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Impact of the Exchange Rate Factor on the Sectors of the Belarusian Economy

The Belarusian economy is an open system where volumes of foreign trade turnover are commensurate with the GDP volume. In turn, the intensity of foreign economic relations depends to a large extent on the foreign exchange rate realignment. Therefore, an assessment of the impact of the exchange rate factor on the most important macroeconomic indicators as well as indicators for the development of individual sectors of the economy's real sector is of practical interest to our country.

Such assessments can be made only on the basis of special economic and mathematical models. Two types of models can be used with this end in view: econometric models which take into consideration current trends in the dynamics of relationships between economic indicators as well as balance models whose equations represent the production cost pattern in individual sectors of the economy.

Those balance models which are built on the basis of the intersectoral balance methodology offer the strongest possibilities for the analysis of negative and positive impacts of the foreign exchange rate realignment. The use of such models makes it possible to assess not only immediate and direct effects of changes in different elements of costs in individual sectors of the economy but also indirect and long-term consequences and effects which follow the chains of intersectoral relations.

The dynamic price model which has been built on the basis of data from the intersectoral production and product distribution balance sheet compiled by the Ministry of Statistics and Analysis of the Republic of Belarus, was used in this research with a view to assessing the impact of the exchange rate factor on indicators for the development of individual industries of the economy's real sector. The information support required to build such model has substantially improved in the past few years because the Ministry of Statistics and Analysis started to compile intersectoral balance on a new methodological basis involving a wider range of data. In particular, intersectoral supply of domestic products as well as flows of imports within the same sectoral structure formed separate part in the cost pattern of each industry's intermediate material consumption. This provides new opportunities for assessing the impact of the exchange rate factor on sectoral costs by taking into consideration their changes stemming from the appreciation/depreciation of imported goods consumed in the process of production and in the future, also, changes in the cost of those elements of material costs of domestic production in whose production imported raw materials and component parts were used.

It is well known that the impact of the exchange rate factor on the production efficiency is highly ambiguous – positive and negative short-term effects of the foreign exchange rate realignment exerting differently directed influence on the competitiveness of the output can often balance out. The outcome is determined, to a large degree, by specific features of sectoral production, and, above all, by the cost pattern and the pattern of demand for the output. In particular, the devaluation of the national currency can promote the competitiveness of domestic product as regards the price factor both in external markets and in the domestic market as it entails the possibility of making it cheaper with respect to the prices of foreign competing enterprises. This effect can be exerted, to a larger extent, in export oriented sectors of the economy whose expenses relating to the materials of home manufacture as well as salaries and wages prevail in the production cost.

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On the other hand, prices for imported raw materials and component parts grow as a result of decline in the exchange rate of the national currency what provokes, without doubt, an increase in total production cost of domestic enterprises, thereby weakening their competitive positions in external markets. Those industries which are mainly oriented to the domestic market and have a significant share of imported raw materials and energy supplies in their expenses pattern are the first to suffer from total negative effect of the devaluation. However, adverse implications of the decline in the foreign exchange rate are not confined to the growth of material costs which is observed in the sectors of the economy consuming imports. For better assessment of such implications, it is necessary to take into consideration indirect impact of the devaluation on the expenses of those producers in whose material costs domestic goods manufactured by enterprises with high imports consumption (e.g., producers consuming a lot of oil products made by domestic refineries out of imported crude oil) account for a major share.

Indirect implications of the foreign exchange rate realignment transmitted via the intersectoral relationships system can be taken into consideration with the help of the aforementioned price model. The distinctive feature of this model is that it is realized in the dynamic form, i.e. includes rates of changes in economic indicators as its variables. If rates also act, in the process of calculations based on the model, as exogenous variables, estimated data obtained with the help of the model take the form of elasticity coefficients which characterize the impact of assigned exogenous factors on the entire system of endogenous indicators.

It was calculated on the basis of this model how nominal volumes of intermediate material consumption in each sector of the economy increase if the exchange rate of the Belarusian ruble is down 1%, given the cost of imported goods and services varies in proportion to the growth of the foreign exchange rate. In addition, it was assumed that real sectoral production volumes remain invariable as well as nominal volumes of the added value in all sectors of the economy also remain unchanged, i.e. the growth of production cost and, accordingly, the growth of sectoral prices is attained only at the expense of material costs appreciation which is initiated by the ruble devaluation at the beginning of intersectoral relationship chains and later on is transmitted to new levels of production cooperation together with intersectoral supplies of domestic product.

Calculated relative changes in nominal sectoral volumes of the intermediate material consumption characterizing their elasticity with respect to the exchange rate realignment are shown in Table 1. The Table also contains data obtained by this elasticity calculation of average sectoral prices which show the extent of their change (percentage change) resulting from 1% realignment of the foreign exchange rate under current structure of the economy. It should be noted that these assessments of price elasticity are characteristic of minimum inflationary implications of the Belarusian ruble devaluation calculated on the assumption that sectoral prices will change only at the expense of the material costs appreciation due to this devaluation given that volumes of the added value in the sectors of the economy will remain unchanged. The above changes in sectoral prices may be deemed the producers' first natural reaction in response to the appreciation of imported raw materials and component parts which are purchased by them.

Table 1 also shows absolute nominal increments in the intermediate material consumption which are linked with an increase in expenses caused by the ruble devaluation (as calculations were made on the basis of the latest currently available intersectoral balance sheet, which refers to the year 2005, assessments in this Table are characteristic of the conditions for this year).

Table 1: Effect of 1% foreign exchange rate devaluation

		Increment in intermediate material consumption, billion Belarusian rubles.	Increment in exports of goods and services, billion Belarusian rubles	Gain (+), losses (-), billion Belarusian rubles.
1	Electric power and thermal power	16.1	0.4	-15.6
2	Petroleum industry products	97.7	105.7	8.0
3	Gas industry products	0.0	2.2	2.2
4	Coal, oil shale, and peat	0.2	0.2	-0.1
5	Ferrous and non-ferrous metals	13.3	18.8	5.5
6	Chemical and petrochemical industry products	29.4	48.1	18.7
7	Machinery and equipment, and metalworking industry products	72.2	77.0	4.7
8	Timber, woodworking, and pulp and paper industry products	10.4	16.1	5.7
9	Construction materials (including glass and porcelain industry products)	9.8	6.4	-3.5
10	Light industry products	15.8	16.9	1.1
11	Food industry products	34.6	29.5	-5.1
12	Other industrial products	5.5	2.0	-3.5
13	Construction products	26.0	1.6	-24.4
14	Agricultural products, services provided to agriculture, and forestry products	25.2	1.8	-23.4
15	Transport services	18.9	25.4	6.6
16	Communication services	3.4	1.9	-1.5
17	Trade and intermediary services (including catering services)	16.4	3.4	-13.0
18	Geology services, prospecting, and other activities products	1.4	0.6	-0.8
19	Housing and communal services, and non-productive types of household services	7.7	1.5	-6.3
20	Health care, physical training, and social services	8.8	0.2	-8.5
21	Education, art and humanities, science services	8.6	0.5	-8.2
22	Financial intermediation and insurance services	2.3	0.1	-2.2
23	Governance, defense, and non-governmental organizations services	6.5	0.7	-5.8
	Total	**430.1**	**361.0**	**-69.2**

The above data show the scale of sectoral losses resulting from the devaluation which have a negative impact on the production efficiency and product competitiveness. For the purpose of comparing them with a positive effect of the devaluation, Table 1 also shows absolute nominal increments in the volumes of export proceeds denominated in rubles which can be generated by the sectors of the economy given that volumes of foreign exchange proceeds remain unchanged and the national currency exchange rate is 1% down (this calculation also refers to the conditions for 2005).

The difference between extra incomes received by the sectors of the economy as a result of an increase in the ruble equivalent of foreign exchange proceeds and extra expenditures on the purchase of more expensive raw materials and component parts may serve as an adequate assessment of an overall effect of the Belarusian ruble devaluation on each sector of the economy. The sign of this assessment makes it possible to judge whether competitiveness of the economy's sectors in the market becomes higher or, conversely, lower while its value characterizes the scale of an increase or decrease in sectoral incomes resulting from the national currency devaluation.

Data in Table 1 indicate that the devaluation incurs the biggest losses to such sectors of the Belarusian economy as construction, agriculture and forestry, power industry and heat-and-power engineering, trade and catering, as well as food industry. Also, it should be noted that the ruble devaluation has a negative impact on all branches of domestic service industry because their dependence on imports is significantly higher than their export potential.

Export oriented sectors of the economy gain from the devaluation most of all, namely: chemical and petrochemical industry, petroleum industry, transport, forestry, woodworking, and pulp and paper industry, metallurgy, and mechanical engineering and metalworking. Particular emphasis should be placed on high favorable assessment of the gain from the devaluation in such industries as petroleum, as well as chemical and petrochemical. For the economy which imports large volumes of crude oil this fact which seems to be, at first glance, unexpected is not a surprise in an environment of the Belarusian economy which received underpriced Russian crude oil and earned, owing to this, extra income from re-exporting thereof to the third countries, as well as from selling abroad products of processing.

The above assessments of extra incomes in export oriented sectors of the economy were made on the assumption that their real production volumes remain unchanged. However, it is obvious that these sectors of the economy gained additional competitive advantages in external markets as a result of the ruble devaluation and could make use of them in order to increase exports of their product. The econometric modeling of the sectoral exports dynamics of those sectors of the economy which, according to Table 1, must gain from the devaluation showed that they reacted fairly adequately to the realignment of the Belarusian ruble real exchange rate which can result, in the short run, from the realignment of its nominal exchange rate.

In econometric models that have been built real GDP of Russia and changes in trade conditions for the Republic of Belarus, along with the real exchange rate of the Belarusian ruble, were also taken into consideration as factors of changes in volumes of sectoral exports. The ratio of export and import prices was taken into account as an indicator characterizing the impact of the latter factor. In some models, changes in energy prices (crude oil and natural gas) which have a significant impact on production cost in individual sectors of the Belarusian economy were taken into account additionally.

The growth of real GDP in the Russian Federation – major foreign trade partner of our country – creating preconditions for the growth of aggregate demand therein, including demand for imported products, stimulates without doubt an increase in physical quantity and value of Belarus's exports. Preliminary statistic analysis showed that intensive development of the Russian economy in recent years was conducive to the significant growth of Belarusian enterprises' exports which was, in turn, one of the factors in the GDP growth in our country.

Economic implications of changes in foreign trade conditions viewed from the standpoint of changes in the competitiveness of domestic product in external markets are similar, in many respects, to the effects resulting from the realignment of the ruble real exchange rate, though in one case they can be caused by price fluctuations in the unstable global market of natural resources and in another case by the exchange rate factor. An increase in export prices for domestic product, all

other conditions being equal, results in the falling demand for it because consumers abroad prefer to buy cheaper goods of own production or similar product from third countries. The reduction in import prices for the product of foreign firms competing with Belarusian producers results in similar effect. Therefore, growing indicator for changes in trade conditions which takes into consideration the dynamics of export/import prices ratio in respect of competing goods, all other conditions being equal, may serve the factor which has a negative effect on exports of Belarusian enterprises.

Changes in import prices for non-competitive industrial goods result in opposite effect. Their growth, increasing production cost of domestic enterprises, hurts ability of product to compete and therefore can lead to the reduction in its exports, whilst their decrease, conversely, stimulates the growth of exports. It is for this reason that indicators for the change in prices for major imported raw materials – crude oil and natural gas which can, increasing or decreasing production cost, significantly influence the competitiveness of domestic product even in cases where real foreign exchange rate remains unchanged – were included into individual econometric models as independent export factors.

Exports of the sectors of the Belarusian economy were modeled on the basis of monthly statistics data. Time series of benchmark statistics were transformed into logarithmic form to avoid heteroscedasticity problems and were subjected, where necessary, to the seasonal adjustment procedure (seasonal adjustment was carried out with the help of Cesus X11 implemented in E-Views).

Preliminary stationarity analysis of variable models was carried out in order to reduce the risk of "false regression". Unit root analysis of data (presence of non-stationarity) was made with the help ADF, PP, as well as KPSS tests. The results of testing showed that all variables used in the models are non-stationary and are first order integrated.

The results of testing underlie the choice of the type and specification of econometric models which were used thereafter to assess the impact of the foreign exchange rate on sectoral volumes of exports. Exports modeling was carried out on the basis of Johancen cointegration analysis (since the use of traditional methods of regression analysis is inappropriate in cases where variables are non-stationary). Three specifications of econometric model were built and analyzed in order to obtain the most complete picture of the impact exerted by different factors on the dynamics of sectoral volumes of exports for each of addressed export oriented sectors of the Belarusian economy:

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$$EX_t = \beta_0 + \beta_1 GDP_t^{RUS} + \beta_2 ERER_t + \varepsilon_t, \quad (1)$$

$$EX_t = \beta_0 + \beta_2 GDP_t^{RUS} + \beta_3 ERER_t + \beta_4 TT_t + \varepsilon_t, \quad (2)$$

$$EX_t = \alpha_0 + \alpha_1 GDP_t^{RUS} + \alpha_2 ERER_t + \alpha_3 POIL_t + \alpha_4 PGAS_t + \varepsilon_t, \quad (3)$$

where

EX_t — indicator for sectoral exports;

GDP_t^{RUS} — indicator for real GDP in the Russian Federation;

$ERER_t$ — index of the effective real exchange rate of the Belarusian ruble;

TT_t — index of changes in trade conditions; and

$POIL_t$ and $PGAS_t$ — accordingly, indices of changes in dollar prices for crude oil and natural gas imported to the Republic of Belarus.

Model (2), of three models in question, showed the most advantageous results in terms of its statistical characteristics as well as in terms of the quantity of statistically significant assessments. Table 2 shows long-term elasticity coefficients of changes in exports with respect to changes in the real exchange rate of the Belarusian ruble, Russia's GDP, and foreign trade conditions for six export oriented sectors of Belarusian industry assessed via Johancen method on the basis of this model which, according to Table 1, must gain from the devaluation (symbol*, in assessing elasticity coefficients in this table, shows their statistical significance, i.e. states that null hypothesis about insignificance of these parameters is rejected at 5% level).

Data in Table 2 indicate that results of cointegration analysis obtained with the help of model (2) correspond, on the whole, to theoretical concepts of the impact of individual factors on the dynamics of exports. An increase in external demand, due to the growth in revenues of our main foreign trade partner, is the most contributing, positive, and statistically significant factor in the growth of Belarusian exports. All addressed sectors of the economy, in an appropriate response to the surge of Russia's external demand, increase supply of their product to this country with very high significant elasticity which can be apparently explained by the scope of the Russian economy standing head and shoulders above the Belarusian economy in terms of production volumes.

Table 2: Elasticity assessments resulting from the factor analysis of the dynamics of sectoral volumes of exports in the Republic of Belarus.

Industries	Elasticity assessments of factors:		
	Russia's GDP	Real exchange rate of the Belarusian ruble	Trade conditions
Petroleum	5.6*	-0.7	0.6
Chemical and petrochemical	2.0*	-0.5	0.1
Metallurgy	4.5*	-0.1	-2.2*
Mechanical engineering and metalworking	2.6*	-0.6*	-0.9*
Forestry and woodworking	3.2*	-0.4*	-1.7*
Light	1.6*	-0.5*	-1.4*

A negative and statistically significant response of exports of most addressed sectors of the Belarusian economy to changes in foreign trade conditions was also revealed as a result of the analysis. Assessments of corresponding elasticity made with the help of model (2) are significantly negative and basically exceed 1 in terms of absolute value. Exceptions are two industries, petroleum as well as chemical and petrochemical, for which exports elasticity assessments with respect to trade conditions turned out to be positive though statistically insignificant. Moreover, model (3) which additionally takes into consideration exports dependence on changes in the prices for major imported energies showed that crude oil appreciation has a positive and statistically significant impact on

exports of two above-mentioned sectors of the economy. This fact can be obviously explained by special conditions for crude oil import from Russia which is purchased, as it was mentioned earlier, at prices that differ from international.

The results of the analysis made on the basis of model specification (2) also show that exports of all addressed sectors of the economy respond to changes in the real foreign exchange rate of the Belarusian ruble with negative elasticity. However, for such industries as petroleum, chemical and petrochemical, as well as metallurgy received assessments turned out to be insignificant. For the first two industries it is the result of inconsistency in the impact exerted by the foreign exchange rate realignment and the price for the crude oil imported from Russia on the competitiveness thereof. The insignificance of the metallurgy exports elasticity assessment in terms of the exchange rate factor is obviously explained by the fact that considerable price fluctuations in the global metal market had a decisive impact on the competitiveness of this industry which is confirmed, incidentally, by very high statistically significant assessment of its exports elasticity with respect to changes in foreign trade conditions.

So, on completion of the analysis it is possible to state that the exchange rate factor has an ambiguous impact on the open Belarusian economy owing to a complex interaction of differently directed effects – changes in proceeds from the sale of exported product and changes in the production cost resulting from the appreciation/depreciation of industrial imports as well as domestic goods with high imports share. In individual sectors of the economy cumulative effects of the Belarusian ruble depreciation differ greatly both in value and in sign owing to sectoral peculiarities of the production pattern and the pattern of demand for the output.

Most sectors in the Belarusian economy represented in the structure of the intersectoral balance sheet compiled by the Ministry of Statistics and Analysis of the Republic of Belarus, including construction and agriculture, as well as all branches of the service industry, bear losses from the devaluation because their dependence on imports is far greater than their export potential.

First and foremost, major sectors of the Belarusian economy which generate large share of export revenue, such as chemical and petrochemical, petrol, forestry, woodworking and pulp and paper, metallurgy, and mechanical engineering and metalworking make significant cumulative gain from the devaluation. The factor analysis of the dynamics of these industries' exports made on the basis of Johancen cointegration analysis showed that they avail themselves, fairly effectively, of additional competitive advantages resulting from the devaluation of the ruble increasing supply of their product to the external market. The results of the same analysis indicate that exports of aforementioned sectors of the economy respond, in a statistically significant manner, with high positive elasticity to the real GDP growth of the main trading partner of our country – the Russian Federation as well as with negative significant elasticity, but not for all industries, to changes in foreign trade conditions.