International Journal of Engineering Research and Technology. ISSN 0974-3154, Volume 13, Number 12 (2020), pp. 4464-4468

Analysis of the Cross-Sectorial Balance and the Importance of the Oil Industry in the Development of the National Economy of the Russian Federation

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Abstract

The oil industry certainly has an impact not only on related sectors of the national economy, such as energy, petrochemicals, engineering, transport, exploration, but also in general for all sectors of the economy. Most of the branches and sectors of the modern economy depend on decisions on state regulation of the oil industry. The "Costs - Release" tables, being an integral part of the system of national accounts, are a set of interconnected tables containing detailed characteristics of the production and use of goods and services, as well as income generated in the production process. Based on a comparison of the tables of production costs, intersectional and fuel and energy balance, the authors analyzed the influence of the oil industry on the entire value chain of the final product In the work, we examined the interaction between the fuel and energy balance and the cross-sectorial balance of Russia, and based on the combination of these data, we analyzed the structure of consumption of primary hydrocarbon raw materials by production stages not only in physical terms, but also in cost terms.

Keywords: Fuel Balance, Power Balance, Oil Production, Cross-Sectorial Balance, Costs-Release Tables

I. INTRODUCTION

In the modern world, the share of interpenetration of industries in the production process is very high, both due to the complexity of the latter, and due to the implementation of the cluster approach to the development of territories. One wrong decision by the state regarding one industry can lead to negative consequences and even recession in another industry. The oil industry is particularly sensitive to these changes. Firstly, oil is a basic resource for petrochemicals and petrochemicals. Secondly, oil products are used both in the energy sector and in bio pharm. And finally, thirdly, given the size and geography of our country, the cost of logistics, and accordingly the cost of a huge amount of final products depends on transportation costs, i.e. prices for gasoline, diesel, aviation fuel, kerosene.

Serious attention in the literature is given to the fuel and energy complex. Some authors analyze and calculate the contribution of the oil and gas industry to total GDP [3; 4; 6]. Other authors consider the oil industry as a driver of innovative development of the state [7; 8; 9; 1]. Also in the literature there is a point of view that the oil industry is developing mainly in a number of resource regions and the basis for development is cluster initiative and cluster policy [10, 5].

To determine the role and analysis of the importance of the oil industry in the development of other sectors of the national economy of the Russian economy, we conducted a study of the inter branch and fuel and energy balances of the Russian Federation. At the first stage, the aim of the study was to determine changes in the cost and price of energy in the fuel and energy complex of Russia during the transition through the stages of the technological cycle - from production to processing and final use of fuel and energy resources. All this will also allow comparing the productivity of the domestic market and exports, and comparing the weighted average prices for various end users by type of fuel.

II. METHODS

The initial data for the analysis were the tables of the resources and use of goods and services of the Russian Federation for 2015. The fuel and energy balance of the Russian Federation for 2015 and also the data of the US Energy Information Agency in the form of Sankey diagrams and tables.

The peculiarity of the analysis consists in comparing the data of the fuel and energy and intersectional balances. It is important to note that a similar problem has not yet been investigated in Russian scientific and expert literature. Due to the fact that the intersectional balance of the Russian Federation is so far published only once every 5 years, the latest data on it are dated 2015. To compare the inter industry and fuel and energy balances, indicators are selected whose data are present or can be calculated in both balances, their

values in rubles and tons of oil equivalent are determined, relative indicators in rubles / so on are calculated, which characterize the cost and the price of fuel or energy. Further, the indicators are ranked by the stages of the technological cycle of production, conversion and use of energy.

Our study is based on a methodological approach to assessing energy efficiency indicators in regions based on the fuel and energy balance. It includes a system of models for forecasting the region's fuel and energy complex based on the calculation of the fuel and energy balance under various scenarios characterizing the volumes of fuel production and consumption

III. RESULTS

The energy sector includes 4 types of activity (product):

1. Coal and brown coal (lignite); peat (code 10 MOB)

2. Oil and natural gas; services related to the extraction of oil and gas, except for exploration (code 11 MOB)

3. Production of coke ovens and petroleum products (code 23 MOB)

4. Electricity, gas, steam and hot water (code 40 MOB)

Products (1) and (2) are assigned to the extractive industries of the inter industry balance and the resources of the fuel and energy balance.

Product (3) is produced on the basis of transformation of primary energy resources into oil products. Product (4) - on the basis of the transformation of primary energy into electric, thermal energy, or through the production of these types of energy.

Consumers of fuel and energy in the economy in their turn are:

- Primary energy resources are consumed by industries (3) and (4) for conversion to other types of fuel / energy

- Primary energy resources, as well as fuel / energy after processing, are intermediate consumption products by sectors of the economy. In the fuel and energy balance, their consumers are industry, transport, non-energy use, other sectors, except for residential sectors

- End-use sectors of fuel / energy - households, the public sector, non-profit organizations (in the fuel and energy balance corresponds to residential)

- Export of fuel / energy - the same in the inter industry balance and fuel and energy balance

Fuel and energy resources in the intermediate consumption of types of economic activity (industries) are primary and secondary energy resources consumed in the mining, manufacturing and service sectors, except for those consumed in energy and oil refining.

The intersectional balance allows us to find out which industries and in what volume consume primary products, in this case we are interested in mineral resources.

To overlay the data of the inter industry balance on the fuel and energy balance, it is necessary to carry out calculations of a number of indicators. To do this, we use the following notation in millions of rubles.

i = 1 to n – products by MOB columns

j = 1 to n - products by MOB lines

N - Many products, total

M – Many products, mining industries (coal, oil and gas)

T - Many products transforming fuel / energy (production of petroleum products, production of electricity, steam and hot water)

a_{ij}- Elements of the table of use of goods and services at basic prices

m_{ij}– Elements of the mark-up table equal to the sum of trade, transport and tax margins

va_i- Value is added to product i

F_j– Final consumption of the product j by sectors of the economy

X_j- Export Product j

Indicators of the fuel and energy balance, so-called:

CoalM - coal mining

OilM - oil production

GasM - natural gas production

OilP - production of petroleum products

EnOut - produced electric and thermal energy, at the output, minus losses

ErD - Used fuel and energy resources in the economy (in the domestic market in intermediate and final demand)

ErX - Export of fuel and energy resources

Table 1 presents the fuel and energy balance data on the final use of energy.

To combine the data of fuel and energy and intersectoral balances, it is necessary to calculate some indicators.

Fuel cost of extractive industries with margins:

$$CM_i = \sum_{i=1}^{M}\left(\sum_{j=1}^{N} a_{ij} + va_i\right) + \sum_{i=1}^{M}\sum_{j=1}^{N} m_{ij}, \quad \text{for} \quad i \in M \qquad (1)$$

Table 1. Fuel and energy balance data on final energy use, mln.t.o.e. 2015

Fuel	Coal	Oil and gas	Oil products	Electricity	Total
Production	200,3	1060,6			1260,9
Transformation: petroleum products - input		283,6			283,6
Transformation: petroleum products - output			283,6		283,6
Transformation: e / t energy - input	59,6	199,7	6,7	73,6	349,9
Transformation: e / t energy - output				216,0	216,0
Used in economics (ErD)	27,4	141,2	114,6	169,2	452,4
Export (ErX)	99,7	412,5	135,2		647,4

Fuel and energy costs for transforming input industries:

$CT_i^{inp} = \sum_{i=1}^{T}\left(\sum_{j=1}^{M+T} a_{ij} + \sum_{j=1}^{N} m_{ij}\right)$, for $i \in T, j \in M, j \in T$ 2)

The energy cost of transforming industries at the exit:

$CT_i^{out} = \sum_{j=1}^{N} a_{ij}$, for $i \in T$ 3)

The cost of intermediate and final consumption of fuel and energy, with margins in the domestic market:

$ED = \sum_{j=1}^{M+T}\left(\sum_{i=1}^{N} a_{ij} + \sum_{i=1}^{N} m_{ij}\right) + \sum_{j=1}^{M+T} F_j + MF_j$, for $j \in M, j \in T, i \in N - T, i \notin T$ 4)

Fuel and energy export, with MX export margins

$EX = \sum_{j=1}^{M+T} X_j + MX_j$, for $j \in M, j \in T$ 5)

Price 1 toe mined coal

$P^{coal} = \frac{CM_{coal}}{CoalM}$, 6)

The average price of 1 toe extracted oil and natural gas. Separate pricing is not possible, as there is only one oil and gas production product in the IOB.

$P^{oil\&gas} = \frac{CM_{oil\&gas}}{OilM+GasM}$, 7)

The price of petroleum products, rubles / t.

$P^{oilP} = \frac{CT_{OilP}^{out}}{OilP}$ 8)

The average price of electric and thermal energy, rub / t.o.

$P^{EnOut} = \frac{CT_{EnOut}^{out}}{EnOut}$ 9)

The average price of fuel and energy resources consumed in the intermediate demand of economic sectors (extractive, manufacturing industries and services) and final demand of economic sectors:

$P^{ErD} = \frac{ED}{ErD}$ 10)

The average price of fuel and energy resources exported:

$P^{ErX} = \frac{EX}{ErX}$ 11)

The cost of 1 toe = Costs, million rubles / volume, mln.toe

Price for 1 toe = Cost 1 t.o. + margins on 1 toe

IV. DISCUSSION

Markups include trade, transport and tax margins. The sum of mark-ups for each product is determined by the sum of the elements of the tables of trade and transport and tax margins, or the difference between the elements of the Table of goods and services at customer prices and the Table of goods and services at basic prices.

Price change during the transition by stages - this indicator reflects the difference in price for 1 toe. Fuel / energy:

- For oil products at the entrance - the difference between the price of oil purchased by the oil refinery and the cost of oil produced

- For oil products at the exit - the difference between the selling price of oil products, without margins, and the price of oil refineries purchased

- For electric (heat) energy at the inlet - the difference between the costs of supplying purchased fuel for power plants and boiler houses and the cost of its production

- For electric (heat) energy at the exit - the difference between the selling price for consumers of electric and thermal energy, and the price of fuel consumed

- For comparison, the indicator "the same without taking into account losses" is calculated - in this case, the cost of electric and thermal energy is allocated to the amount of fuel and energy resources at the input, and not at the output. TERs at the output are reduced by the sum of losses, which depend on the efficiency of stations and losses in networks. This

indicator is needed to assess which part of the added value of electric and thermal energy is determined by technological factors, and which part is determined by economic

- In the intermediate consumption of fuel and energy by sectors of the economy - the difference between the price of fuel / energy supplied and the purchase price of activities for intermediate consumption, taking into account the structure of the consumed fuel / energy

- In the final consumption of fuel and energy by economic sectors - the difference between the price of fuel / energy supplied and the purchase price of households, state and non-profit sectors, taking into account the structure of consumed fuel / energy

- Export - the difference between export prices and selling prices of fuel / energy, taking into account export margins

V. SUMMARY

Prices in terms of oil price, in dollars per barrel, are calculated:

$$Pd = Pr \cdot \frac{TiB}{Kd} \quad 12)$$

Where Pd - price per barrel of oil, USD

Pr - price per barrel of oil, rubles,

TiB - conversion factor of energy units, from t.u. to barrels, is 0.1364 barrels per ton;

Kd is the average annual exchange rate of the US dollar to Russian rubles, in 2015 equal to 61.3194 rubles / dollar.

The price of petroleum products per 1 liter of fuel equivalent is determined by:

$$Pop = Plprub \cdot \frac{1000}{0{,}8} \quad 13)$$

Where Pop is the estimated retail price of petroleum products, taking into account margins, rub / liter

Plp - estimated retail price of light petroleum products (the price of petroleum products at the outlet), rub / so-called.

0.8 - the average mass of light petroleum products (gasoline and diesel fuel), kg / liter

Estimated selling price of electricity, rubles / kWh:

$$Pe = Poutrub \cdot 11630 \quad 14)$$

Where Poutrub is the price of electric and thermal energy at the output, rub / so-called.

11630 - Conversion factor of the so-called in kWh, kWh / so-so.

Table 2 presents the results of a combined analysis of the inter industry balance and the fuel and energy balance of the Russian Federation in monetary terms.

Table 2. The results of a combined analysis of the inter industry balance and the fuel and energy balance of the Russian Federation in monetary terms.

Stage	Product	volume, mln.toe	Costs, million rubles	The cost of 1 toe, rub.	Extra charges, million rubles	Extra charges for 1 toe, rub	Price for 1 toe, rub
Resou r-ces	Coal and brown coal; peat	200	806973	4029	22927	114	4143
	Oil and natural gas	1061	8978465	8465	19430	18	8484
Conve r-sion	Petroleum products: raw materials received	284	4015255	14158	239452	844	15002
	Petroleum products: produced by fuel and energy resources	284	7182568	25326	0	0	25326
	Electricity, gas, steam and hot water: fuel received	350	3284083	9386	827700	2366	11751
	Electricity, gas, steam and hot water: energy produced	216	6954304	32196	0	0	32196
	the same without losses	350	6954304	19875	0	0	19875
Final cons	Used in economics	452	8392836	18552	1419192	3137	21689
	Export	647	8055695	12443	4742010	7325	19768

VI. CONCLUSION

Thus, based on a combination of data from the intersectional and fuel and energy balances of the Russian Federation, the structure of consumption of primary hydrocarbon raw materials by production stages is analyzed not only in physical but also in cost terms. The costs of extraction and conversion of oil and oil products have been allocated, both the general margins and the margins per 1 ton of oil equivalent have been calculated.

This analysis allows us to more closely trace the dependence of the national economy on the oil industry of Russia, to draw conclusions about the mechanisms of creating added value in the process of movement of raw materials along the production chain. As can be seen from the above analysis, there is not a single industry that would not directly or indirectly use oil or its derivatives in its production cycle.

For this reason, the issue of effective intersectional interaction seems to be important both from a production and regulatory point of view. It is important to assess the regulatory impact with the introduction of new industry regulation tools not only for the oil industry and organizations included in it, but also for related industries, the activities of which directly depend on management decisions made in the “anchor” area for them.

ACKNOWLEDGEMENTS

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

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