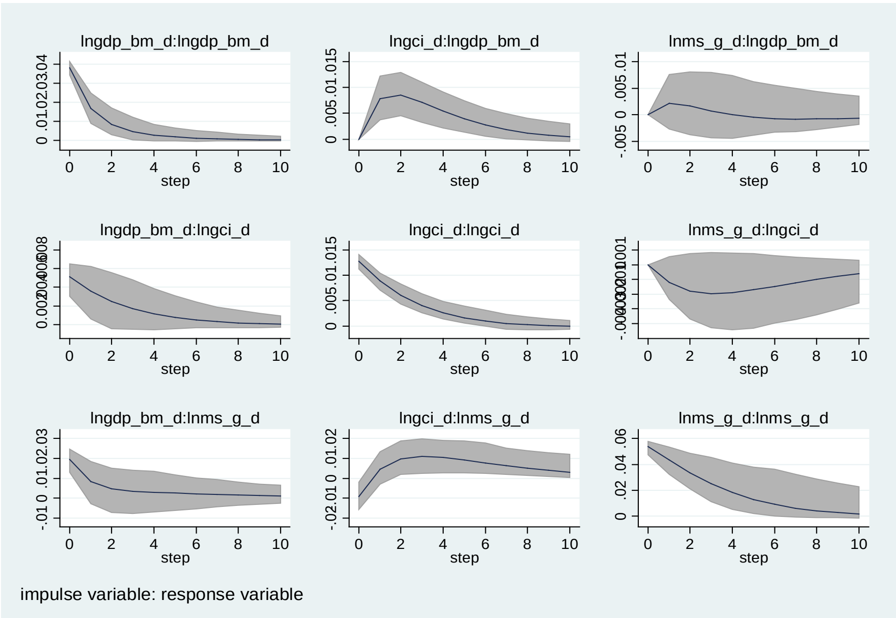
Charts. Short-term impulse response functions

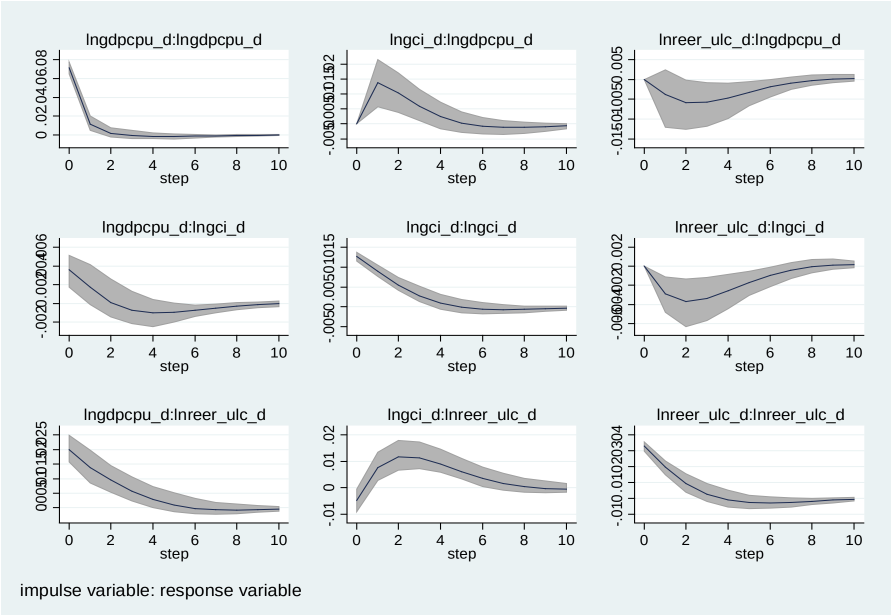




gdp_bm=GDP level, gci=Global Competitiveness Indicator, exp_g=Exports of goods, reeer_ulc=ULC-based REER with 37 partners
Note: variables are expressed in logarithm and are Helmert transformed
Source: World Economic Forum, World Bank, IMF, Eurostat, own calculations

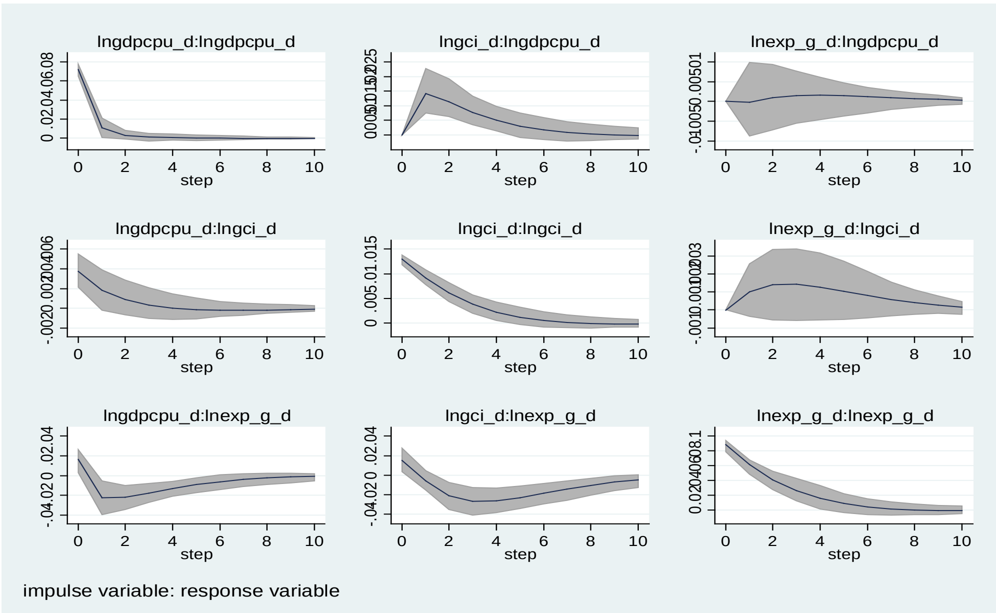
Chart. Short-term impulse response functions –continued-

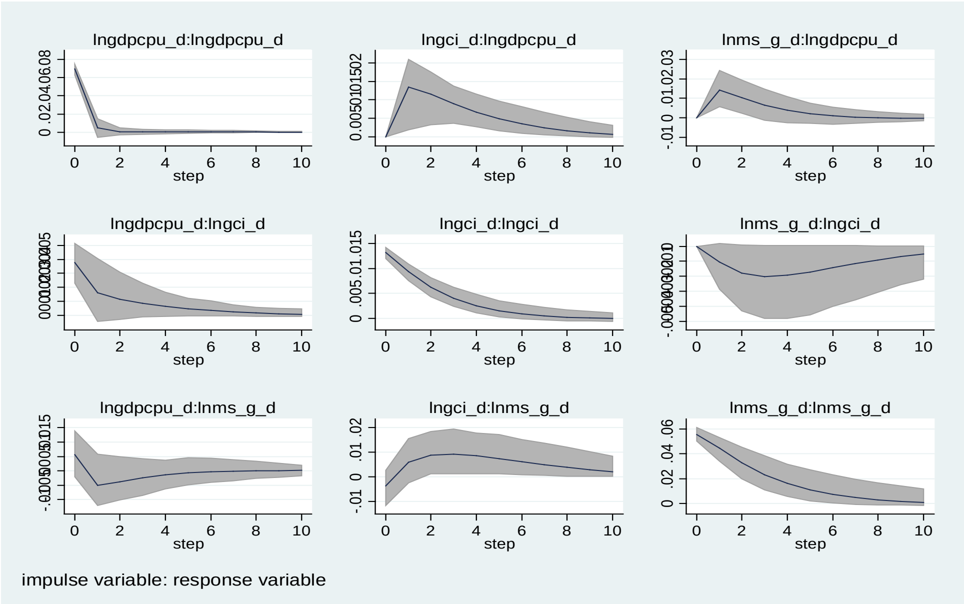




ms_g=Exports of goods' market shares
Note: variables are expressed in logarithm and are Helmert transformed
Source: World Economic Forum, World Bank, IMF, Eurostat, own calculations

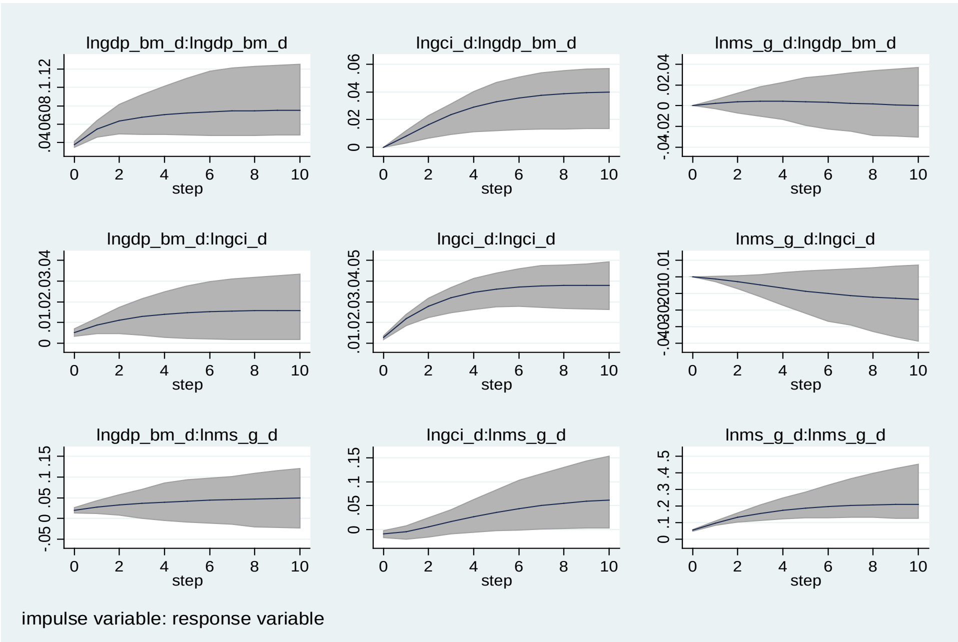
Chart. Short-term impulse response functions – continued-

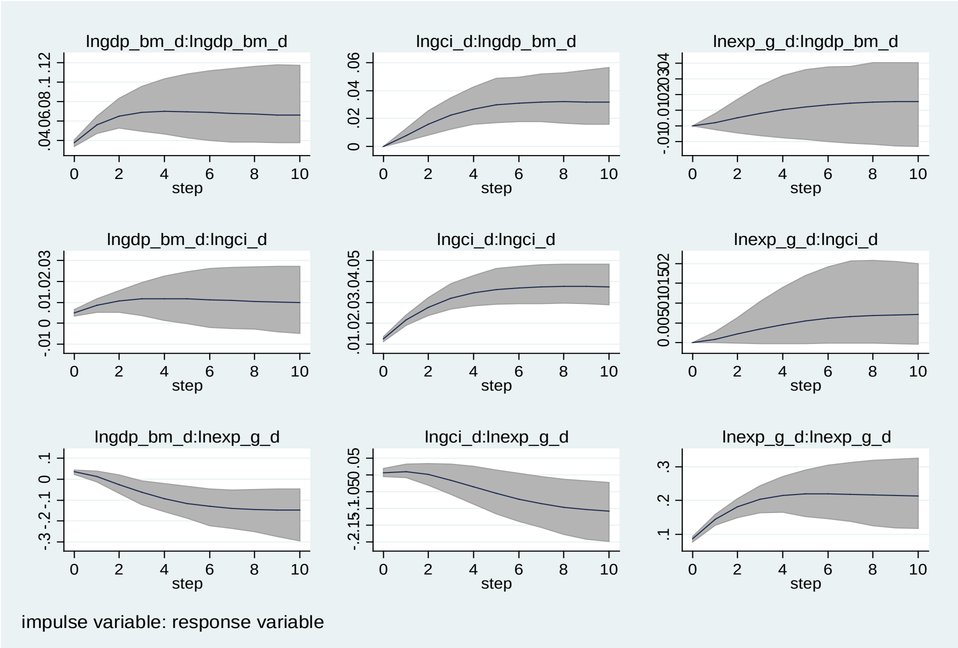




Note: variables are expressed in logarithm and are Helmert transformed
Source: World Economic Forum, World Bank, IMF, Eurostat, own calculations

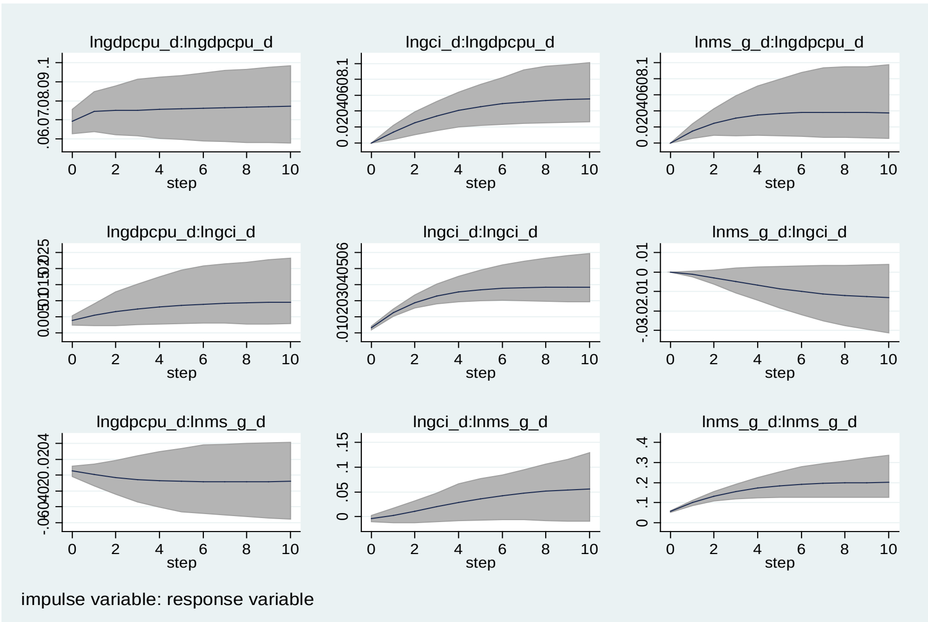
Chart. Accumulated impulse response functions

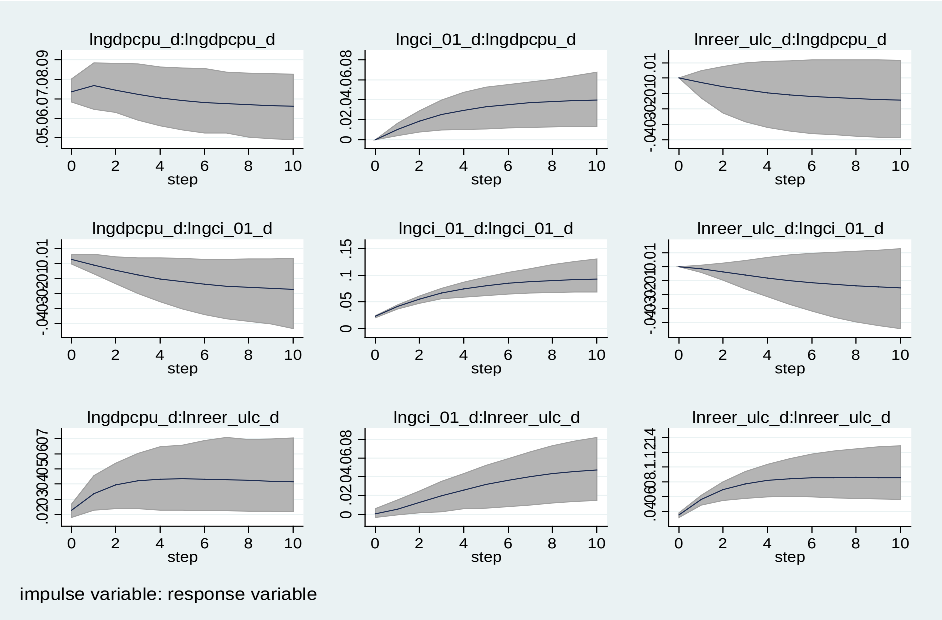




Note: variables are expressed in logarithm and are Helmert transformed
Source: World Economic Forum, World Bank, IMF, Eurostat, own calculations

Chart. Accumulated impulse response functions –continued-





gci_01=1st pillar of Global Competitiveness Indicator, related to institutions
Note: variables are expressed in logarithm and are Helmert transformed
Source: World Economic Forum, World Bank, IMF, Eurostat, own calculations

Table 2. Variance decomposition (share in the variation of the row variable due to column variable after n periods)

	Periods	lngdp_bm_d	lngci_d	lnreer_ulc_d
lngdp_bm_d	1	1.000	-	-
lngci_d		0.115	0.885	-
lnreer_ulc_d		0.001	0.000	0.998
lngdp_bm_d	5	0.726	0.019	0.255
lngci_d		0.099	0.789	0.111
lnreer_ulc_d		0.212	0.091	0.697
lngdp_bm_d	10	0.719	0.028	0.254
lngci_d		0.106	0.780	0.113
lnreer_ulc_d		0.210	0.093	0.697

	Periods	lngdpcpu_d	lngci_d	lnreer_ulc_d
lngdpcpu_d	1	1.000	-	-
lngci_d		0.076	0.924	-
lnreer_ulc_d		0.252	0.014	0.733
lngdpcpu_d	5	0.922	0.058	0.019
lngci_d		0.055	0.830	0.114
lnreer_ulc_d		0.273	0.171	0.556
lngdpcpu_d	10	0.920	0.059	0.021
lngci_d		0.059	0.820	0.120
lnreer_ulc_d		0.267	0.182	0.551

	Periods	lngdp_bm_d	lngci_d	lnexp_g_d
lngdp_b	1	1.000	-	-

	Periods	lngdpcpu_d	lngci_d	lnexp_g_d
lngdpcp	1	1.000	-	-

lngdp_bm_d				
lngci_d		0.138	0.862	-
lnexp_g_d		0.124	0.004	0.873
lngdp_bm_d	5	0.883	0.085	0.033
lngci_d		0.127	0.856	0.017
lnexp_g_d		0.344	0.041	0.616
lngdp_bm_d	10	0.877	0.087	0.035
lngci_d		0.127	0.854	0.019
lnexp_g_d		0.346	0.076	0.578

lngdpcpu_d				
lngci_d		0.077	0.923	-
lnexp_g_d		0.030	0.027	0.943
lngdpcpu_d	5	0.924	0.074	0.002
lngci_d		0.053	0.926	0.020
lnexp_g_d		0.109	0.120	0.772
lngdpcpu_d	10	0.921	0.076	0.003
lngci_d		0.053	0.921	0.026
lnexp_g_d		0.108	0.169	0.724

	Periods	lngdp_bm_d	lngci_01_d	lnreer_ulc_d
lngdp_bm_d	1	1.000	-	-
lngci_01_d		0.044	0.956	-
lnreer_ulc_d		0.008	0.010	0.982
lngdp_bm_d	5	0.722	0.002	0.276
lngci_01_d		0.041	0.849	0.110
lnreer_ulc_d		0.271	0.011	0.719
lngdp_bm_d	10	0.723	0.002	0.276
lngci_01_d		0.045	0.839	0.116
lnreer_ulc_d		0.269	0.011	0.720

	Periods	lngdpcpu_d	lngci_01_d	lnreer_ulc_d
lngdpcpu_d	1	1.000	-	-
lngci_01_d		0.018	0.982	-
lnreer_ulc_d		0.285	0.000	0.715
lngdpcpu_d	5	0.955	0.042	0.004
lngci_01_d		0.051	0.942	0.007
lnreer_ulc_d		0.241	0.068	0.692
lngdpcpu_d	10	0.950	0.046	0.004
lngci_01_d		0.055	0.935	0.009
lnreer_ulc_d		0.232	0.099	0.669

	Periods	lngdp_bm_d	lngci_02_d	lnexp_d
lngdp_bm_d	1	1.000	-	-
lngci_02_d		0.039	0.961	-
lnexp_d		0.164	0.055	0.781
lngdp_bm_d	5	0.981	0.003	0.016
lngci_02_d		0.033	0.895	0.072

	Periods	lngdpcpu_d	lngci_02_d	lnexp_d
lngdpcpu_d	1	1.000	-	-
lngci_02_d		0.056	0.944	-
lnexp_d		0.047	0.071	0.882
lngdpcpu_d	5	0.992	0.001	0.007
lngci_02_d		0.040	0.876	0.084

lnexp_d		0.248	0.257	0.494
lngdp_bm_d	10	0.976	0.008	0.017
lngci_02_d		0.051	0.865	0.085
lnexp_d		0.237	0.290	0.473

lnexp_d		0.103	0.387	0.510
lngdpcpu_d	10	0.992	0.001	0.007
lngci_02_d		0.039	0.859	0.102
lnexp_d		0.095	0.416	0.489

	Periods	lngdp_bm_d	lngci_d	lnreer_42_d
lngdp_bm_d	1	1.000	-	-
lngci_d		0.126	0.874	-
lnreer_42_d		0.014	0.003	0.983
lngdp_bm_d	5	0.812	0.024	0.164
lngci_d		0.124	0.810	0.067
lnreer_42_d		0.173	0.018	0.809
lngdp_bm_d	10	0.810	0.024	0.166
lngci_d		0.125	0.805	0.070
lnreer_42_d		0.175	0.023	0.803

	Periods	lngdpcpu_d	lngci_d	lnreer_42_d
lngdpcpu_d	1	1.000	-	-
lngci_d		0.081	0.919	-
lnreer_42_d		0.156	0.044	0.799
lngdpcpu_d	5	0.924	0.067	0.010
lngci_d		0.056	0.892	0.052
lnreer_42_d		0.235	0.063	0.702
lngdpcpu_d	10	0.922	0.068	0.011
lngci_d		0.057	0.887	0.057
lnreer_42_d		0.233	0.070	0.697

	Periods	lngdp_bm_d	lngci_d	lnms_g_d
lngdp_bm_d	1	1.000	-	-
lngci_d		0.146	0.854	-
lnms_g_d		0.107	0.021	0.872
lngdp_bm_d	5	0.896	0.101	0.003
lngci_d		0.135	0.862	0.003
lnms_g_d		0.052	0.047	0.901
lngdp_bm_d	10	0.881	0.116	0.003
lngci_d		0.134	0.859	0.007
lnms_g_d		0.046	0.071	0.883

	Periods	lngdpcpu_d	lngci_d	lnms_g_d
lngdpcpu_d	1	1.000	-	-
lngci_d		0.087	0.913	-
lnms_g_d		0.014	0.003	0.983
lngdpcpu_d	5	0.840	0.072	0.088
lngci_d		0.057	0.939	0.004
lnms_g_d		0.010	0.036	0.954
lngdpcpu_d	10	0.826	0.080	0.094
lngci_d		0.056	0.935	0.008
lnms_g_d		0.009	0.053	0.937

Table 3. Panel VAR-Granger causality test

Panel VAR-Granger causality Wald test				Panel VAR-Granger causality Wald test			
H0: Excluded variable does Granger-cause Equation variable Ha: Excluded variable Granger-causes Equation variable				H0: Excluded variable does Granger-cause Equation variable Ha: Excluded variable Granger-causes Equation variable			
Equation\ Excluded				Equation\ Excluded			
lngdp_bm_d				lngdp_bm_d			
	lngci_d	8.17	**0.004**		lngci_d	4.11	**0.043**
	lnms_g_d	0.57	0.45		lnreer_ulc_d	14.91	**0**
	ALL	8.39	**0.015**		ALL	16.23	**0**
lngci_d				lngci_d			
	lngdp_bm_d	0.06	0.81		lngdp_bm_d	0.03	0.86
	lnms_g_d	1.54	0.215		lnreer_ulc_d	6.41	**0.011**
	ALL	1.65	0.438		ALL	6.93	**0.031**
lnms_g_d				lnreer_ulc_d			
	lngdp_bm_d	3.34	**0.068**		lngdp_bm_d	5.83	**0.016**
	lngci_d	13.19	**0**		lngci_d	7.79	**0.005**
	ALL	13.2	**0.001**		ALL	19.67	**0**
+--+				+--- ----+			
lngdp_bm_d				lngdp_bm_d			
	lngci_d	7.93	**0.005**		lngci_01_d	0.57	0.449
	lnexp_g_d	0.54	0.462		lnreer_ulc_d	14.33	**0**
	ALL	8.08	**0.018**		ALL	14.37	**0.001**
lngci_d				lngci_01_d			
	lngdp_bm_d	0.03	0.861		lngdp_bm_d	1.27	0.259
	lnexp_g_d	1.03	0.311		lnreer_ulc_d	6	**0.014**
	ALL	1.13	0.569		ALL	8.6	**0.014**
lnexp_g_d				lnreer_ulc_d			
	lngdp_bm_d	12.11	**0.001**		lngdp_bm_d	8.3	**0.004**
	lngci_d	0.06	0.806		lngci_01_d	0.73	0.392
	ALL	24.54	**0**		ALL	11.94	**0.003**

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