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Article

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UKRAINE'S METALLURGICAL INDUSTRY: OUTPUT DYNAMICS THROUGH THE PRISM OF EXTERNAL FACTORS

Domestic metallurgical industry is an integral part of the world industry, and its development takes place in the context of global trends, such as constant growth of metallurgical production with simultaneous excess of smelting, increasing concentration of production, and increasing consumption and export of metal products in TOP-15 leading smelting countries. The main consequence of such trends is a significant intensification of competition on the global steel market.

Despite the fact, that Ukraine's metallurgical industry is an important participant in the global market of ferrous metals and raw materials for their production and has certain advantages in their production and export, like the whole Ukraine's economy, is open and small in macroeconomic terms. This gives grounds to refer Ukraine's metallurgical industry of to the category of "small open industry", which is characterized by export orientation, a small share of output in global output, exports, imports, and domestic consumption and, most importantly – by the lack of decisive influence on world prices.

Since Ukraine's metallurgical industry is small and open, and the vast majority of its products are shipped to world markets, it was suggested that the dynamics of metallurgical output is directly influenced by external factors such as world steel prices, the hryvnia exchange rate and the price for natural gas. The obtained results confirmed the hypothesis that Ukraine's metallurgical industry throughout the entire study period was completely dependent on the action of external factors. In particular, the favorable price situation on the global market of metal products ensured a high dynamics of metallurgical output. At the same time, devaluation of Ukrainian national currency in different periods had different effects. The price

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for natural gas restrained the metallurgical output throughout the entire study period.

***Keywords**: Ukraine's metallurgical industry, small open industry, external factors, global steel price, hryvnia exchange rate, price for natural gas, econometric model*

In the current conditions of economic development, the problems of efficient functioning of Ukraine's industry are becoming more important. For a long time, the key driver of Ukraine's industry has been the metallurgical industry. Its importance is difficult to underestimate, because for many strategically important sectors of Ukraine's economy, such as engineering, car industry, shipbuilding, and construction, it is the key to successful functioning and development. The metallurgical industry is also one of the leading budget-forming economic sectors, as it provides a significant part of Ukraine's foreign exchange earnings due to its developed export potential. Despite the fact that the metallurgical industry of Ukraine is an important actor in the global market of ferrous metals and raw materials, which has certain advantages both in production and export, it is open like the whole Ukrainian economy, and small in macroeconomic terms. For example, in 2017 the share of Chinese metallurgy in world steel output exceeded Ukraine's metallurgy more than 40 times, the share of world exports - almost 5 times, the share of world imports - almost 13 times, the share of world consumption - almost 150 times. Even without comparison with China's metallurgy, Ukraine's metallurgical industry is much smaller than many of its competitors. In particular, in India's steel output exceeds Ukraine's corresponding figure 5 times, Japanese exports - 2.5 times, and German imports - more than 25 times. In addition, speaking about Ukraine's consumption, it also lags behind all top manufacturing countries, in particular: Brazil - 4.1 times; Turkey - 7.5; Germany - 8.4; the Russian Federation - 8,6; South Korea - 11.4; Japan - 13.6; India - 19.6; and the USA - 21.3 times.

This comparison indicates that the metallurgical industry of Ukraine does not have a dominant position in the global steel market and is forced to adapt to foreign market conditions, which are generated by the dynamics of more important actors in the world economy [1, p. 216]. There is even a general dependence of Ukraine's macroeconomic dynamics on the key export markets, including the metallurgical one [2, p. 74–85]. The analysis of the metallurgical industry of Ukraine makes it possible to characterize it as *"small and open"*. This application of the concept of "big/small market actor" at the meso level is similar to the way it is used for the purposes of micro- and macroeconomic analysis.

Taking into account everything mentioned above, the consideration of the metallurgical industry of Ukraine as a *"small open industry"* takes into its export orientation, its small share in world output, as well as in exports, imports, consumption and, most importantly, the lack of decisive influence on the formation of global prices [3, p. 15].

Analysis of the recent dynamics of foreign trade in metallurgical products shows a significant loss of export potential, which restrains metallurgical output and negatively affects the financial and economic situation of the metallurgical industry

in Ukraine as a whole. There is some evidence that Ukraine's metallurgical companies are unprepared for the challenges of the global crisis, especially the excessive output of ferrous metals, falling demand for low quality metal products, increased competition and the emergence of new players in world steel markets such as China, India, and South Korea. In addition, the industry has accumulated systemic problems related to the need for technical and technological re-equipment of production, improving the quality of ferrous metals, new types of the manufacturing of steel and rolled products, etc. Mentioned above indicates that today the economic activity of Ukraine's metallurgy requires detailed analysis, identification of problems and development of recommendations for its further development.

The works of S. Aptekar, O. Amosha [4], V. Bolshakova, L. Tuboltseva [5] and others are devoted to the study of the peculiarities of development of the metallurgical industry of Ukraine in the conditions of market transformation. They analyze the impact of the economic crisis on the development of the metallurgical industry during the transformation period (1991-1995) and prove that the predominance of negative trends in this period was due to the lack of Ukraine's market of ferrous metals. It is shown that the presence of the country's own raw material base and a large of productive capacity has created preconditions for the development of export activities.

Scientific developments of O. Amosha V. Nikiforova [6], B. Burkynskyi, V. Osypova [7], A. Kasych [8], Yu. Makohon [9], V. Tochylin [10] etc., are devoted to modern tendencies of the world market development of metallurgical products and its influence on activities of Ukraine's metallurgy. However, researchers do not pay attention to the unsolved tasks of determining the impact of exogenous factors on the economic growth of Ukraine's metallurgical industry and the development of priority areas for its further development. This is because for a long time the study of economic growth has been focused on the study of key factors of production and structural components. However, economic processes were considered somewhat separately from those of social development and the characteristics of the environment where numerous economic factors interact. This means that the nature of the influence of certain factors on the economic growth of the metallurgical industry requires further research, especially in the direction of finding endogenous factors of development.

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of the influence of certain factors on the economic growth of the metallurgical industry requires further research, especially in the direction of finding endogenous factors of development.

Thus, taking into account everything mentioned above, the purpose of the article is to analyze and assess the impact of exogenous factors on the growth of output of Ukraine's metallurgical industry.

One of the key indicators that characterizes the growth of the metallurgical industry is the physical steel output over a certain period. As the final product of the metallurgical industry, it is necessary to use the indicator that characterizes total physical steel output and semi-finished products for the corresponding period (Y). Independent variables should be selected only those factors that most influenced the output of metallurgical products during the study period.

Since the metallurgical industry of Ukraine is small and open, and the vast majority of its metallurgical products are shipped to global markets, it can be assumed that the growth of steel output and semi-finished products is directly influenced by global steel price (XWPS). If the global steel price is higher, the income of Ukraine's metallurgical companies is higher too, and vice versa, lower global steel prices reduce their income. However, despite the fact that Ukraine is in the TOP-15 largest steel producers, Ukrainian exporters do not affect global pricing, as the output and exports of Ukraine's metallurgical products are too small compared to major competitors.

Another important factor that directly affects foreign trade in metallurgical products is the hryvnia exchange rate (X_{ER}). The change in the nominal exchange rate has a significant effect primarily on the amount of revenue in the national currency that metallurgical companies receive from exports, and thus creates incentives to change the output of metallurgical products for export. At the same time, in order to change the exports of metallurgical products, the demand on the global steel market must change. Therefore, the impact of changes in the hryvnia exchange rate on the price and exports of metallurgical products depends on several factors: the elasticity of demand on the global market for Ukraine's metallurgical products; the elasticity of deliveries of metallurgical products from other countries; at the same time, the metallurgical industry depends on sales in foreign steel markets.

The price of natural gas (X_{PNG}) is a rather significant exogenous factor on which the metallurgical output depends. This is due to the fact that natural gas, as one of the main fuel and energy resources, is still used in Ukraine's metallurgical production: in blast furnaces it burns to carbon dioxide, which, reacting with coke, forms a reducing agent carbon monoxide; in the process of open-hearth steel making, natural gas is used as a heat source.

In our opinion, due to export openness and small size of Ukraine's metallurgical industry in the global steel market, the selected factors are the most significant, and therefore will be included in practical calculations in the process of building an econometric model, which will assess their impact on metallurgical output during the study period.

The dynamics of metallurgical output is shown in Fig. 1.

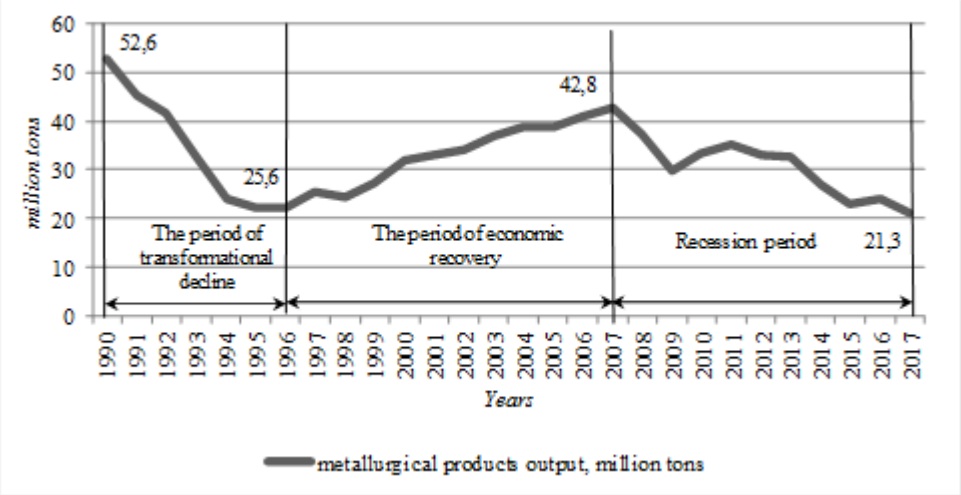

Fig. 1. Metallurgical products output in 1990–2017, *million tons*

Source: compiled according to: Main types of industrial products output for 1990-2017 / State Statistics Service of Ukraine.URL: http://www.ukrstat.gov.ua; Steel Statistical Yearbook 2005, 2015, 2018 / World Steel Association. URL: http://www.worldsteel.org

As can be seen from Fig. 1, the metallurgical products output during 1990–2017 was uneven. This unevenness makes it possible to further divide the time series of metallurgical products output into conditional periods. The period from 1990 to 1996 reflects the period of transformational decline. During this period, the country experienced a transformational crisis, characterized by an economic downturn due to a sharp decline in exports to foreign markets, especially in post-Soviet countries. However, due to the significant specifics of market changes in the metallurgical industry of Ukraine, until it reached the "bottom" in 1995-1996, the period of transformational decline has not been considered in the statistical study.

At the same time, along with the transformational crisis, other transformational changes took place during this period, which were aimed at creating a domestic institutional environment, namely: introduction of a mechanism of free pricing; transfer of Ukraine's companies to an independent balance sheet in order to further transform them into independent business entities with different forms of ownership; and granting Ukraine's companies the right to carry out export-import activities [11, p. 100]. In our opinion, these changes, especially the granting to metallurgical enterprises the right to independently carry out export-import activities, initiated the economic basis for the growth of metallurgical output during the next period (1997 to 2007). This period can be considered as economic recovery, because having reached the "bottom" in 1995-1996, since 1997, for the first time during the entire period of independence, Ukraine's metallurgy began to increase gross physical output.

It should be noted that during the period of economic recovery in the economy of Ukraine a number of latent events took place, which gradually stopped the process of cumulative growth of Ukraine's commodity output in general and in metallurgy in particular. In addition to the domestic problems that hampered economic growth in the industry, in 2008, the global financial and economic crisis erupted that marked

the beginning of the next period for Ukraine's metallurgists, which can be called a period of recession (2008-2017) and still continues. This period is characterized by a sharp decline in metallurgical output and the beginning of a systemic economic crisis, which later intensified with Russia's trade-and-occupation war against Ukraine and the not-always-balanced Ukraine's economic policy.

Given the fact that the activities of Ukraine's metallurgical industry are aimed at the primary satisfaction of external demand, which makes it an open sector, and that the share of its products in Ukraine's total, both in the overall structure of output and in the overall structure of exports is small, it is logical to assume that the metallurgical output during both the period of economic recovery (1997–2007) and the period of recession (2008–2017) was influenced by such exogenous factors as the global steel price; hryvnia exchange rate; and the price of natural gas.

The influence of exogenous factors on the dynamics of metallurgical output in the period of economic recovery 1997–2007 and its assessment

Throughout the period of economic recovery (1997-2007) in the metallurgical industry of Ukraine, there was a positive trend in the output of metallurgical products. The greatest amounts of outputs were recorded in 2007 at 42.8 million tons, which was almost equal to the level of output in 1991 (45.1 million tons). Such dynamics was provided mainly by external demand - about 70% of metallurgical products were shipped for export, and the rest (about 30%) satisfied domestic demand. In particular, due to the increase in global steel consumption, in 1997–2007 the export demand for Ukraine's metallurgical products almost doubled (from 16.1 million tons in 1997 to 30.3 million tons in 2007).

Focusing on meeting external demand, Ukraine's metallurgists became dependent on foreign economic conditions. This was confirmed by a simple econometric model (1) built in the environment of the Eviews 9.0 package. In particular, it confirmed the hypothesis that the growth of metallurgical output throughout the economic recovery period was influenced by such exogenous factors as the global steel price, the hryvnia exchange rate and the price of natural gas. Based on this assessment, the coefficients of elasticity of the impact of changes in these factors are obtained, in particular: global steel price ($\boldsymbol{X_{WPS}}$), hryvnia exchange rate ($\boldsymbol{X_{ER}}$) and natural gas price ($\boldsymbol{X_{PNG}}$) on metallurgical output ($\boldsymbol{Y}$):

$$\boldsymbol{Y} = 0.17*\boldsymbol{X_{WPS}} + 3.25*\boldsymbol{X_{ER}} - 0.16*\boldsymbol{X_{PNG}} + 4.06 \quad (1)$$
$$(0.0002) \quad (0.0635) \quad (0.0694) \quad (0.6954)$$
$$R^2=0.93, \quad DW=1.62, \quad Prob(F\text{-}statistic)=0.00.$$

Model based estimates with a high level of statistical significance (*Prob. t-Statistic* for each factor is given in parentheses) confirm that during 1997–2007 the largest influence on metallurgical production was exerted by world steel price, hryvnia exchange rate and natural gas price. The analysis of the statistical characteristics of the regression equation and verification of its quality (in the absence of autocorrelation of the first and higher orders, multicollinearity, and heteroscedasticity) indicate the adequacy of the model.

Analyzing this period, we can say that on average, when the global steel price (X_{WPS}) increased by 1 US dollar, metallurgical output (Y) increased by 0.17 million tons; with the increase of the hryvnia exchange rate (X_{ER}) by UAH 1 / USD, the output of metallurgical products (Y) increased by 3.25 million tons, while the increase in natural gas prices by 1 US dollar / thousand cubic meters reduced metallurgical output (Y) by 0.16 million tons. This indicates, in particular, that during 1997–2007, the domestic metallurgical industry depended significantly on fluctuations in global prices for semi-processed materials that it produced. At the same time, it had no decisive influence on these prices.

Fig. 2 shows the growth rates of global steel prices and output of metallurgical products throughout the period of economic recovery.

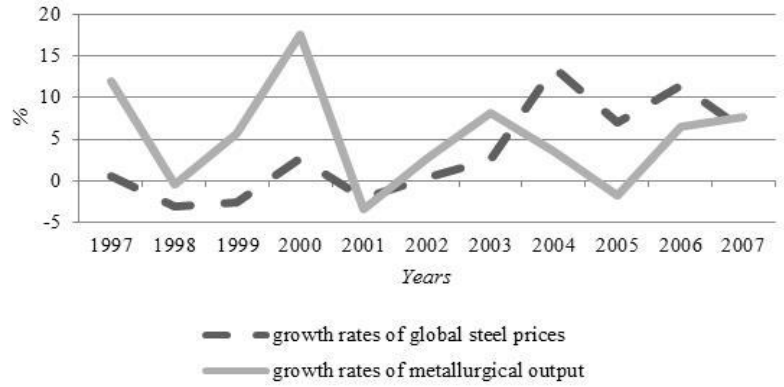

Fig. 2. Average annual growth rates of global prices for steel and metallurgical products in 1997–2007, *%*

Source: calculated according to: Steel Statistics archives 1990–2014 / World Steel Association. URL: http://www.worldsteel.org; Steel Statistical Yearbook 2018 / World Steel Association. URL: http://www.worldsteel.org; PPI Commodity data for Metals and metal products / U.S. Bureau of Labor Statistics. URL: https://data.bls.gov/pdq/SurveyOutputServlet

As can be seen from Fig. 2, fluctuations in global prices for steel exported by Ukraine correlate with the output of metallurgical products. This relationship can be considered as a kind of alphabet of ups and downs of Ukrainian metallurgy. Thus, some fluctuations are observed in the periods of increase in external prices for Ukrainian metallurgical products, while others are observed in the periods of decline.

Thus, in 1998 and 2000–2001, there was a slight "failure" of global steel prices on the global steel market. In 1998, it was caused by the financial crisis that began in mid-1997 in South and East Asia. At that time, Ukraine was still feeling the effects of the shocks and hyperinflation of the early 1990s. In the same period, there was a reduction in Ukraine's metallurgical output. The decline in global steel prices during 2000–2001 was primarily due to excess supply over demand. Since 2001, several high-level meetings took place within the OECD Steel Committee, where representatives of the top largest metallurgical countries discussed the problem of subsidies in the context of overproduction. In the process of these meetings between the participating countries, a preliminary agreement was reached to reduce excessive, primarily obsolete and worn-out, production capacity [12, p. 86]. Another

consequence of lower world prices for Ukrainian metallurgy, as in the previous period, was the reduction in metallurgical output. The growth of demand for ferrous metals on the global steel market since the beginning of 2002 eased the problem and countries weakened control over the use of agreements. Ukraine, which had a significant mass of the above mentioned capacities, continued to use them in the improving situation on the global steel market (Fig. 3).

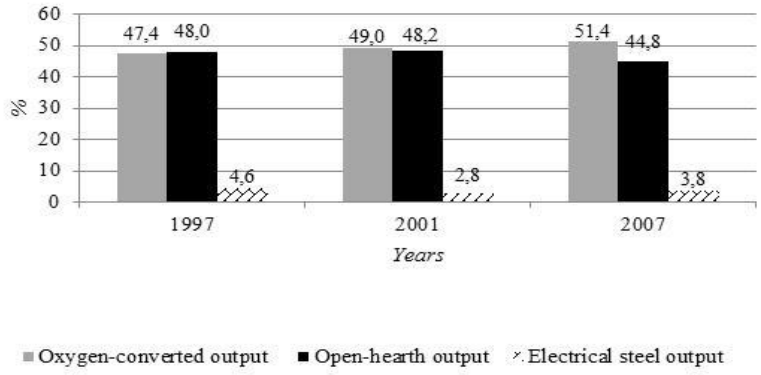

Fig. 3. Technological structure of Ukraine's steel output in 1997, 2001 and 2007, *%*

Source: calculated according to: Steel Statistical Yearbook 1998, 2002, 2008 / World Steel Association. URL: http://www.worldsteel.org

Thus, as we can observe, the technological structure of Ukraine's steel output in 2007, compared to 1997, did not actually changed.

Over the subsequent six years, the global steel prices increased sharply. This, in particular, clearly explains why the only sustainable economic recovery of both the metallurgical industry and the whole Ukraine's economytook place in 2002–2007. It should be noted that the recovery of raw materials during 2002-2007 occurred simultaneously with high inflation in the United States, which in this period usually exceeded 2%, reaching four percent or more [1, p. 232]. In 2002–2007, the average increase in global steel prices was 6.9%. This contributed to the average growth of metallurgical output by 4.4% per year. Due to this, the metallurgical industry received a significant influx of foreign currency, investment and loans. Thus, during 1997–2007, the investments in the fixed capital of metallurgical companies increased almost 6.2 times (from $ 361.5 million in 1997 to $ 2,224.6 million in 2007). The share of investments per ton of steel also increased (from USD 14.1 / t in 1997 to almost USD 52 / t in 2007). However, the growing amount of investment resources was not aimed at radical modernization of metallurgical companies, but mainly at the commissioning of temporarily decommissioned productive capacity in the crisis years, which was primarily caused by growing global demand for Ukraine's metallurgical products (with a significant growth of investment in fixed assets only since 2004). In addition, in the presence of production potential that significantly exceeds Ukraine's own needs and, due to lack of strategic vision for further development of the industry, the companies' owners considered it inexpedient to build new metallurgical plants. Some new technologies and types of equipment were

introduced into existing productions only in cases when it gave a quick economic return [12, p. 22]. Such "modernization" was carried out mainly based on Ukraine's equipment and domestic technological developments, which are cheaper compared to foreign counterparts. The result of such investment activities was that metallurgical companies faced an acute problem of aging (depreciation) of fixed assets (63.1% in 200 against 56.7% in 1997), which for a long time were almost not renewed.

Everything mentioned above shows that the more than six-fold growth of investment in fixed assets of metallurgical companies during the entire period of economic recovery was caused by the need to meet external demand, rather than the owners' desire to technologically upgrade productive capacity and thus change composition of output to produce environmentally cleaner products with higher value added. The insufficient effectiveness of investment activity is evidenced, in particular, by the report of the Accounting Chamber of the Verkhovna Rada of Ukraine "On the results of analysis of the Law of Ukraine "On conducting an economic experiment at the companies of Ukraine's mining and metallurgical complex"" [13]. Thus, based on the review of the analysis, the Board of the Audit Chamber noted that the activity of companies during the experiment was *positively affected by the coincidence in time of tax benefits, which were granted them and increased demand for metallurgical products in the foreign market*. The growth of metallurgical output at the participating companies was too unstable, as it mainly depended on foreign market conditions, rather than relied on constantly increasing demand in Ukraine's market, which did not give any reason to expect output growth in subsequent periods. There were also no significant changes in the restructuring of metallurgical companies. The structure of production costs of the participating companies did not change. The share of the companies' expenditures on raw materials and energy remained high. Further growth in metallurgical output (until 2007) was also caused primarily by growing demand in the foreign market.

Hryvnia exchange rate ($\boldsymbol{X_{ER}}$) had a positive effect on the output of metallurgical products during 1997–2007. However, experience shows that high export openness, combined with the small size and semi-processed products of Ukraine's metallurgical industry requires careful attention to the hryvnia exchange rate policy and its stability.

During the period of transformational decline with the government's excessively liberal monetary and budgetary policy, there was a rapid devaluation of the national currency, because of which a significant number of experts believed that the national currency was over-devaluated [14, p. 137]. After the change in economic policy in 1995, an increase in the real hryvnia exchange rate began, which is known to affect export-import amounts when prices rise faster than the nominal exchange rate. In 1996–1997, the nominal exchange rate stabilized. In 1998, relative to the same period in 1997, the nominal exchange rate increased by 32%, while the real exchange rate decreased by 14%.

For a long time, a significant number of experts in Ukraine, as well as international experts, believed that the prevailing trend of rising prices over the

depreciation of the national currency would not cause significant losses to exporters. To some extent, this could be agreed upon for some time, but since 2005, according to the analysis, the margin of safety of metallurgical exporters almost exhausted.

The growth of the real exchange rate since 2005 indicates that the competitiveness of Ukraine's metallurgical products on world steel markets began to gradually decline. This happened primarily due to the revaluation of the nominal exchange rate, although many of the experts, such as V. Heyets [14, p. 138] and S. Korablin [15], stressed the need for its moderate devaluation according to price changes. In other words, it is necessary to keep a stable real exchange rate rather than the nominal one, so that it corresponds to the real state of the economy. In particular, S. Korablin emphasized that the "real" stability of hryvnia (in other words, its gradual devaluation relative to the level of inflation) is more in the interests of national production than the policy of "nominal" stability. At the same time, the advantages of the exchange rate peg to the US dollar during periods of long-term depreciation were noted [16].

If we compare the growth rate of global steel prices with similar indicators of hryvnia exchange rate (Fig. 4), we can see that the sharp depreciation of the national currency during 1998-1999 occurred with a simultaneous fall in global steel prices. During this period, neither the Ukrainian economy nor its metallurgical industry was able to withstand the commodity recession. At the same time, given the rise in global steel prices, the hryvnia exchange rate in Ukraine gradually strengthened. This suggests that one of the main reasons for the growth was quite trivial: it was not based on radical structural reforms, nor a special business climate, nor an attractive investment environment nor budgetary discipline, but on an independent of them rise in global commodity prices [1, p. 236].

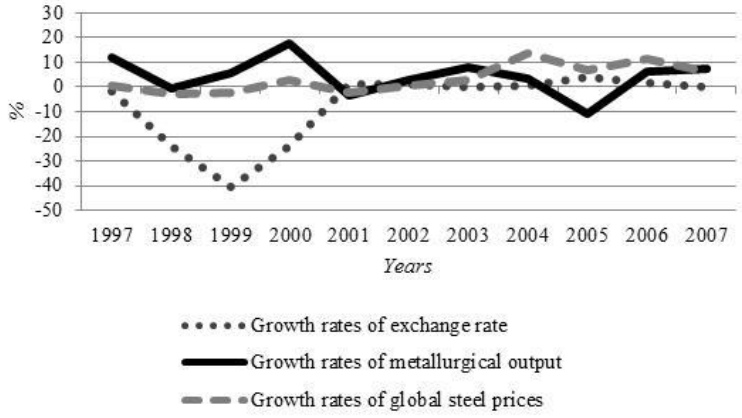

Fig. 4. Growth rates of exchange rate, global steel prices and metallurgical output in 1997–2007, *%*

Source: calculated according to data: Production of main types of industrial products for 1990–2017 / State Statistics Service of Ukraine. URL: http://www.ukrstat.gov.ua; PPI Commodity data for Metals and metal products / U.S. Bureau of Labor Statistics. URL: https://data.bls.gov/pdq/SurveyOutputServlet; The official exchange rate of the hryvnia against foreign currencies / NBU. URL: http://www.bank.gov.ua

Another factor that influenced the production of metallurgical products throughout the period of economic recovery was the price of natural gas. The dependence of metallurgical output on the price of natural gas is due primarily to the fact that the industry throughout the period of economic recovery used, in the production process, technologically obsolete productive capacity (see Fig. 3), which encouraged them to consume significant amounts of natural gas (from 13.7 million tons in 1997 to 20.7 million tons in 2007). Unlike iron ore, natural gas is a resource that is imported. During 1997–2007, part of it came from Turkmenistan, Kazakhstan and Uzbekistan. However, the largest amounts of imports were from the Russian Federation. Territorial and political proximity of the exporters of fuel and energy resources until the mid-2000s created a fairly stable situation for the development of Ukraine's metallurgical industry (the price of imported natural gas during 1999-2005 ranged from 50.1 to 67.5 US dollars / thousand cubic meters) [17]. However, in 2006 the price of imported natural gas for industry began to rise sharply due to a change in policy and in 2007 amounted to 171.1 US dollars / thousand cubic meters, which is almost 2.5 times higher than in 1997. It should be noted here that the relations between Ukraine and Russia on the issue of natural gas prices have never been based on market conditions and depended mainly on political agreements between the two countries [18]. The increase in the price of natural gas in the last few years of the study period had a negative impact on the output of metallurgical products.

The analysis and assessment of the impact of exogenous factors on the dynamics of metallurgical output during the recession period in 2008-2017

Due to the global financial and economic crisis of 2008-2009, the global steel market showed a sharp and synchronous reduction in demand and output of metallurgical products. Most metallurgical countries, including Ukraine, suffered from this reduction. In particular, in 2009 the deepest decline in steel production, compared to 2008, was observed in: the United States - 57.0%; Italy - 53.8; Germany - 40.1; Japan - 35.7; Brazil - 27.2; Ukraine - 24.7; The Russian Federation - 14.2; South Korea - 10.3; Turkey - 5.9%, etc. At the same time, during this period it was possible to observe an increase in steel output in China - 12.8% and India - 9.0%. In general, due to the decline in global steel consumption, its production in 2009 compared to 2008 decreased by 7.9%. Ukraine's exports in 2009 decreased compared to 2008 by 19.2%.

Based on a simple econometric model (2), built in the environment of the Eviews 9.0 package, the coefficients of elasticity of the impact of changes in global steel prices ($\boldsymbol{X_{WPS}}$), hryvnia exchange rate ($\boldsymbol{X_{ER}}$) and natural gas prices ($\boldsymbol{X_{PNG}}$) on metallurgical output ($\boldsymbol{Y}$) during the recession period were estimated and obtained:

$$\boldsymbol{Y} = 0.13*\boldsymbol{X_{WPS}} - 0.45*\boldsymbol{X_{ER}} - 0.014*\boldsymbol{X_{PNG}} + 4.06 \quad (2)$$

(0.0992) (0.0062) (0.1072) (0.3668)

$R^2=0.88$, *DW=2.65, Prob(F-statistic)=0.00.*

Model based estimates with a high level of statistical significance (in parentheses the value of *Prob. t-Statistic* for every factor is shown) confirm that during 2008-2017, the greatest influence on the output of metallurgical products, as in the period

of economic recovery, was exerted by the factors such as the global steel price, hryvnia exchange rate and natural gas price. The analysis of the statistical characteristics of the regression equation and verification of its quality (in the absence of autocorrelation of the first and higher orders, multicollinearity, and heteroscedasticity) indicates the adequacy of the model. It should be noted that estimates of the parameters of the econometric model were obtained *"other things being equal"*, in other words, without highlighting the influence of other important external and internal factors.

If we analyze this period, we can conditionally say that on average, with a 1 US dollar increase in global steel prices (X_{WPS}), metallurgical output (Y) increased by 0.13 million tons; when the hryvnia exchange rate (X_{ER}) increased by UAH 1 / USD, the metallurgical output (Y) decreased by 0.45 million tons; and with the growth of natural gas prices by 1 US dollar / thousand cubic meters, the output of metallurgical products (Y) decreased by 0.014 million tons.

This indicates, in particular, that Ukraine's metallurgical industry both in the period of economic recovery (1997-2007) and in the recession period (2008-2017) continued to depend significantly on fluctuations in global prices for its own semi-finished products. It did not have a decisive influence on the formation of the global steel price, it did not have enough capacity to replace technologically intensive imports and it could not count on serious investment and financial impetus from outside. This is despite the fact that its exports reached more than 70% of metallurgical output, supporting one more or less safe channel for the emission of hryvnia [1, p. 231].

Figure 5 shows the growth rates of global steel prices and metallurgical output throughout the recession period. As it can be seen from Figure 5, fluctuations in global prices for steel exported by Ukraine until 2013 correlated with metallurgical output. Lower prices reduced metallurgical output, and their increase ensured its growth. At the same time, when in 2009 the global steel price decreased by 14.0% compared to 2008, the output of Ukraine's metallurgical products decreased by 24.7%.

A gradual economic recovery of the United States, Europe, Japan, and China was a major factor in the global recovery in steel prices. Their new peak values for Ukrainian exporters of metal products were registered on 2011, later they began to gradually decline. Thus, the growth of global steel prices in 2010 compared to previous period by 10.0%, and in 2011 - by another 8.1%, contributed to the growth of Ukraine's metallurgical output by 10.5 and 5.4%, respectively. However, the rise on the global commodity market did not last even for two years (2010-2011), and its short-term nature did not allow speeding up the growth of Ukraine's metallurgical output by the end of the study period (2017). However, on the contrary, the decrease in global steel prices by 2.8% in 2012 led to a decrease in the Ukraine's metallurgical output by 7.0%.

The decline in global steel prices during the next four years (2013–2016) was accelerated due to the Russian intervention, due to which Ukraine lost control of the Autonomous Republic of Crimea, part of the occupied Donbas economy, and the

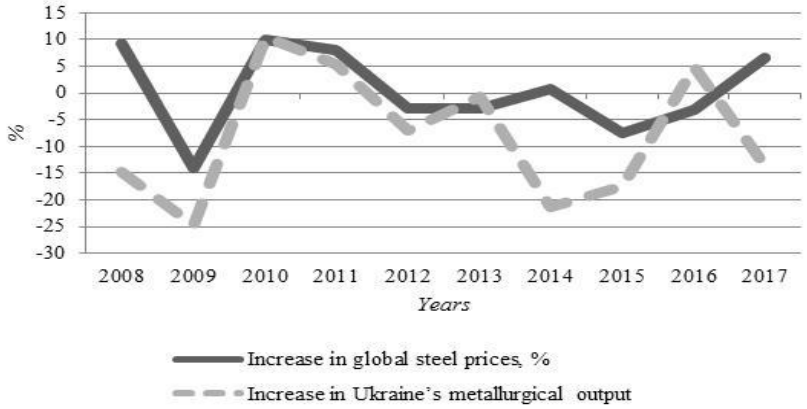

Fig. 5. Annual growth rates of global steel prices and metallurgical products in 2008–2017, %

Source: calculated according to data: Steel Statistical Yearbook 2018 / World Steel Association. URL: http://www.worldsteel.org; PPI Commodity data for Metals and metal products / U.S. Bureau of Labor Statistics. URL: https://data.bls.gov/pdq/SurveyOutputServlet

region's business assets and infrastructure. Industrial companies, land, state property, and social facilities were illegally seized in the east of the country [19]. There are 388 state-owned companies, 4,500 state-owned facilities and more than 100 large non-state-owned companies left in the occupied territories. Due to this, Ukraine's metallurgical industry suffered significant losses.

The occupation of the industrial part of Donbas led not only to the loss of some metallurgical companies (Yenakiieve Iron and Steel Works, Donetsk Iron and Steel Works and Alchevsk Iron and Steel Works), but also to the severance of raw-material, economic and infrastructural ties. Thus, at the end of 2013, before the Russian troops occupied the industrial part of Donbas, there were 150 coalmines of all forms of ownership in Ukraine, including 90 state-owned ones. With the beginning of Russian military occupation, most state-owned mines were left in uncontrolled territories (hereinafter – "ORDLO"). Since July 2014, government agencies effectively lost control over the work of most coal companies located in "ORDLO", totaling 85 coal-mining companies, or 57% of their total number [20, p. 25]. However, the market factors of Ukraine's crisis of 2014-2015 began to take shape as early as in 2012, when the fall in global steel prices resumed. This means that the structural vulnerability of Ukraine's metallurgical industry and lower steel prices did not promise it anything good until early 2014. Under these conditions, the annexation of Crimea and the war in Donbas only exacerbated economic problems not only in the metallurgical industry but also in Ukraine as a whole, which are deeply rooted in this country's half-raw-material production [1, p. 237]. Completely in line with this logic, the 2016 recovery in the global steel market contributed to the resumption of growth in Ukraine's metallurgical output (5.0%). However, its future trajectory, with the invariability of the government's economic policy, will continue to be determined by this external factor, which of independent of domestic ones.

Under such conditions, even a slight decrease in the global steel prices leads to the devaluation of the national currency.

The most informative indicator of changes in the price competitiveness of Ukraine's goods relative to the products of its major trading partners is *the real effective exchange rate* (REER) (Fig. 6).

Fig. 6. The dynamics of the hryvnia REER according to the sliding geographical structure of exports (sliding average structure for three years, including the current one), 2003 = 100, based on CPI deflator, *%*

Source: calculated according to: Industrial producer price indices for 2003–2019 / State Statistics Service of Ukraine. URL: http://www.ukrstat.gov.ua; Steel Statistical Yearbook 2020 / World Steel Association. URL: http://www.worldsteel.org; PPI Commodity data for Metals and metal products / U.S. Bureau of Labor Statistics. URL: https://data.bls.gov/pdq/SurveyOutputServlet; The official exchange rate of hryvnia against foreign currencies / NBU. URL: http://www.bank.gov.ua

Since Ukrainian goods usually compete in foreign markets with more than one country, and in Ukraine's market with imports from many countries too, which in turn apply various policy measures (structural, monetary, and anti-inflationary ones) aimed at supporting their specific goods, then, the meaningful factors to determine the competitiveness of Ukraine's goods are not aggregated REER indices of the hryvnia, but partial ones calculated for each of the goods exported. It should be emphasized that the list of partner countries for exports and imports in practice is almost the same, which actualizes the calculation of partial (individual) indices of REER hryvnia by structure of exports (*"export basket"*) and by structure of imports (*"import basket"*). The calculated indices will always differ from the aggregate REER index (for example, those calculated by the NBU) both in the number of countries included in the analysis andin the volume of trade flows with them. However, despite the complexity of the calculations of partial REER, as world experience shows, this approach makes it possible to distinguish the effects of external and internal factors. In practical terms, it means that since external demand cannot be influenced by the Ukrainian side, the estimation of the existing and expected margin of competitiveness of Ukraine's goods (through forecast estimates

of partial REER) shows opportunities for Ukraine's economic policy measures to expand the potential of export flows. [21, 22].

The dynamics of the real exchange rate shows that during the economic recovery, the devaluation of the national currency provided elastic demand on the global steel market and increased the output of Ukraine's metallurgical products (Fig. 7), and then during the recession period its sharp depreciation along with lower global prices on steel had an opposite effect (Fig. 8).

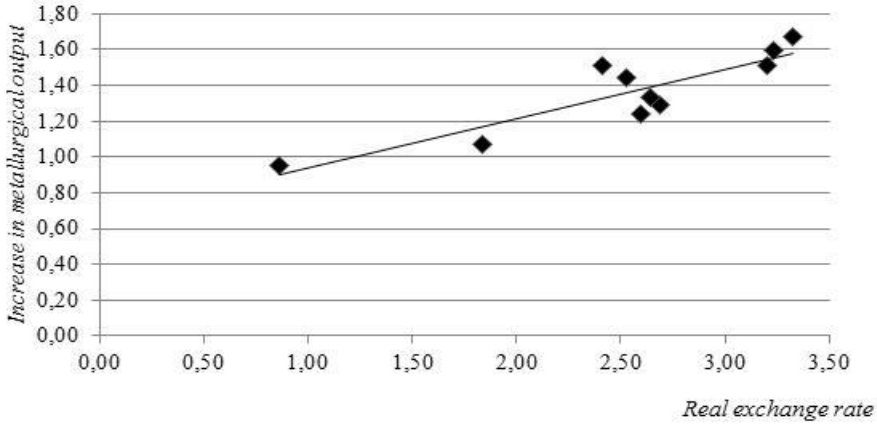

Fig. 7. The relationship between the real exchange rate of the hryvnia and the metallurgical output in 1998-2007 compared to 1997

Source: calculated according to: Industrial producer price indices in 1997–2017 / State Statistics Service of Ukraine. URL: http://www.ukrstat.gov.ua; Steel Statistical Yearbook 2018 / World Steel Association. URL: http://www.worldsteel.org; PPI Commodity data for Metals and metal products / U.S. Bureau of Labor Statistics. URL: https://data.bls.gov/pdq/SurveyOutputServlet; The official exchange rate of hryvnia against foreign currencies / NBU. URL: http://www.bank.gov.ua

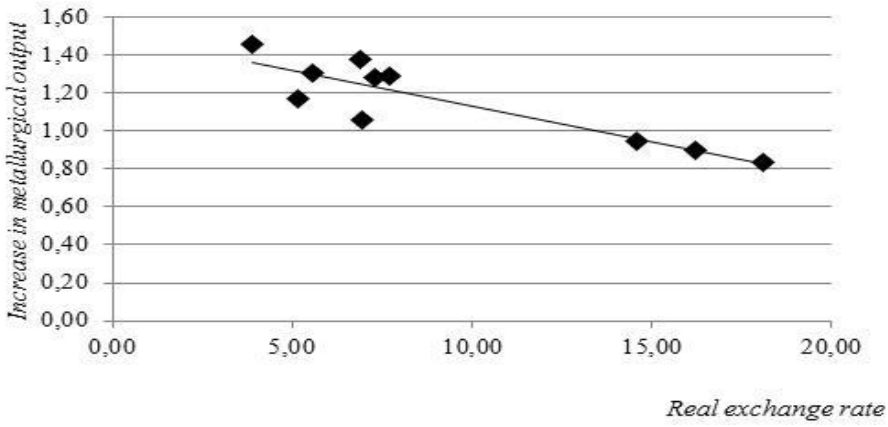

Fig. 8. The relationship between the real exchange rate of the hryvnia and the metallurgical output in 2008-2017 compared to 1997

Source: calculated according to: Industrial producer price indices in 1997–2017 / State Statistics Service of Ukraine. URL: http://www.ukrstat.gov.ua; Steel Statistical Yearbook 2018 / World Steel Association. URL: http://www.worldsteel.org; PPI Commodity data for Metals and metal products / U.S. Bureau of Labor Statistics. URL: https://data.bls.gov/pdq/SurveyOutputServlet; The official exchange rate of hryvnia against foreign currencies / NBU. URL: http://www.bank.gov.ua

This was caused primarily by the sharp threefold devaluation of the national currency. In particular, in 2009 the national currency depreciated against the US dollar by 32.4%. During the same period, metallurgical output decreased by 24.7%. The devaluation of the national currency occurred primarily due to the global financial and economic crisis, which actually brought down the level of global steel prices by 14.0%.

The subsequent major jump was recorded in 2014 - the national currency depreciated against the US dollar by 32.8%. During the same period, metallurgical output decreased by 21.4%. The depreciation of the national currency and the reduction of output in 2014 were caused primarily by the annexation of the Autonomous Republic of Crimea and the beginning of hostilities in the Donbas region. However, in 2015, the hostilities in the East of our country were accompanied by another reduction in global steel prices by 7.4%, which led to another sharp devaluation of the national currency by 45.6%. The output of metallurgical products in this period decreased by 17.5% compared to 2014. In fact, for the entire period of decline during 2008-2017, the national currency depreciated more than 5-fold. It was the sharp devaluation of the national currency, caused by the decline in global steel prices and hostilities in the east of Ukraine, which had a negative impact on the competitiveness of the metallurgical industry.

Everything mentioned above shows that, in contrast to the period of economic recovery, where the devaluation of the national currency until 2005 provided a competitive advantage to Ukraine's metallurgists in the global steel market, during the recession its sharp and repeated depreciation significantly restrained Ukraine's metallurgical output, which was caused by the excess of Ukraine's steel prices over external ones. In general, during the period of decline, the ratio of Ukraine's and global prices ranged from 1.1 to 1.8, which testified to the almost complete exhaustion of the competitiveness of Ukraine's metallurgical products in international markets. Currency inflows, as well as investments, began to decline. Thus, in 2008 the share of foreign exchange earnings from exports of metallurgical products in the total structure of Ukraine's exports was 43.2%, then at the end of 2017 their share decreased by more than 1.7 times - up to 24.9%.

Along with the reduction of foreign exchange earnings from metallurgical exports, there is a reduction in investment in fixed assets. Thus, during this period, investment in fixed assets of metallurgical companies decreased almost three times (from 1994.0 million US dollars in 2008 to 670.3 million US dollars in 2017). There is also a decrease in the share of investment per ton of steel (from 53.5 US dollars / ton in 2008 to almost 31.5 US dollars / ton in 2017). This trend indicates that, contrary to the theory, in the metallurgical industry, investment in fixed capital does not increase the metallurgical output, but on the contrary, investment in fixed capital depends on the increase in metallurgical output. And the latter depends on global steel consumption. In other words, the economic experiment conducted by the state in the late 1990s to technologically upgrade the metallurgical industry completely

failed with the beginning of the first crisis (2008-2009), and Ukraine's metallurgists still cannot get out of the crisis.

Both in the period of economic recovery and in the period of recession, the price of natural gas had a negative impact on Ukraine's metallurgical output. However, before 2006, the price of Russian natural gas was relatively stable, and then during the subsequent period it had a multi-vector trend. This was primarily due to the signing of a contract for supply and transit of natural gas between Gazprom and Naftogaz of Ukraine for the period from 2009 to 2019. The price of natural gas began to be determined by a formula linked to the cost of oil and its products in global markets [23]. Accordingly, in the period from 2008 to 2013, due to rising global oil prices and Ukraine's dependence on monopolistic supplies of natural gas from the Russian Federation, the price of natural gas steadily rose. The share of Russian natural gas in total imports in 2013 was 92%, or 51% of total consumption.

Due to high prices for oil and "gas leverage effect", which the Russian Federation was constantly used for achieving its political goals in Ukraine's territory, the principles of the agreement became unfavorable for Ukraine. The annexation of the Autonomous Republic of Crimea and the occupation of part of the territory of Donbas became the starting point for reducing the dependence on the imports of Russian natural gas. For this reason, the reverse supplies were opened from EU countries and Ukraine's natural gas output was increased. Due to the increase in reverse gas supplies from Europe and the reduction of consumption, Ukraine's dependence on Russian natural gas in 2014 decreased to 34% of total consumption [18]. The price of imported natural gas in 2014 began to decline. However, despite its decline, it remained at a fairly high level for Ukraine's producers of metallurgical products, primarily due to the sharp devaluation of the national currency. In 2017, the price of natural gas was about 310 US dollars / thousand cubic meters.

It should be noted that during this period, as well as during the period of economic recovery (1997–2007), metallurgical companies continued to consume imported natural gas in the process of metallurgical production. This is because Ukrainian metallurgical companies continue to operate open-hearth furnaces (in 2017, there were nine open-hearth furnaces in Ukraine). In general, at the end of 2017, in the metallurgical industry, the open-hearth method of steel smelting accounted for 21.5%. In the world, this figure was only 0.4% together with Ukraine. A very low share in the metallurgical industry of Ukraine, compared to developed countries, is occupied by the technology of electric steel production, respectively 6.8 and 28.0%. At the same time, the oxygen-converter steel production technology in Ukraine in 2017 was at the level of international standards and amounted to 71.7 and 71.6%, respectively.

Conclusions

The obtained results confirm the hypothesis that Ukraine's metallurgical industry, which is characterized by export openness, is economically small and is characterized by medium level of processing and both in the period of economic recovery (1997-2007) and in the period of economic downturn (2008-2017)

completely depended on external factors. In particular, the favorable price situation on the global market of metallurgical products almost throughout the study period favored the growth of Ukraine's metallurgical products. At the same time, in contrast to the period of economic recovery (1997-2007), where the devaluation of the national currency ensured the competitiveness of Ukraine's metallurgical products on the global steel market and supported the expansion of its output, during the recession (2008-2017) its excessive depreciation together with the Russian annexation of the Autonomous Republic of Crimea, the occupation of the industrial part of Donbas, and the severance of raw material-economic and infrastructural ties made it non-competitive. It is exactly because of price competition that Ukrainian producers were forced to reduce their metallurgical output. The price of natural gas throughout the study period also restrained the metallurgical output.

In general, the analysis showed that the division of the study period (1997–2017) into two intervals - the period of economic recovery (1997–2007) and the period of economic recession (2008–2017) made it possible to more clearly identify the influence of exogenous factors on the dynamics of metallurgical output and proved that the metallurgical industry of Ukraine, characterized by excessive export openness, small size, medium level of processing and technological imperfection, seriously depends on the international market conditions for raw materials, which it produces and supplies to foreign markets. At the same time, according to the calculations, in case of a simultaneous reduction of prices and demand in international markets for Ukraine's metallurgical products, it finds itself in a financial crisis, even if it follows a prudent business strategy.

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МЕТАЛУРГІЙНА ГАЛУЗЬ УКРАЇНИ: ДИНАМІКА ВИРОБНИЦТВА КРІЗЬ ПРИЗМУ ЗОВНІШНІХ ФАКТОРІВ

Вітчизняна металургійна промисловість – невід'ємна частина світової галузі, і її розвиток відбувається в контексті глобальних тенденцій: постійного зростання обсягів металургійного виробництва з одночасним перевищенням виплавки металу, збільшенням концентрації виробництва, зростанням обсягів споживання й експорту металопродукції в ТОП-15 країнах – лідерах із виплавки металу. Головним наслідком таких тенденцій є суттєве загострення конкуренції на світовому ринку сталі.

Незважаючи на те, що металургійна галузь України є важливим учасником глобального ринку чорних металів та сировини для їх виготовлення, має певні переваги у їх виробництві та експорті, вона, як і вся національна економіка, є відкритою та за макроекономічними рисами – малою. Це дає підстави віднести металургійну галузь України до категорії «малої відкритої галузі», яка характеризується експортною орієнтованістю, незначною часткою випуску у світовому виробництві, експорті, імпорті, внутрішньому споживанні продукції і, що найголовніше, – відсутністю визначального впливу на формування світової ціни.

Оскільки металургійна галузь України є малою та відкритою, а переважна кількість виробленої нею металопродукції відвантажується на світові ринки, було зроблено припущення, що прямий вплив на динаміку металургійного виробництва здійснюють такі зовнішні фактори, як світова ціна на сталь, обмінний курс гривні та ціна на природний газ.

Отримані результати підтвердили гіпотезу про те, що вітчизняна металургійна галузь протягом усього досліджуваного періоду повністю залежала від дії зовнішніх чинників. Зокрема, динаміку металургійного виробництва забезпечувала сприятлива цінова кон'юнктура на світовому ринку металопродукції. Водночас девальвація національної валюти у різні періоди мала різний ефект. Упродовж усього досліджуваного періоду випуск металургійної продукції стримувала ціна на природний газ.

Ключові слова: *металургійна галузь України, мала відкрита галузь, зовнішні фактори, світова ціна на сталь, обмінний курс гривні, ціна на природний газ, економетрична модель*

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