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Economic assessment of the implementation of the resource-efficient strategy in the oil and gas sector of the economy on the basis of distribution of trade margins between extracting and processing enterprises

Abstract: The article present the results of use of the proposed economic and mathematical apparatus to develop scenarios that provide for the partial or complete elimination of contradictions associated with the pricing policy between oil and gas production and the production of refined products. In the output we noted changes in the material consumption of products of the oil and gas sector of Ukraine. We corrected a certain contradiction between the extractive and processing enterprises of the oil and gas sector. This is related to the uneven distribution of value added between them,

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which allows extractive enterprises to make a profit, while processing enterprises are at a break-even point. This situation, as we have seen, also distorts the results of the real assessment of resource efficiency in this sector of the economy. Thus, the research is aimed at developing scenarios that provide for a gradual decrease in the price of extractive products and its simultaneous growth in processing so that the corresponding impact on the economy was minimal. The first scenario envisaged a reduction in the price by –10% for the products of oil and gas companies with a simultaneous increase in the price of refining so that the average share of value added in the country as a whole was not decreased, taking appropriate adjustments of resource efficiency indicators into account. The second scenario was based on the need for deeper price adjustments in the oil and gas sector. Thus, the reduction of the price of products at the extractive enterprises at the level of –20% and its increase it in processing while maintaining the national average share of value added was envisioned. The third scenario provided for the equalization of material consumption in production and processing due to the price factor.

Keywords: oil and gas sector, oil and gas production, indicators of material resources, resource-efficient strategy

Introduction

Ukraine's oil and gas sector plays an important role in ensuring the country's energy balance. Since the intensive development of the economy involves a more efficient use of available resources, the problem of resource conservation is always extremely important and relevant in those areas of the economy where their production and primary processing occurs.

1. Actual scientific researches and issues analysis and the research objective in Ukraine

The main tendencies of development and value of innovative technologies in the oil and gas sector were studied by foreign scientists, including: Karev A., Milovidov K., Nechully S., Pokhriyal S., Thomas S. and others (Karev 2015; Milovidov 2019; Nechully et al. 2018).

To develop measures and an economic assessment for the implementation of the methodological approach to the effective development of resource conservation in the oil and gas sector of Ukraine (Shmygol et al. 2020; Kostetska et al. 2020), we will use model of price equilibrium based on the intersectoral balance of Leontief (Vitlinsky 2003; Pottosina and Juravlev 2003; Wolf 2012) which allows the mutual influence of value added shares and industry price indices on the structure of intermediate consumption and, accordingly, changes in material output of these sectors to be

assessed. The need for the practical implementation of this stage of the study is due to the extremely high value added generated by oil and gas companies due to the high level of prices for their products. This, in turn, distorts the real indicators of all types of resources. At the same time, refineries of the oil and gas sector have significant financial problems due to low value added.

2. Developing scenarios for the elimination of contradictions between pricing policy oil and gas production and the production of refined products

We will use the proposed economic and mathematical apparatus to develop scenarios that provide for the partial or complete elimination of contradictions associated with the pricing policy between oil and gas production and the production of refined products. Changes in the material consumption of products of the oil and gas sector of Ukraine should be indicated in the output. The study of the influence of these factors on the performance indicators should be carried out by calculating the appropriate coefficients of elasticity.

Firstly, we will assess how the increase in the price of oil and gas products by +1% will affect the efficiency of consumption of material resources in the oil and gas sector and value added in the economy as a whole.

The recalculation of the coefficients of direct costs and the corresponding sectoral shares of value added was performed according to formulas (1) and (2). The adjustment of direct cost ratios, taking new prices into account (Shmygol et al. 2020):

$$a'_{ij} = a_{ij} \cdot \frac{P_i}{P_j} \tag{1}$$

where:

a'_{ij} – the ratio of direct costs, taking industry indices of the price into account,
P_i and P_j – vectors of industry price indices.

Accordingly, after the completion of the adjustment, according to formula (2), new shares of value added are set for each industry in the economy:

$$v'_j = 1 - \sum_{i=1}^{n} a'_{ij} \qquad \text{for all} \quad j = 1, \ldots, n \tag{2}$$

where a'_{ij} is the ratio of direct costs taking into account changes in sectoral shares of value added and prices.

The results of calculations indicate the following changes in material consumption:

- at oil and gas production enterprises the material consumption will decrease by –0.10%, from 13.93% to 13.83%. As previously predicted, rising prices for the products of enterprises have a positive effect on their indicators of efficiency of resource use. However, it should be considered that specified positive changes, in this case, were due to an extensive factor, which is undesirable because its effect is limited;
- at oil refineries, as a result of these changes, the material consumption will increase by +0.23%, from 27.66% to 27.89%, which is negative. This is due to the high dependence of refineries in the oil and gas sector on the products of the extractive industry. This reflects the corresponding ratio of direct costs, which according to 2018 was 0.226.

Also the price factor of a particular industry through a system of intersectoral relations has a direct impact on the development of the economy of the entire state. To assess it, consider what changes will occur with the shares of value added according to 2018 (Fig. 1).

As can be seen from Figure 1, price increases by +1% for the products of oil and gas companies have a positive effect only for themselves, as their share of value added will increase by +0.31%. However, the negative showing of such a pricing policy is much deeper. The largest reduction in the share of value added will take place in oil refining (–0.23%), electricity, gas, steam and water production (–0.15%), transport and communications (–0.08%).

The functioning of these industries is mostly related to the direct consumption of oil and gas. That is why, worthy of the effect of distribution, they lose value added due to additional intermediate consumption.

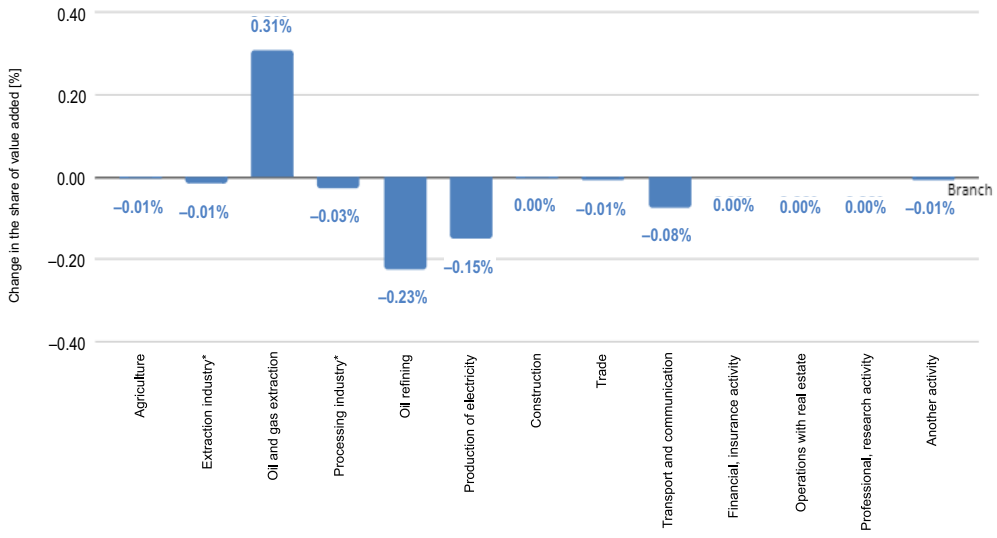

Fig. 1. The impact assessment of the growth of the price of oil and gas products by 1% on the industry value added according to 2018 data

Rys. 1. Ocena wpływu wzrostu cen produktów naftowych i gazowych o 1% na wartość dodaną przemysłu według danych z 2018 roku

The extractive and refining industries, which included enterprises of the relevant industries, with the exception of oil and gas production and refining were marked by «*» symbol on the diagram (Fig. 1).

If the price decreases, we will have the opposite effect from its reduction.

Similarly, the analysis of how an increase in the price of oil refineries by +1% will affect the efficiency of consumption of material resources of this sector of the economy. According to calculations, we will have the following changes in indicators:

- at oil and gas production enterprises the material consumption remains practically unchanged, at the level of 13.93%. That is, taking into account given the intersectoral linkages, the refining industry of the oil and gas sector has a high dependence on the extractive industries. At the same time, feedback is much weaker, or almost absent;
- at oil refineries there is a reduction in material consumption by –0.26%, from 27.66% to 27.41%, which is positive.

The results of the study of the influence of the price factor on the development of other sectors of the economy in graphical form are shown in Figure 2.

As we can see, the most advantageous position from the proposed changes was received by oil refineries. Their share of value added increased by +0.74%, from 23.35% to 24.10%. Given that today this indicator at the level of the economy as a whole is about 40%, it can be argued that these changes are a necessary condition for the balanced development of the industry. The situation is exacerbated by the fact that according to 2018 data, refineries operated almost at the break-even point, with a return on sales of 1.8%.

At the same time, such management actions have a negative impact in most sectors of the economy. Thus, the most significant reduction in the share of value added is expected in such in-

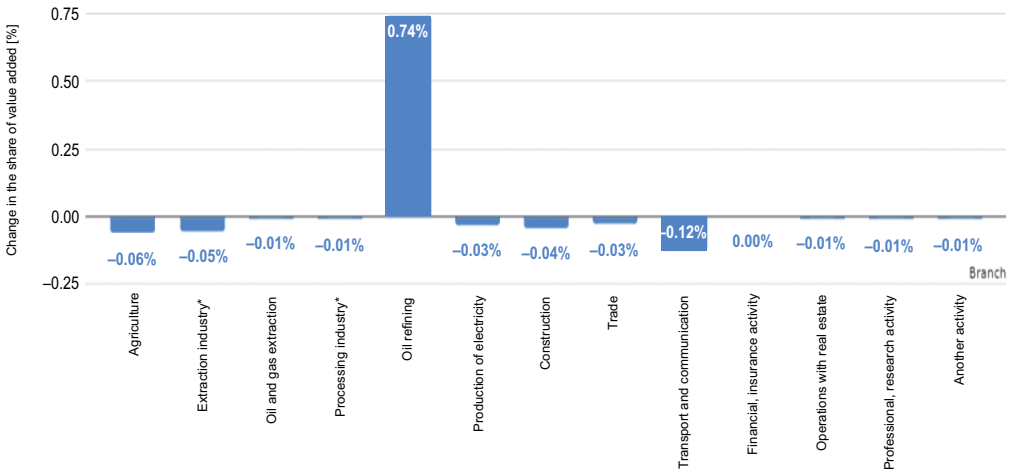

Fig. 2. Assessment influence of price growth of production of oil refining enterprises on 1% on branch value added

Rys. 2. Ocena wpływu wzrostu cen produkcji przedsiębiorstw rafineryjnych na 1% na wartość dodaną branży

dustries as: transport and communications (–0.12%), agriculture, forestry and fisheries (–0.06%), the extractive industry except for the oil and gas sector (–0.05%), construction (–0.04%) and others.

Thus, at this stage of the study, due to the price factor, we need to correct a certain contradiction between the extractive and processing enterprises of the oil and gas sector. This is related to the uneven distribution of value added between them, which allows the extractive enterprises to make a profit, while processing enterprises are at a break-even point. This situation, as we have seen, also distorts the results of the real assessment of resource efficiency in this sector of the economy. Thus, further research is aimed at developing scenarios that provide for a gradual decrease in the price of extractive products and its simultaneous growth in processing so that the corresponding impact on the economy was minimal.

2.1. The first scenario

The first scenario envisaged a reduction in the price by –10% for the products of oil and gas companies with a simultaneous increase in the price of refining so that the average share of value added in the country as a whole was not decreased, taking appropriate adjustments of resource efficiency indicators into account.

2.2. The second scenario

The second scenario was based on the need for deeper price adjustments in the oil and gas sector. Thus, a reduction in the price of products at the extractive enterprises at the level of –20% and its increase in processing while maintaining the national average share of value added was envisioned.

2.3. The third scenario

The third scenario provided for the equalization of material consumption in production and processing due to the price factor. We will consider each of the proposed scenarios in more detail and conduct a comparative assessment.

The redistribution of the price escalation factor under the first scenario between the enterprises of the oil and gas sector allowed the price of refined products to be increased by +10.75%, provided that the price of oil and gas production decreased by –10.0%. At the same time, the share of value added in the economy as a whole remains at the level of 2018 and is equal to 40.01%. As a result of this adjustment, resource intensity indicators will take such values:

- at the extractive enterprises the material consumption increased by +1.15%, from 13.93% to 15.08%;
- at the processing enterprises decreased by –4.58%, from 27.66% to 23.08%.

It can be noted that there was some alignment of both efficiency indicators of material resources use and shares of value added in the structure of the oil and gas sector, which is positive. However, the proposed measures are insufficient to correct the existing disparities. The results of the calculations on the impact of this scenario on the economy of Ukraine are given in Table 1.

Table 1. The impact of the pricing policy of oil and gas companies on the value added of industries according to scenario I

Tabela 1. Wpływ polityki cenowej spółek sektora ropy i gazu na wartość dodaną branż według scenariusza I

Industries	Share of value added [%]		
	2018 data	Scenario	Deviation
1	2	3	4
Agriculture, forestry and fisheries	37.49	36.89	–0.60
Extractive industry*	36.97	36.54	–0.43
Oil and gas sector: - oil and gas production - production of refined products	 64.88 23.35	 61.37 32.69	 –3.51 +9.34
Processing industry*	25.38	25.52	+0.14
Production and distribution of electricity, gas, steam and water	32.96	34.16	+1.19
Construction	22.91	22.48	–0.43
Wholesale and retail trade	49.47	49.24	–0.22
Transport and communication	46.88	46.33	–0.55
Financial and insurance activities	66.69	66.68	–0.01
Real estate activities	75.21	75.14	–0.07
Professional, scientific and technical activities, telecommunications	51.28	51.20	–0.08
Other activities	65.94	65.92	–0.02

The extractive and refining industries, which included enterprises of the relevant industries, with the exception of oil and gas extraction and refining are marked by symbol "*" in Table 1.

As can be seen from Table 1, the proposed changes in price adjustments within one sector of the economy have an impact on all industries without exception. These columns (3) reflect the new equilibrium state of the economic system. The increase in the share of value added impacted direct consumers of extraction products: oil refining (+9.34%), production and distribution of electricity, gas, steam and water (+1.19%) and the processing industry (+0.14%).

All other industries depended more on processed products. Therefore, their share of value added tended to moderately decrease. The largest relative losses took place: oil and gas production (–3.51%), agriculture, forestry and fisheries (–0.60%), transport and communications (–0.55%), construction (–0.43%) and others.

Thus, the first scenario allowed the availability of refineries with their own sources of further economic development to improve and the resource intensity of their products to increase.

The second scenario provided for a deeper redistribution of trade margins between oil and gas companies. A proposal was made to increase the price of refined products by +21.5%, provided a decrease in the price of oil and gas production by –20.0%. The share of value added in the economy as a whole also remained at the level of 2018. As a result of such changes, the efficiency of resource use will be equal to:

- at the extractive enterprises the material consumption will increase by +2.59% to 16.52%. The corresponding share of value added will decrease by –7.89% to 56.98%;
- at processing enterprises the material consumption index will decrease by –8.35% to 19.31%, which is positive. At the same time, the share of value added will increase by +17.02% to 40.37%, meaning, it will reach the national average.

Thus, in economic terms, this scenario is more appropriate than the previous one.

Table 2. Comparative analysis of scenarios by impact on industry shares of value added

Tabela 2. Analiza porównawcza scenariuszy pod względem wpływu na udział wartości dodanej w przemyśle

Industries	Change in the share of value added [%]		
	Scenario I	Scenario II	Scenario III
1	2	3	4
Agriculture, forestry and fisheries	–0.60	–1.20	–1.53
Extracting industry*	–0.43	–0.85	–1.09
Oil and gas sector: ✦ Oil and gas production ✦ Production of refined products	 –3.51 +9.34	 –7.89 +17.02	 –10.84 +20.73
Processing industry*	+0.14	+0.29	+0.37
Production and distribution of electricity, gas, steam and water	+1.19	+2.39	+3.05
Construction	–0.43	–0.85	–1.09
Wholesale and retail trade	–0.22	–0.45	–0.57
Transport and communication	–0.55	–1.10	–1.41
Financial and insurance activities	–0.01	–0.01	–0.02
Real estate transactions	–0.07	–0.13	–0.17
Professional, scientific and technical activities, telecommunications	–0.08	–0.15	–0.19
Other activities	–0.02	–0.04	–0.05

In order to equalize the indicators of resource efficiency, the estimated price indices in the third scenario should be equal to: for extractive enterprises 0.744, or –25.6%; processing enterprises –1.2748, or +27.48%. In this case, the material consumption throughout the oil and gas sector will be set at 17.49%.

At the same time, under the conditions of this scenario, the share of value added in extracting will remain at the level of 54.04%, and in processing it will increase to 44.09%, which is positive. The results of the comparative analysis of the industry dynamics of this indicator for all the above scenarios are given in Table 2.

As can be seen from Table 2, the condition of maintaining the existing level of return, allowed the negative impact of the proposed price adjustment on the functioning of other sectors of the economy to be minimized. For its further mitigation, in order to ensure economic growth, the price index for the production of refined products should be reduced relatively to the specified level above.

3. Summary results of comparison of scenarios

Summary results of the comparison of scenarios on the material consumption indicator of production of the enterprises of the oil and gas sector are shown graphically in Figure 3. They give an idea of how the elimination of the identified disparities in the economic development of the objects of study affect the target and confirm the need for the proposed changes.

Thus, based on the results of the study, it can be concluded that the oil and gas sector of Ukraine has had significant problems in recent years with the uneven distribution of trade margins

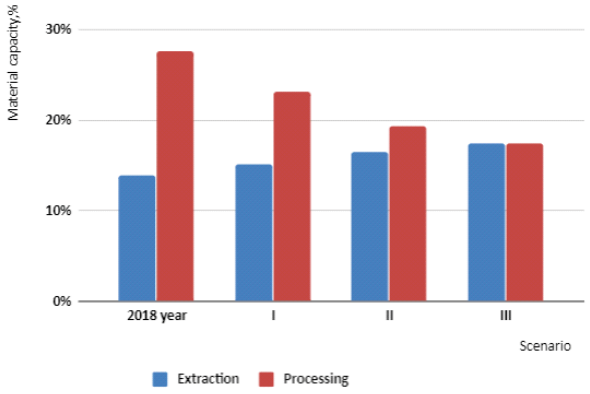

Fig. 3. Comparative analysis of scenarios due to the material consumption of products indicators at oil and gas sector enterprises

Rys. 3. Analiza porównawcza scenariuszy ze względu na wskaźniki materiałochłonności produktów w przedsiębiorstwach sektora ropy i gazu

between extracting and processing enterprises. The direct relationship between this factor and resource efficiency demonstrates that the problem of efficient use of resources in the industry cannot be solved separately.

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Ocena ekonomiczna realizacji strategii efektywnej gospodarki zasobami w sektorze ropy i gazu w oparciu o rozkład marż handlowych pomiędzy przedsiębiorstwami wydobywczymi i przetwórczymi

Streszczenie

W artykule przedstawiono wyniki wykorzystania opracowanych zależności ekonomicznych do budowy scenariuszy, które pozwalają na częściowe lub całkowite wyeliminowanie sprzeczności związanych z polityką cenową między wydobyciem ropy i gazu a produkcją produktów rafinowanych. Uzyskano

zmiany materiałochłonności produktów sektora ropy i gazu Ukrainy, skorygowano pewną nierównowagę między przedsiębiorstwami wydobywczymi i przetwórczymi tego sektora. Wiąże się to z nierównomiernym rozkładem wartości dodanej między nimi, co pozwala przedsiębiorstwom wydobywczym na osiąganie zysków, podczas gdy przedsiębiorstwa przetwórcze znajdują się na progu rentowności. Pokazano, że taka sytuacja zniekształca również wyniki rzeczywistej oceny efektywności wykorzystania zasobów w tym sektorze gospodarki. W związku z tym badania mają na celu opracowanie scenariuszy zakładających stopniowy spadek cen produktów wydobywczych i jednoczesny wzrost cen produktów przetworzonych, przy minimalizacji wpływu tych zmian na gospodarkę. Pierwszy scenariusz zakłada obniżenie ceny o 10% na produkty firm wydobywczych ropy i gazu przy jednoczesnym wzroście ceny produktów ich rafinacji, tak, aby średni udział wartości dodanej w kraju nie zmniejszył się, biorąc pod uwagę odpowiednie dostosowanie wskaźników efektywnego gospodarowania zasobami. Drugi scenariusz opiera się na potrzebie głębszych korekt cen w sektorze ropy i gazu. Przewidziano w nim obniżenie ceny produktów w przedsiębiorstwach wydobywczych o 20% i zwiększenie cen produktów przetworzonych, przy zachowaniu średniego krajowego udziału wartości dodanej. Trzeci scenariusz zakłada wyrównywanie zużycia materiałów w produkcji i przetwórstwie ze względu na cenę.

Słowa kluczowe: sektor ropy i gazu, wydobycie ropy i gazu, wskaźniki zasobów materiałowych, strategia efektywnej gospodarki zasobami