

Structural shifts in the exports and industrial production effects in Ukraine

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Abstract

Sources of structural changes in the export sector and industrial production in Ukraine are examined. As the composition of export in favor of commodities has been relatively stable over the last decade, it is proven to be a factor facilitating growth of primary exports at the expense of manufactured exports, as suggested by the income and import elasticity of exports and production sectors. In order to assess robustness of the results, the empirical estimation is conducted by alternative statistical methods, such as the two-stage least-squares (2SLS), vector autoregression (VAR), and the Kalman filter. The main finding is that devaluation of the *hryvna* does not contribute to the growth of manufactured exports, which is highly dependent upon the import of capital goods. The exports of non-traditional commodities with higher value-added have higher import sensitivity but lower real exchange rate elasticity. Asymmetrical impact of exchange rate dynamics on the industrial production and exports in the primary and technological branches of industry is established.

Keywords: *export structure, industrial production, exchange rate, import elasticity*

JEL Classification: C32, F14

AMS Classification: 62H12

1. Introduction

The investigation of the foreign trade structure is not a new trend in the literature. Improving technology and information sharing, reducing trade barriers and promoting the benefits of technological products cause diversification of stages and production location as was shown in Baskaran et al. [1]. Currently, the international division of production provides new opportunities for economic development stimulation for those countries that intensify corresponding structural changes in industrial production, exports and imports structure [11, 12]. The functional relations of foreign trade structure and economic growth were empirically investigated by Chen, Jefferson and Zhang [3], Patnaik et al. [9], Sato and Fukushige [10] to explain the success stories in development of many countries. Despite convincing global trends and numerous studies [4, 14], the structure of Ukraine's exports remains relatively constant with a significant prevalence of primary sector, which causes a threat to sustainable economic development.

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The aim of the study is to investigate the main factors of structural changes in Ukraine's exports and industrial production, including the imports and exchange rate elasticities. A country that expands its economic activities in high-tech sectors and limits the spread of low technology industries which have low possibilities of technological improvement is sure able to achieve a much higher quality of export growth. Leamer and Maul [6], showed the negative impact of natural resources abundance on economic development for Latin American panel data, in particularly through increasing the income inequality. Primary sector industries absorb capital that potentially could use the technology sector. This oppresses workers incentives to accumulate knowledge and delays industrialization. Similar results were obtained for the Ukrainian economy [13]. Naudé and Rossouw [8] studying exports from Africa also indicated the importance of not only the quantity of exports, but also its structure. In regions with higher export diversification, the higher rates of economic growth and greater weight in total continent exports share were observed. Also, while studying the technological sophistication of exports the special attention should be paid to the quality of products as used in Xu [12] studying structural changes in China's exports.

2. Data Analysis

Table 1 reports the list of product groups that occupy the highest positions in Ukraine's exports from 2001 to 2011. It is noticeable that the export structure remained almost unchanged with uncompetitive advantage of metallurgy. Among the top-10 main export industries the technological sector is presented by only XVI and XVII groups that in 2011 occupied the 3 and 6 positions, respectively (9.9 and 7.1% of total exports). Ukraine's exports have very high level of concentration (Fig. 1).

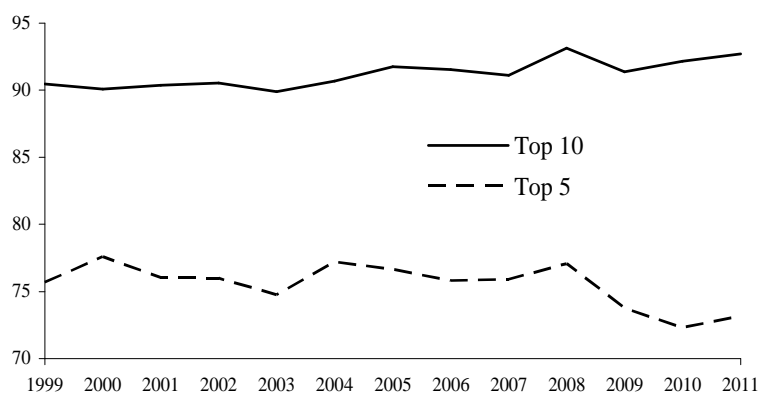


Fig. 1. Shares of TOP-10 and TOP-5 sectors in total exports of Ukraine [%].

The top ten industries cover over 90% of exports, and the first five positions occupy more than 70%. In 2008-2011 a slide decline in concentration of "Top-5" was observed from 77 to 73%. Instead, the share of "Top-10" remained practically steady. The high level of exports specialization on commodities enhances the structural deformation that could provoke periodic crisis of balance of payments.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	XV	XV	XV	XV	XV	XV	XV	XV	XV	XV	XV
2	V	V	V	V	V	V	XVI	V	II	V	V
3	XVI	XVI	XVI	XVI	VI	VI	V	XVI	XVI	XVI	XVI
4	VI.	VI.	VI.	VI.	XVI	XVI	VI	II	V	II	II
5	II	II	XVII	XVII	II	XVII	XVII	VI	VI	VI	VI
6	XI	XVII	IV	IV	XVII	II	IV	XVII	IV	XVII	XVII
7	XVII	XI	XI	II	IV	IV	II	IV	III	III	III
8	IV	IV	II	XI	XI	III	III	III	XVII	IV	IV
9	I	I	III	I	I	XI	XI	VII	X	X	X
10	X	III	I	XVIII	III	VII	VII.	XI	XI	XI	XI

Notes: I – Live animals and livestock products; II – Plant products; III – Animal or plant fats and oils; IV – Finished food industry products; V – Mineral Products; VI – Products of chemical industry; VII – Polymeric materials, plastics and articles of them; X – Paper bulk from wood or other vegetable fibres; XI – Textiles materials; XV – Base metals and articles thereof; XVI – Machines, equipment and mechanisms; XVII – Ground, air and water transport facilities. Data from Ukrstat.

Table 1 TOP-10 sectors of Ukraine’s exports, 2001-2011.

3. 2SLS model and main results

As it was shown more than ¾ of Ukraine’s exports is occupied by only five commodity groups. An empirical investigation was conducted to define the factors of "Top-5" exports groups and to estimate the elasticity of the exchange rate, and import of the same group. According to Saygılı [11] the empirical model for further 2SLS verification can be specified as follows (1a-1b):

$$\ln Ex_t = a_0 + a_1 \ln Ex_{t-1} + a_2 \ln rer_t + a_3 \ln Im_t, \quad (1a)$$

$$\ln Ex_t = b_0 + b_1 \ln Ex_{t-1} + b_2 \ln cpi_t + b_3 \ln Indukrsa_t, \quad (1b)$$

where Ex_t is specific export group (XV, V, XVI, II, VI) (in \$ millions); Im_t is specific import group (XV, V, XVI, II, VI) (in \$ millions); $Indukrsa_t$ is industrial production (index, 1994=100); cpi_t is consumer price index (1994 =100) and rer_t is real exchange rate of hryvna per \$ (index, 2000=100). Quarterly data ranging from 1998Q1 to 2012Q2 were used. Time series were seasonally adjusted using Census X–12 method. Data are from State Statistics Committee of Ukraine, except for RER which is derived from IMF international financial statistics.

Dependent variables	Independent variables						R ²	DW
	Constant	Export _{t-1}	RER _t	Import _t	CPI _t	Indukrsa _t		
XV	5.132 (6.363 [*])	0.134 (1.402)	0.383 [§] (2.381 ^{**})	0.527 (8.875 [*])			0.96	1.52
	2.722 (4.768 [*])	0.435 (4.868 [*])			0.160 (2.063 ^{**})	1.207 (6.237 [*])	0.94	1.88
V	-2.564 (-2.502 ^{**})	0.574 (6.288 [*])	0.534 [§] (1.832 ^{***})	0.481 (4.445 [*])			0.91	1.75
	0.918 (1.551)	0.529 (4.870 [*])			0.286 (2.349 [*])	0.865 (3.299 [*])	0.90	1.66
XVI	-0.941 (-1.093)	0.515 (6.372 [*])	-0.518 (-1.853 ^{***})	0.450 (5.992 [*])			0.93	1.73
	0.844 (1.734 ^{***})	0.314 (2.572 ^{**})			0.621 (4.247 [*])	0.893 (4.114 [*])	0.93	2.08
II	3.614 (1.828)	0.634 (5.764 [*])	-1.269 [§] (-1.689 ^{***})	0.338 (2.667 ^{**})			0.74	1.81
	-3.021 (-2.476 ^{**})	0.383 (3.228 [*])			0.946 ^{§§§} (3.452 [*])	0.871 ^{§§§§} (1.887 ^{***})	0.81	1.79
VI	-0.227 (-0.290)	0.747 (6.909 [*])	0.752 ^{§§} (3.448 [*])	0.141 [§] (2.065 ^{**})			0.92	2.04
	2.537 (3.995 [*])	0.425 (3.576 [*])			0.149 (1.911 ^{***})	1.076 [§] (4.377 [*])	0.92	1.71

Notes: § – lag (-1); §§ – lag (-2); §§§ – lag (-3); §§§§ – lag (-4)

Table 2. 2SLS analysis for Top-5 export sectors.

According to regression results (2SLS), the currency devaluation stimulates exports of XV, V, and VI commodity groups, whereas the negative impact of exchange rate on the export dynamics in groups II and XVI was revealed (Table 2).

This confirms the importance of price factor for boosting commodity components of exports. However we observed adverse effects on technological changes in the exports structure. The exchange rate depreciation affects the export of plant products (group II) because of the critical dependence on energy imports. For all "Top-5" export groups the positive impact of imports of similar products was defined, but a more detailed analysis of its structure showed that Ukrainian imports have significantly higher levels of technological sophistication. Ukrainian exports was revealed to be highly positively dependent upon the growth of industrial production in Ukraine (including 1 lag for XV, V, XVI and VI groups and 4 lags for group II).

4. Vector autoregression (VAR) estimations

In order to verify the robustness of the 2SLS results we used the model of vector autoregression (VAR). The estimation of the relationship between the five specific groups of exports and imports, RER and industrial production was conducted. In order to test the cointegration between parameters of five groups the Johansen test was implemented. As the test for long-run cointegration rejected the null hypothesis of the existence of at least one cointegrating among the dependent variables, the use of VAR model is suggested (2):

$$y_t = \sum_{i=1}^n A_i y_{t-i} + Bx_t + \varepsilon_t, \quad (2)$$

where y_t is the vector of dependent variables, x_t is the vector of independent variables, A_i is the coefficient matrix for dependent variables, B – is the coefficient matrix for independent variables, ε_t is a stochastic factor.

The results for impulse response functions and variance decomposition of residuals for five exports groups are summarized in figures 2-4. The exchange rate depreciation has a positive effect on the dynamics of groups XV, V and VI of exports, while for group II negative impact changes to positive within 5 periods (Fig. 2). At the same time the negative impact of devaluation on the export of XVI group is observed, that is consistent to 2SLS estimates above. The export of metal products is characterized by the highest price elasticity (decomposition variance explained by innovations of RER increases to about 25%) as well as the export of chemical industry (over 20%). Instead, the proportion of exchange rate in the

variance decomposition of export groups II, V and XVI remain low and explain near 10% at a horizon of 10 quarters.

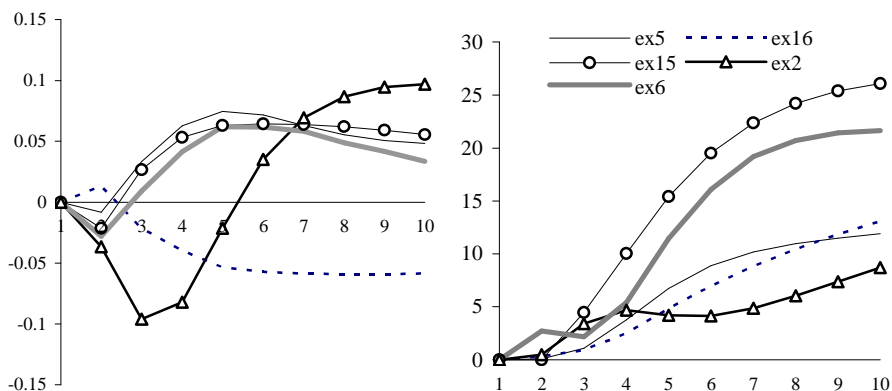


Fig. 2. Impulse response of *exports groups* to *exchange rate* endogenous shocks and variance decomposition of residuals.

Additionally, the VAR model revealed the negative impact of the exchange rate on the dynamics of industrial production. These results clearly indicate the incorrectness of the assumptions about the role of devaluation as the driving force of industrial production in Ukraine. Similar results were obtained in our previous studies [13].

The major export groups are positively correlated with imports of similar products (Fig. 3), except of group II (unlike estimates of regression analysis for plant products).

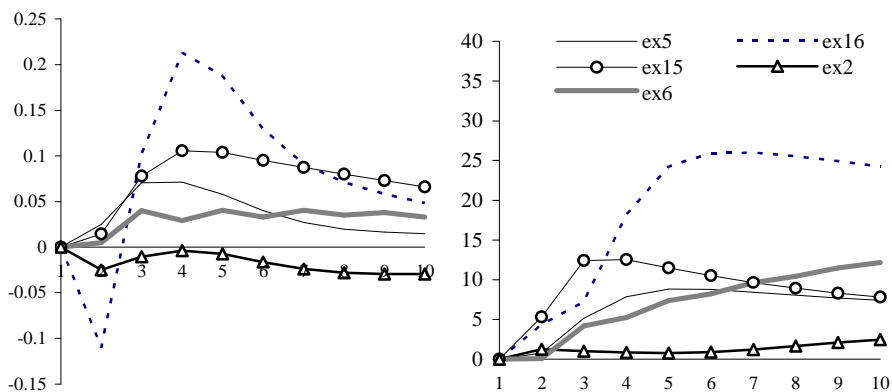


Fig. 3. Impulse response of *exports groups* to *imports groups* endogenous shocks and variance decomposition of residuals.

The imports explain only 2.5% of the variance decomposition of exports of group II and near 25 % of the group XVI. The exports of machines and equipment have higher import sensitivity compared to products with lower value added.

5. Kalman filter approach

Having identified a long-term relationship between the variables (Table 2), further we apply the Kalman filter approach to analyze the dynamics of flexible coefficients. The Kalman filter is a recursive algorithm to express dynamic systems [7]. Our estimation model implies the following structure (3a-3b):

$$Ex_t = F_t * B'_t + u_t, \quad u_t \sim \text{iid } N(0,1) \quad (3a)$$

$$F_t = [1 \quad rer_t \quad im_t \quad indukrsa_t], \quad B'_t = [\beta_{0t} \quad \beta_{1t} \quad \beta_{2t} \quad \beta_{3t}] \quad (3b)$$

where $\beta_{0t}-\beta_{3t}$ are time coefficients, iid are normally distributed shocks. Flexible coefficients were modeled as recursive or random walk.

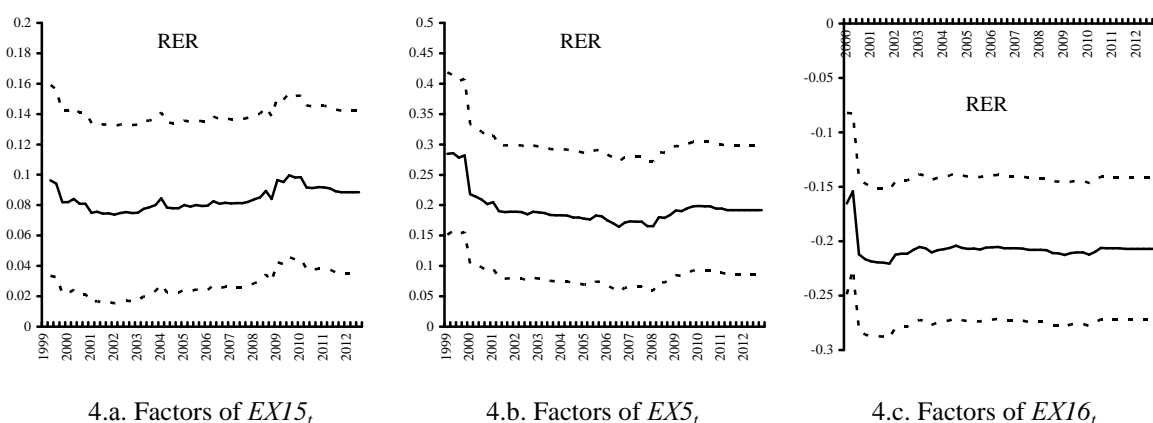


Fig. 4. The impact of RER_t on XV, V and XVI export groups.

Empirical results of Kalman filter approach (Fig. 4) are in accordance with previously used statistical models. Impact of currency depreciation on exports in industries with low value added is positive (estimates for II and VI groups also showed the positive impact of devaluation), but the impact on the group XVI is opposite. Worthwhile that most of flexible coefficients of RER impact show no significant instability. However, in the case of imports the flexible coefficients show the changes of the estimated dependence on time and the tendency of effect increasing is noticeable.

6. Conclusions

The basic positions of Ukrainian exports belong to commodity sectors with low value added, while the technology sector amounts only 17% (in 2011). It was proved that commodity

exports groups with low value added are significantly dependent on the exchange rate fluctuations. Simultaneously the dependence on imports of similar products was observed that most applies to group XVI. The negative impact of currency depreciation on industrial production was revealed. Estimates of Kalman filter generally correspond to 2SLS and VAR, confirming the robustness of the results. The RER effects confirm previous results concerning the asymmetric impact of exchange rate on technological (machineries) and primary (metals, chemicals, plant and mineral products) sectors.

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