Real Effective Exchange Rates and Deindustrialization: Evidence from 25 Post-Communist Eastern European Countries

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Contents of the presentation

- The aim of research is to examine the impact of the REER on the deindustrialization or reindustrialization process in 25 post-communist Eastern European countries.

Structure of presentation:

1. Background and motivation for research
2. Research objective
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Background and motivation for research

- Despite the importance of the industrial sector for economic growth, economies have exhibited a decline in the share of industrial production in GDP (Kuznets, 1966; Herrendorf et al., 2014; Timmer et al., 2015; Rodrick, 2016).

- Deindustrialization trend has been exhibited by both advanced and developed economies in the last few decades.

- "Premature deindustrialization" implies that a decrease in industrial productivity occurs before reaching the levels of the industrial capacity of developed countries (Dasgupta and Singh, 2006; McMillan and Rodrik, 2011; Rodrik, 2016).

Background and motivation for research

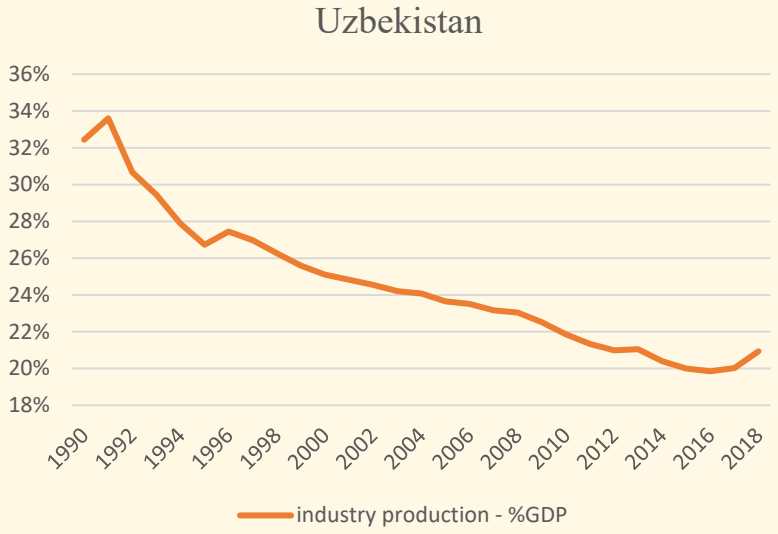
- Two explanations for this premature deindustrialization of developing countries are at the forefront, namely:
  - trade and
  - globalization (Rodrik, 2016).

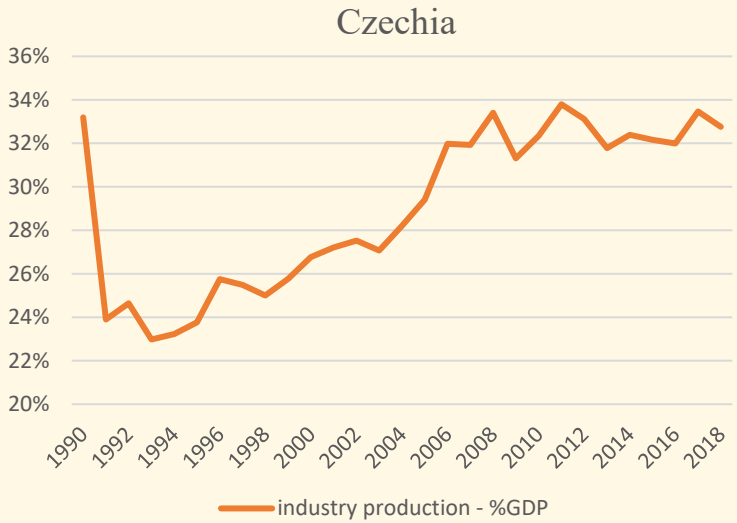
- The impact of globalization, by reducing import prices, implies that developing countries have to counterbalance globalization by increasing technological progress in the export sector.

- Dynamic real exchange rate policy stimulates technological processes in the trade sector.

Background and motivation for research

- Since 1990 and the following three decades, the countries of Eastern Europe, overall, but not uniformly, have exhibited a noticeable decline in their share of the industrial production sector.
- This decline for specific countries is better described by a U-shaped curve.





Background and motivation for research

- Suitable explanations as to why the industrial sector decreased in the 1990s lie in the process of:
    - transformation from the “old” to the “new” economic systems (communism vs. market economies).
    - breaking the old international and regional relations while simultaneously opening to trade and increasing financial inflows.
    - high initial share of the industrial sector in the pre-transition period and the rigidity of the business structures that could not easily adapt to new market conditions.

Background and motivation for research

- After the year 2000 some of the countries geographically located in Central Europe (CE), exhibited an opposite trend and a slight increase in industrial production.

- In the CE countries, gradual increase of participation in global value chains (GVCs) starting in the 1990s, which resulted in extensive involvement in GVCs (Gunnella et al., 2019).

- CE countries – more diversified and complex export basket products, requiring more sophisticated technology.

Background and motivation for research

- Mundell-Fleming model (Mundell 1963, Fleming 1962) - the undervalued exchange rate causes domestic goods to be more competitive in foreign markets, which stimulates investment and industrial production.

- However, if the economy largely depends on imported capital goods, strengthening of the domestic currency leads to an increase in investment and industrial production (Diaz Alejandro, 1963).

- These disparate effects could eventually reflect different levels of economic development and complexity (Hausmann and Hidalgo, 2011), as well as the extent of participation in international trade.

Research objective

Building on these explanations, we examine the following dilemmas empirically:

- **The long-term relationship between (REER) and industrial production** for 25 post-Communist countries of Eastern Europe.

- The magnitude of this relationship **for different levels of export diversification and complexity**, as well as the countries' level of development and production capacity for future growth.

- The effect of intensity of the **countries' participation in global value chains** on the type and the magnitude of the relationship between REER and industrial production.

- Variations in the REER-industrial production relationship depending on the countries' **upstream or downstream position** in the global value chains.

Data and variable formation

The estimate long-term relationship between REER and industrial production we used the set of economic indicators:

- Industry value added share in GDP

- Our main independent variable controlling for the **REER** is extracted from the Zsolt (2012) database. REER used to measure the relationship between the real value of a country's currency versus a basket of its trading partners' currencies.

- Set of control variables: trade oppeness; gross domestic product per capita; gross fixed capital formation as a share of GDP; general government final consumption expenditure as a share of GDP; the World Bank Governance Indicators; ICT, CPI, Human development index.

Data and variable formation

- To check for the robustness of the tests, we use two REER proxies:
    - The first is the **bilateral real exchange rate** between the national currency and the USD, obtained from the World Bank and Penn World Table database (RER).
    - The second is the variable capturing the **misalignment of the real effective exchange rate** from the long-term level aligned with productivity growth (REERM) to take into account the assumption that the Balassa - Samuelson's effect is present in observed countries.

Data and variable formation

- In process of estimation of REERM we closely follow the model of Rodrick (2008). We applied AMG methodology to deal with possible estimation problems.

- Additionally, to separately assess the impact of undervaluation and overvaluation changes on industrial production, we replaced variable REERM with two variables:

    - The first variable (***overvaluation***) for the periods of the overvalued exchange rate (when the REERM values are higher than one)
    - The second variable (***undervaluation***) for the periods of the undervalued exchange rate (when the REERM values are lower than one)

Data and variable formation

- To estimate magnitude of REER and industry relationship for different levels of export complexity we introduced the **Economic Complexity Index (ECI).**

- ECI indicates the overall level of economic diversification and production capabilities of a country and is a measure to predict its future economic growth.

- The literature shows that ECI is successful in explaining the cross-country differences in economic growth and productivity measured as GDP per capita (Hausmann et al., 2014; Ertan-Özgüzer and Oğuş-Binatlı, 2016; Mealy et al., 2018)

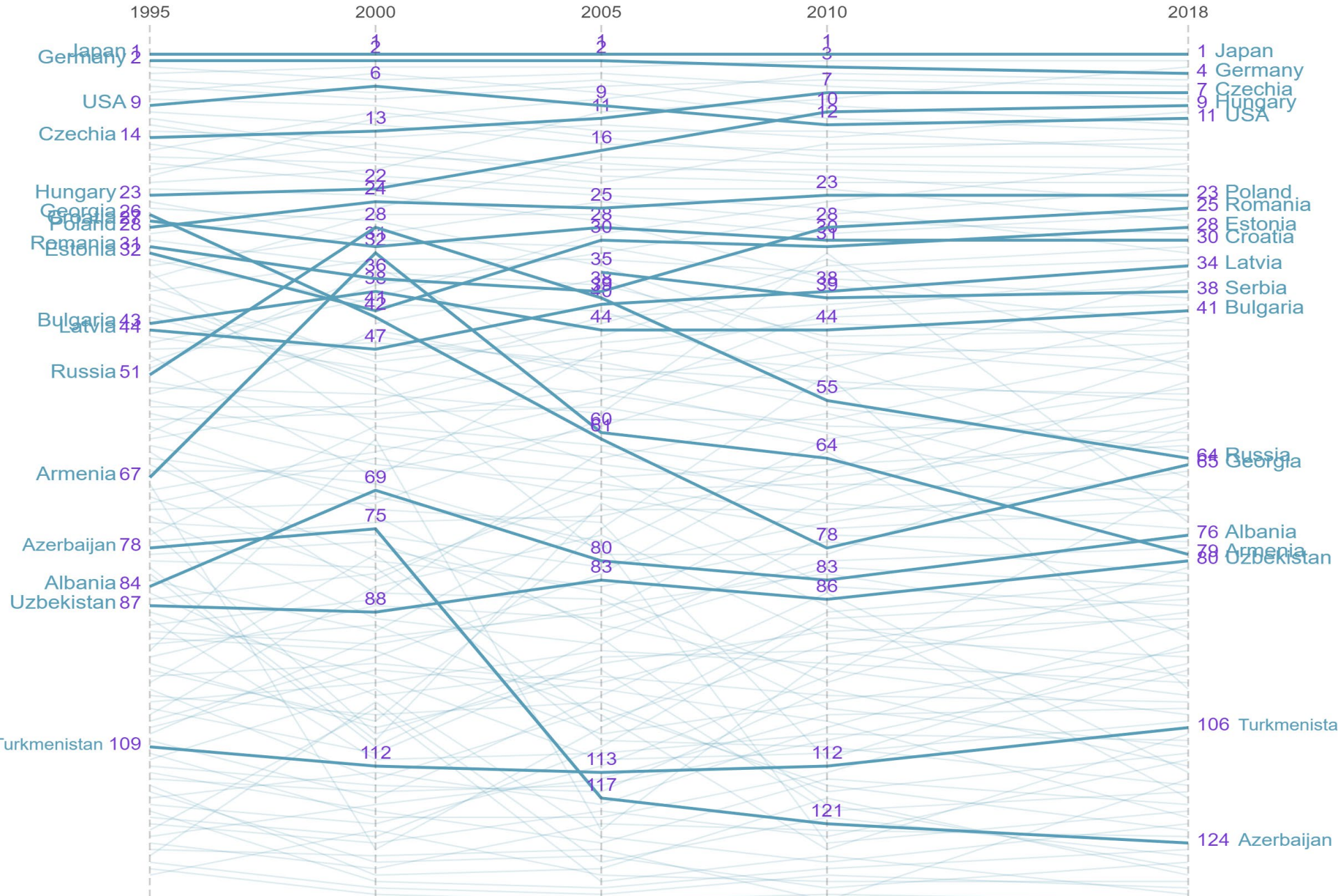
Data and variable formation

- Export data are used in calculating the ECI index, specifically information on the:
  - diversity and
  - similarity of export products (Hidalgo and Hausmann, 2009).

- Countries at the top of the ECI rank have diversified export baskets as well as export products produced in none or only a few other countries.

- If a country's ECI rank is higher compared to the expected one according to current level of GDP per capita, that country can be expected to experience faster growth in the future.

Country complexity ranking



Data and variable formation

- To estimate magnitude of REER and industry relationship for different levels of intensity of the countries' participation in global value chains we introduced following variables:

- **Foreign Value Added (FVA)** - measure of foreign inputs used in the process of production of exported goods (downstream participation in GVCs or backward linkages)

- **Domestic Value Added (DVA)** - measures the value of exports created using domestic inputs

Data and variable formation

- Domestic value-added exported as an intermediate product to trade partners **(DVX)** - represents upstream participation in GVCs or forward linkages.

- **Global Value Chain participation** - the sum of FVA and DVX, expressed as a share of gross export

- **Global Value Chain position** - Measures relative relation between backward and forward linkages. Calculated with the formula:

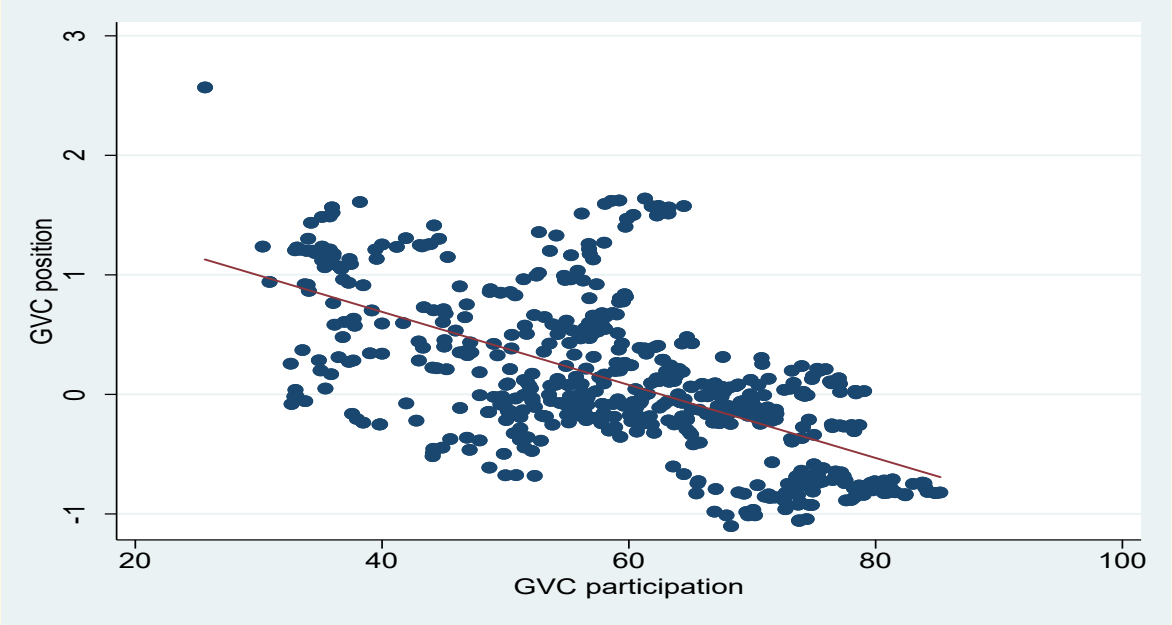
$$GVCposition_i = \ln\left(1 + \frac{DVX_i}{EX_i}\right) - \ln\left(1 + \frac{FV_i}{EX_i}\right)$$

EX_i is a gross export.

Data and variable formation

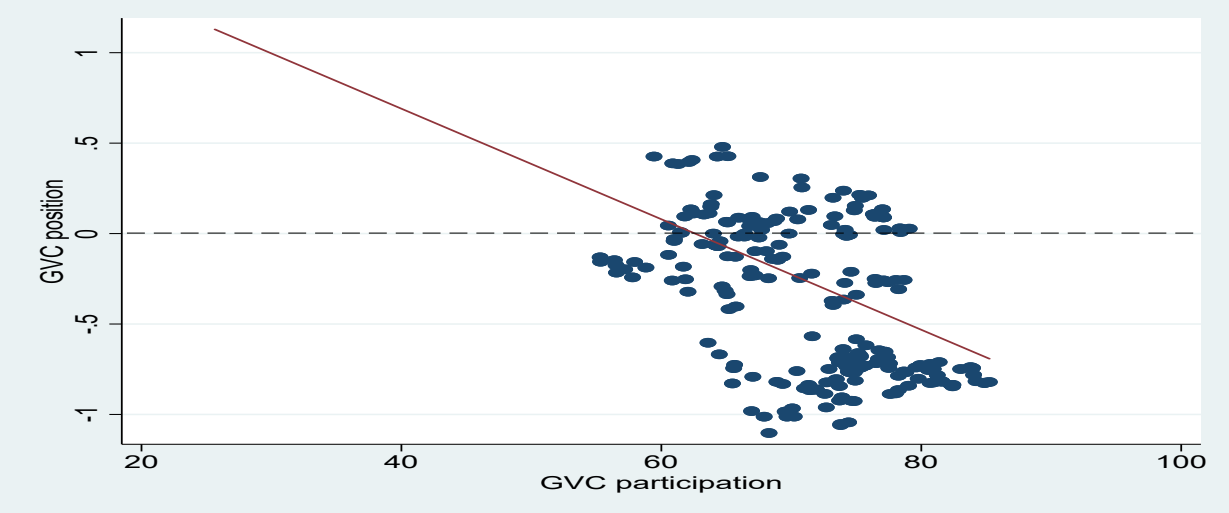
- Over the observed period, trade in intermediates for countries in the EE have become successively more important, with noticeable differences in GVC position among them.

- On average, for all observed region, countries are more integrated through backward linkages. An increase in the participation index is accompanied with a decrease in GVC position.



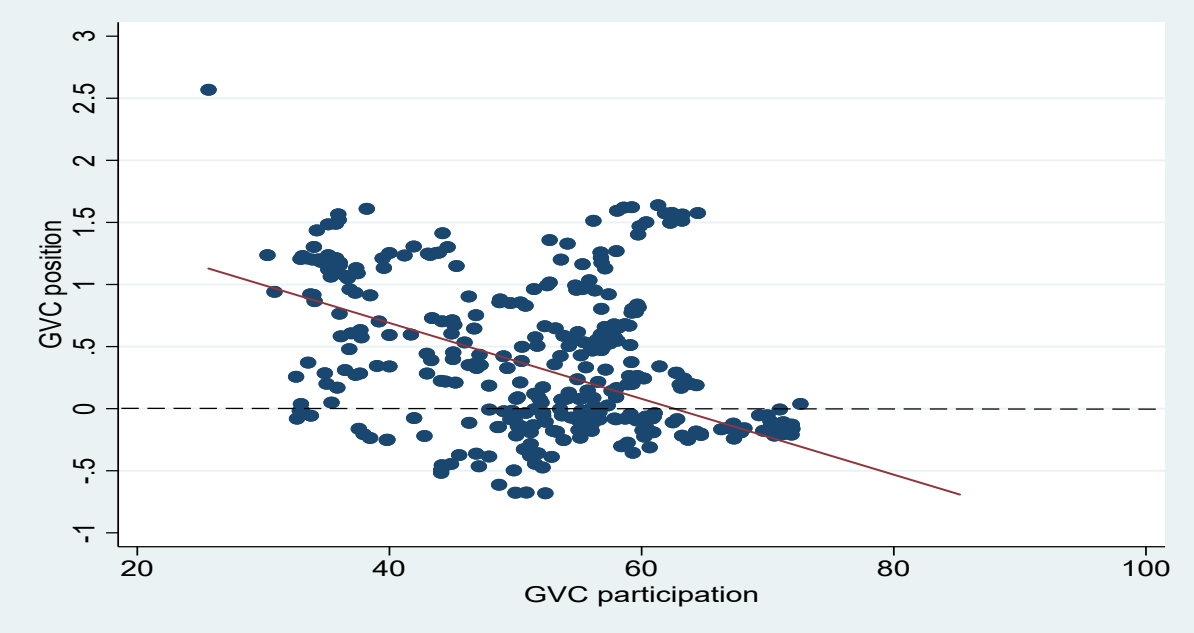
Data and variable formation

- Exporters from Central Europe (CE) and Baltic countries are generally located further downstream in GVC compared to their partners (Slovakia, Hungary, Estonia, Latvia, Slovenia)
- Import of mostly higher value-added components and industrial equipment used for the production of intermediate or final goods.



Data and variable formation

- Other countries from the sample are mostly located upstream in GVC.
- Exports of commodities from these countries are inputs in the production of other countries' industrial sectors.



Descriptive statistic

Variable	Mean	Std. Dev.	Min	Max
Industry production (% GDP)	24.77	7.32	8.63	59.79
Real effective exchange rate	100.17	34.54	43.44	409.15
Logarithm of real exchange rate	0.92	0.41	0.07	1.98
REER misalignment	0.00	0.08	-0.32	0.38
GDP per capita	6893	5212	384	23460
Trade openness (%)	90.82	38.53	15.86	287.46
ECI	0.40	0.70	-1.78	1.69
ECI (normalised variables)	0.63	0.20	0.00	1.00
GVC participation (%)	59.34	13.26	25.65	85.24
FVA share (%)	29.69	13.99	0.97	59.72
DVX share (%)	29.72	7.27	15.64	54.36

Methodology

- Due to the close and mutual economic, trade, and social relations between the countries in our sample, we can expect **cross-sectional dependency** for a majority of their macroeconomic and fundamental indicators.

- Even though countries in this region have had a similar “transition path,” they comprise an economically **heterogeneous group**.

- Furthermore, these countries are more or less **globally integrated**, such that global economic changes and shocks (called ”strong“ factors) have simultaneously impacted their industrial sectors.

Methodology

- The basic equation of interest for our analysis mostly follows the Rodrik (2008). This model is adjusted to capture potential heterogeneity between countries, as well as common dynamic factors.

- Baseline specification employs heterogeneous panel common factor approach:

$$lnindustry_{it} = \beta_i lnREER_{it} + \psi_{mi} x_{mit} + e_{it} \qquad e_{it} = \alpha_i + \gamma_i' f_t + \varepsilon_{it}$$

- **The first part** of equation presents the observable part of the model.
- **The second part** of equation includes unobservable inputs, e_{it}.
- With second part the model accounts for the common dynamic process, which represents the development and level of country-specific weighted common factors that affect industrial production for all countries in panel.

Methodology

- To resolve these issues of heterogeneity, cross-sectional dependence, and the presence of unobservable effects (such as external economic shocks) we used Augmented Mean Group (**AMG**), a technique developed by Eberhardt and Teal (2012).

- AMG estimator deals with a dynamic panel with heterogeneous coefficients and cross-section dependence is accounted by explicit estimation of unobservable common factors.

- In the robustness part, we used Common Correlated Effects mean group (CCE) estimator and the Chudik and Pesaran (2015) extension of this model to allow for a dynamic specification (DCCE).

Methodology

- In the preparation for our regression analysis, we have examined :
  - **the time series properties of the data** by a range of unit root test statistics for individual country time-series as well as the panel as a whole - using first and second generation panel unit root tests (including CADF and CIPS test by Pesaran (2007), which removes the cross-section dependence)
  - **the potential cross-sectional dependence** between panel units using the Pesaran (2015) CD test
  - **poolability of data** (Anova F-test and Welch F-test statistics, the formal Swamy (1970) S statistic of parameter constancy and the Roy-Zellner test for poolability (Baltagi, 2005)).
  - As an informal **cointegration test**, we have used the stationarity CIPS test for residuals of AMG model (Banerjee and Carrion-i-Silvestre, 2011), as well as set of formal panel cointegration tests, following Pedroni (1999, 2004), Kao (2000) and Gengenbach, Urbain and Westerlund, (2009). Estimate of common dynamic is included in the cointegrating vector.

	Cross-sectional dependance					Anova F-test		Welch F-test	
Variable	**CD-test**	**p-value**	**alpha**	**Std. Err.**	**95% Conf. Interval**	**Value**	**Probability**	**Value**	**Probability**
Industry production (% GDP)	84.724	0.000	1.007	0.037	(0.935, 1.078)	104.054	0.000	159.310	0.000
Real Effective Exchange Rate	84.68	0.000	1.007	0.022	(0.964, 1.049)	9.516	0.000	11.616	0.000
Real Exchange Rate	82.955	0.000	1.006	0.034	(0.940, 1.072)	33.994	0.000	43.775	0.000
GDP per capita	84.828	0.000	0.989	0.050	(0.891, 1.087)	359.159	0.000	659.436	0.000
Trade openness	84.653	0.000	1.007	0.060	(0.889, 1.124)	49.038	0.000	67.253	0.000
Economic Complexity Index	12.718	0.000	0.693	0.095	(0.693, 0.095)	207.230	0.000	514.625	0.000
GVC participation share %	77.913	0.000	1.007	0.028	(1.008, 0.028)	269.359	0.000	380.226	0.000
FVA share of export value added	77.544	0.000	1.006	0.039	(0.930, 1.083)	241.048	0.000	533.524	0.000
DVX share of export value added	77.862	0.000	0.989	0.032	(0.927, 1.051)	96.954	0.000	169.854	0.000
Notes: H0: variable is weakly cross-sectional dependent. Alpha is estimated cross-sectional exponent (0.5 <= alpha < 1 implies strong cross-sectional dependence)									

Empirical results - REER and de(re) industrialization

- The baseline results, confirm the expected relationship for developing countries showing the negative impact of the increase of REER on the share of industrial production in total income.

- The estimated negative coefficient of REER indicates that on average the relative size of the industrial sector depends negatively (positively) on the degree of REER appreciation (depreciation).

- These results are in line with findings of studies done by Hausmann, Pritchett and Rodrik, 2005; Rodrik, 2008; Freund and Pierola, 2012; Vaz and Baer, 2014.

Empirical results - REER and de(re) industrialization

The first column shows results of basic model of the impact of the REER on the share of industry in GDP. The estimates in the second column are for the group of upper and lower- middle income countries, column three for high income countries, in fourth column additional control variables are added to account for institutional and market failures. In the fifth column variable real effective exchange rate is replaced with bilateral exchange rate (national currency versus US dollar). In the sixth column real effective exchange rate is replaced with misalignment of real effective exchange rate from the long-term level aligned with productivity growth, column seven and eight shows estimates with variable overvaluation and undervaluation instead of REER.

VARIABLES	I	II	III	IV	V	VI	VII	VIII
REER	-0.229**	-0.147**	-0.256	-0.227**				
	(0.102)	(0.070)	(0.208)	(0.097)				
RER					-0.096**			
					(0.042)			
REERM						-0.243**		
						(0.113)		
Overvaluation							-0.210*	
							(0.127)	
Undervaluation								-0.271
								(0.211)
CDF	1.041***	0.550**	1.141***	0.853***	0.793***	1.000***	0.894***	0.925***
	(0.230)	(0.235)	(0.302)	(0.225)	(0.198)	(0.252)	(0.210)	(0.269)
Constant	2.543**	4.505***	4.286***	2.473**	0.532	1.600*	1.423	1.638
	(1.220)	(1.070)	(1.211)	(1.010)	(1.167)	(0.882)	(0.947)	(1.229)
Observations	600	384	216	534	534	534	534	534
Number of id	25	16	9	24	24	24	24	24
e - integrated	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
Pesaran CSD test (p value)	0.77	0.018	0.274	0.188	0.144	0.151	0.291	0.186
RMSE	0.042	0.046	0.021	0.028	0.027	0.027	0.028	0.027

*** p<0.01, ** p<0.05, * p<0.1

Empirical results - REER and de(re) industrialization

- We extrapolated the observed panel, based on the difference in income level according to World Bank classification.

- The results confirm a statistically significant and negative relationship between REER and the share of industrial production for countries of the less developed region, while lack of significance was found for more developed countries.

- These results shows that REER depreciation is the „second best solution" for dealing with weak institutions and market failures, mostly pronounced in developing countries. Along with countries development, REER depreciation as incentive for growth should be replaced with direct effect of economic policy instruments.

Empirical results - REER and de(re) industrialization

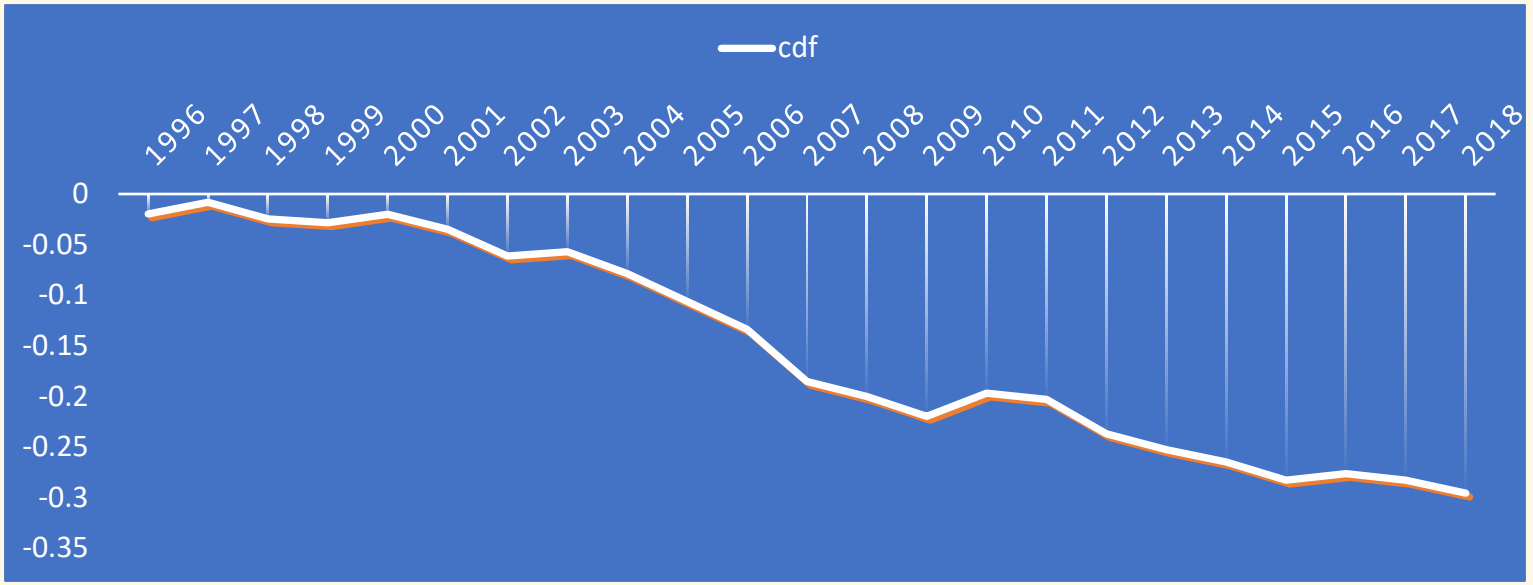
- Similar results was found when REER is replaced with variables representing REER misalignment, and overvaluation.

- Effect of undervaluation on industrial production is negative, but not statistically significant, which was expected in these transition countries with long periods of overvalued exchange rate.

- The results indicate that, on average for these countries, especially less developed one, lowering overvaluation is more beneficial, over the observed period, then increasing undervaluation.

Empirical results - REER and de(re) industrialization

- The significant coefficients for the Common Dynamic Factor (CDF) indicate an important role of unobservable inputs, such us common global shocks and price of industrial products, in variations of industrial production's share in GDP in all observed countries, albeit with different importance for each country.



- Increasingly negative impact of external factors in determining industrial production

Robustness check. We employed Neal (2015) further extensions of the CCE/DCCE approach by estimating the regressions equation with 2SLS or GMM to account for endogenous regressors and improve the efficiency of the DCCE estimator using further lags of the variables to form the instrument set.

VARIABLES	I DCCE-2SLS	II DCCE-GMM
l.lnindustry	0.586***	0.543***
	(0.161)	(0.187)
lnREER	**-0.253****	**-0.270****
	(0.121)	(0.117)
lnGDPpc	0.036	0.298
	(0.186)	(0.296)
L2.lnindustry_csa	0.043	-0.104
	(0.241)	(0.180)
L.lnindustry_csa	-0.827	0.096
	(0.662)	(0.261)
lnindustry_csa	1.207**	1.024
	(0.577)	(0.626)
L2.lnREER_csa	0.082	-0.206
	(0.194)	(0.174)
L.lnREER_csa	0.034	0.437*
	(0.178)	(0.250)
lnREER_csa	0.047	0.143
	(0.210)	(0.297)
L2.lnGDPpc_csa	-0.472	0.092
	(0.511)	(0.212)
L.lnGDPpc_csa	0.397	-0.325
	(0.594)	(0.440)
lnGDPpc_csa	0.169	0.022
	(0.408)	(0.500)
constant	-0.776	-2.222
	(2.681)	(3.163)
Observations	525	550
Number of id	25	25
e - integrated	I(0)	I(0)
Pesaran CSD test (p value)	0.053	0.165

Empirical results - ECI and GVC impact on REER and industrial production relationship

- Previous studies indicate that, as a country becomes more developed, a weakened exchange rate is less important for the development of its industrial sector and the growth of the country (Rodrik, 2008; Egert, 2005, Razmi et al., 2012).

- Rodrik (2008) emphasizes the positive roles of strong institutions and the absence of market failures for industrial production as well as the economic growth of the country.

- Instead of separately analyzing those fundamental factors of economic growth, the ECI serves as a composite measure to proxy the level of development and product sophistication.

Empirical results - ECI impact on REER and industrial production relationship

- Results show that higher values for the ECI-- as a proxy for higher economic potential, better institutions, and higher level of embedded knowledge--should diminish the impact of REER on the share of industry in GDP.

- For ECI values higher than 0.92 (cases for the most developed countries with diversified industries and better positioned for higher future economic growth), REER appreciation can have a positive effect on the industrial structure of a country.

- Conversely, for less developed countries with less diversified industries and less sophisticated exports, REER depreciation is more important for the development of the industrial sector and the growth of the country.

ECI and GVC impact on REER and industrial production relationship

VARIABLES	ECI	GVC participation	FVA	DVX
REER	-0.682**	-14.122**	-1.718**	0.051
	(0.342)	(6.096)	(0.817)	(1.788)
ECI	-3.487**			
	(1.620)			
REER*ECI	0.743**			
	(0.349)			
GVC share		-15.719**		
		(6.666)		
REER*GVC share		3.381**		
		(1.449)		
FVA share			-2.303**	
			(1.002)	
REER*FVA share			0.492**	
			(0.221)	
DVX share				0.169
				(2.417)
REER*DVX share				-0.041
				(0.496)
cdf	0.908***	0.859***	0.334**	0.343**
	(0.224)	(0.243)	(0.135)	(0.137)
Constant	3.163	65.744**	8.224**	2.330
	(2.098)	(27.541)	(3.752)	(7.839)
Observations	465	488	488	488
R-squared				
Number of id	21	22	22	22
e - integrated	I(0)	I(0)	I(0)	I(0)
Pesaran CSD test (p value)				
	0.06	0.17	0.282	0.193
RMSE	0.0201	0.0223	0.0226	0.0233

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

GVC impact on REER and industrial production relationship

- Usual gains from GVC participation (and backward linkages) for developing countries include higher productivity from the application of foreign technology, technological learning, and acquisition of new skills (Grossman and Rossi-Hansberg, 2008).

- For the CE countries, the main channel for knowledge acquisition and technology transfer are intermediate inputs, their variety and embedded technology.

- Companies involved in the GVC benefit directly from new technology, while other companies that are not a part of the GVC can acquire indirectly benefits from knowledge spillover through production networks in a country.

GVC impact on REER and industrial production relationship

- Participation in GVC can affect REER elasticity of export. When country`s production is more integrated in GVCs, REER depreciation improves the competitiveness of only a domestic value added embodied in a final goods' export.

- Empirical evidence shows that larger GVC participation decreases REER elasticity of manufacturing exports (Ahmed et al. 2017).

- When a country`s participation in GVC changes, REER elasticity of export also changes, consequently, changing its effects on the country's industrial structure.

GVC impact on REER and industrial production relationship

- Result show that the higher GVC reduces negative impact of REER increase on the industrial sector share in GDP, with a threshold value of GVC participation of 65 percent.

- Specifically, up to this value, an increase of REER has a negative marginal effect on the industrial production, but then a positive one above this value.

- One explanation of this positive relationship is that higher participation in GVC may be the benefits channel of cheaper imports of intermediate products for the involved industries in case of REER appreciation.

- Additionally, REER depreciation can be less effective for industry promotion as it only impacts the domestic value-added share of the gross exports, whose share is decreasing when the GVC participation increases.

GVC impact on REER and industrial production relationship

- Decomposing GVC participation share into FVA and DVX share, indicates that backward linkages are the ones that have contributed to the explanation of lower sensitivity of industrial production to changes in the REER.

- Increasing FVA shares in gross export reduces the negative impact of appreciation on industrial production.

- If the share of backward linkages is higher (more than 33% of gross export), a REER appreciation reduces the cost of imported intermediate inputs. This has a positive impact on overall industrial growth through the multiplicative effect of skills and knowledge acquisition.

Conclusion and policy implications

- New industries emerged, and the relation between the share of the country's export and import of intermediate products has been changed. All these changed conventional analysis of REER influence on industrial production, and the role of depreciation in growth promotion.

- Our baseline result reports a negative relation between REER changes and share of industrial production in GDP when effects of product sophistication or participation in GVCs are not included.

- These results confirmed one of the main concepts of export-led growth theories that depreciation is beneficial for growth promotion.

Conclusion and policy implications

- We examined how this relation changes if we account for modification in economic complexity and participation in international production networks.

- We establish that the relationship between the REER and industrial production is weaker in countries with a higher economic complexity and export sophistication, which exhibits lower negative consequences when REER appreciates.

- Finally, deeper integration of industries into GVCs lessens the negative effect of appreciation on industrial production.

- Our research confirmed that REER impact on industrial production depends on the country's GVC position, indicating that negative consequences of REER appreciation are less pronounced for countries with higher percentages of backward linkages.

Conclusion and policy implications

- These results may have important policy-relevant implications, especially when using undervaluation as a policy tool.

- It is important to emphasize that REER policy is the only “second-best” solution for growth and industry promotion.

- At the same time, the elimination of market and institutional distortions are the best strategies, which is not easy to implement in developing countries.

- In the observed post-communist countries, the implementation of these reforms was at a different pace, which has led to different industry structures, the degree of participation in GVCs, and different levels of the countries development

Conclusion and policy implications

- Differences across countries are an important factor that policymakers have to consider when discussing the implications of real undervaluation on industrial production.

- Countries that have a higher share of GVC participation will experience milder rection of their exports to REER depreciation, then the one foreseen by models that do not appropriately account for the involvement in cross-border production chains.

- This can lead to inaccurate policy actions. So, as the country`s GVCs participation and position changes, the effects of REER on industry production also changes, and countries' optimal REER policies should be modified over time.