Forecasting the Influence of World Oil and Gas Prices on Ukraine's Electric Power Industry

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Abstract: Given the peculiarities of the dominant structure of the economy and the available export potential, the most important exogenous factor of economic dynamics for Ukraine is the world oil and gas prices. The purpose of the study is to forecast the impact of the world price of oil and gas on the electricity industry of Ukraine. The article analyses the dependence of the main macroeconomic indicators of the Ukrainian economy on the dynamics of world oil prices. Several hypotheses about the sensitivity of macroeconomic indicators of the Ukrainian economy to fluctuations in oil prices have been put forward, as well as a system of simultaneous equations has been specified and evaluated, what makes it possible to test these hypotheses. Scenarios of the reaction of the Ukrainian economy to exogenous shocks associated with a sharp change in the level of oil prices are considered, and some measures are proposed to reduce the negative consequences of fluctuations in world oil prices for the Ukrainian economy. The results of the analysis show that the Ukrainian economy is extremely sensitive to fluctuations in world oil and gas prices. Sustainable development is impossible without the implementation of urgent measures for diversification and modernization, the transition from export-raw material to innovation-oriented model of economic development.

1. INTRODUCTION

Given the peculiarities of the dominant structure of the economy and the available export potential, the most important exogenous factor of economic dynamics for Ukraine is world oil and gas prices. Despite the presence of an inhibitory (relative to economic growth) effect caused by the strengthening of the real exchange rate of Ukrainian hryvnia, the increase in world oil prices and the correlated prices for natural gas, metals and mineral fertilizers has a positive effect on the dynamics of the Ukrainian economy, both due to the increase in demand for the results of its current functioning, as well as due to increased investment activity. On the contrary, a decrease in world prices for oil and gas almost inevitably leads to a drop in real GDP and the volume of investments.

The significant dependence of the Ukrainian economy on the export of raw materials in conditions of significant fluctuations in their prices exacerbates the problem of macroeconomic instability. The seriousness of the possible consequences of an unfavorable change in the foreign economic situation can be confirmed by a sharp drop in real GDP, which is caused primarily by a significant decrease in world prices for oil and gas.

The purpose of the study is to forecast the influence of the world price of oil and gas on the electricity industry of Ukraine.

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2. LITERATURE REVIEW

Analysis of recent research and publications. The problem of the sensitivity of the economy of Ukraine and the countries of the world in general to fluctuations in world prices for oil and gas attracted the attention of a number of researchers, such as: Bezsmertna O.M. (2023), Vytvytskyi J.S. (2023), Maksyshko N.K., Cheverda S.S. (2023), Rahman M.S., Yevtushenko V.A., Chuprynyuk Yu. V. (2023), Batten J., Siner K., and Lucy B. (2017), Gedych T. (2017), Gen J.G., and Fan Y. (2016), Gutium T.G. (2019; 2021), Moldabekova G., Raimbekov Z., Tleppayev A., Tyurina Y., Yesbergen R., Amaniyazova G. (2022) and many others. From our point of view, the attempt to formulate and test several basic hypotheses about the nature of the impact of the dynamics of world oil prices on the dynamics of electricity production in Ukraine in modern conditions, as well as to trace the impact of an external shock associated with a sharp drop in world oil prices on dynamics of Ukrainian GDP, investments, and exchange rate, deserves attention. To do this, you can use a compact system of simultaneous econometric equations, which is quite economical in terms of the number of parameters used and reflects the dependence of the main parameters of the electric power industry (electricity production) on the dynamics of world oil prices.

3. RESEARCH RESULTS

Oil is one of the most important raw materials on the world market. Countries actively use this natural resource, increasing the volume of extraction and production. One of the factors in the development of the country's economy is the suc-

cessful processing of oil and obtaining oil products from it, the use of oil in various industries, and not only as an export of raw materials. Today, the dynamics of oil prices are significantly influenced by OPEC countries.

World oil prices are determined by several factors: the cost of oil extraction, the used supply base, and the supply and demand ratio. In addition, state regulation of prices, conditions of stock and over-the-counter markets, characteristics of oil, etc., are of great importance.

Moderately favorable trends were visible in global industry at the end of 2021: the EU and Japan sharply increased the growth rates of industrial production in November (up to +2.5% and +7.0% m/m, respectively), in China this indicator increased for three months in a row, reaching +4.3% y/y in December. But forecasts remain cautious: in January 2022, the IMF reduced the expected growth rate of the world economy by 0.5 pp to +4.4% y/y against the background of continued quarantines, the effects of logistics and energy crises, and a reduction in the amount of state support (Global Energy Outlook, 2021, 2023).

Quotations of the oil market in January 2022, although characterized by consistently positive dynamics, still feel the influence of such restraining factors as the strengthening of the dollar, the growth of commercial oil reserves in the USA and the threat of new local lockdowns. At the same time, the OPEC countries maintain the former parameters of the agreement, considering the risks of reduced demand due to the spread of new strains of COVID-19 as insignificant (US Energy Information Administration, 2023).

In December 2021, world gas prices reached record high values, but from the end of the month began to decrease due to the reorientation of American LNG supplies from Asia to Europe and favorable weather conditions for increasing wind generation in the European region. However, already in the second decade of January, prices once again exceeded the $1,000/Tm3 mark against the background of risks of aggravation of geopolitical conflicts in Eastern Europe (Global Energy Outlook, 2021, 2023).

The price of oil depends on a number of standards, factors and complex processes. In addition, it should be emphasized that the price, which is announced daily in the mass media, is intended for immediate sale in the markets and does not necessarily reflect the real situation in this area. The world is divided into three oil markets: Namix, West Texas in the USA and Brent for Europe, Oman, or Dubai and for the markets of East Asia. Oil is evaluated in three places according to five types of oil. For example, Arab oil prices in the US market have fallen $7 per barrel from Namix or West Texas, while European market prices are estimated to be $5-7 per barrel below Brent, while in the East Asian market it is $2-4 per barrel. While the price of Arab oil is higher (it is the most expensive type of oil in the US market at a price of $1-2 per barrel) than the price of Namix or West Texas, and in the European markets it is $2 more per barrel, than the price of Brent, and the price on the East Asian market is $3-4 more per barrel.

Therefore, for the rest of the consumers, oil prices change according to the contracts and according to the conditions of the oil market. The price of oil has been formed over a long period, which has led to fluctuations in the history of oil, which has been going on for more than 150 years. Oil prices were stable (around $3.6) for many years until 1973 (Erickson, 1980). They were regulated by international companies, especially the group of companies known as the "Seven Sisters" (Exxon, Mobil, Chevron, Gulf, Texaco, Shell, and BP). The size of supply was determined by the market, and therefore the market was stable and often balanced.

This system collapsed after the decision of the Arab oil producers within OPEC in 1973 to ban the export of Arab oil to the United States of America in protest of Israel's support in the war against the Arabs at the time (Erickson, 1980). Oil prices soon began to rise. Between 2000 and 2008, global oil demand rose sharply, following increased demand from China, India, and other developing countries. Where the increase in demand was unexpected and OPEC was not prepared for it, it caused prices to rise due to the limited supply of oil at the time.

In July 2008, oil price speculation intensified, driving prices up to $140 per barrel, the highest price level in history. But prices fell in the second half of the same year as speculation waned and demand weakened due to the global financial crisis caused by the collapse of major US banks and the collapse of mortgage companies. By the end of 2008, prices had fallen below $40 per barrel. In 2014, at a meeting in Algeria, OPEC decided to reduce the amount of oil exported from the market to 4.2 million barrels per day. Prices recovered in the second half of 2014 (Augutis, 2015). It is worth emphasizing that prices have increased due to the evolution of alternatives and the appearance of shale oil in larger volumes than in the previous year. High prices helped to search for ways and alternatives for oil extraction. The main reason for the drop in oil prices in 2014 was changes in the policy of OPEC.

The price of crude oil is one of the most important indicators of the world economy. The most important factors affecting prices:

- increased supply due to technical innovations, especially hydraulic fracturing and horizontal drilling, which led to a decrease in prices;

- demand for oil is one of the most important factors that allows controlling oil prices worldwide;

- the Organization of Petroleum Exporting Countries (OPEC), which consists of 13 countries, directly affects oil prices, it has the ability to control prices by changing or reducing production rates;

- production cost is one of the most important factors affecting prices;

- the exchange rate of the US dollar.

In the short term, a weaker dollar will increase speculation in oil contracts after investors realize that oil is priced like any other commodity in dollars, so it will be cheap relative to other foreign currency-denominated investments, and therefore associated with the rise in world oil prices.

In the long term, a low dollar exchange rate will change market fundamentals through its impact on supply and demand for oil reserves. Indirect causes that significantly affect prices are crises, natural disasters and political instability.

Historically, wars have seen a significant increase in demand for oil due to consumer fears of worsening economic conditions. This is evidenced by the rise in oil prices, which in 2008 reached over $140 per barrel after the wars that took place at that time in Iraq and Afghanistan (Kohut, 2015). Economic crises have a negative impact on the economy of a particular country or group of countries. Political crises that usually occur in one country affect more than one country through civil, regional or international wars. This has a negative impact on oil prices, and such crises usually lead to higher prices as demand from countries increases.

The oil extraction boom is taking place in the USA, where the markets are glutted with oil, which is probably why OPEC countries, led by Saudi Arabia, are maintaining the current rate of fossil fuel production without reduction. This led to a sharp drop in oil prices, increased pressure on the US rival and a slowdown in the development of the Chinese economy, which negatively affected global oil demand. It is worth noting that the effect on oil prices is that there are some countries where oil is running out. This will be a serious problem for the country unless new deposits are discovered or new technology is applied to replace oil with another product. These countries include Colombia, UAE, Algeria, Norway, Mexico, Britain, Angola, Brazil, USA, Indonesia, China and Malaysia. In the long term, these countries will depend on new discoveries. In particular, in a report published by the BBC, it is stated that oil production in Great Britain will continue for another twenty years.

Although the rise in oil prices is a positive indicator for oil-producing countries, the decline in the value of the dollar against world currencies contributed to a decrease in profits from the sale of oil, which is valued in dollars.

Taking into account the inflation factor and the deterioration of the dollar exchange rate between 1986 and today, it is clear that the dollar has lost about 65% against the Japanese yen, 60% against the pound sterling and 35% against the euro. Therefore, the real value of oil prices today is $60 per barrel and about $24 per barrel if there is no inflation factor.

However, it is unlikely that the oil countries will return to pricing their oil without the dollar, because the world trade volume in US dollars is about three trillion dollars. More than 50% of world exports are paid in US dollars, a third of the world's foreign exchange reserves are denominated in dollars, and more than 80% of the world's currency is through the US dollar. Energy and oil prices have been priced in US dollars for a long time, making it difficult to negotiate currency swaps.

It is worth noting that the real goal of all countries of the world is to achieve the so-called sustainable economic growth, aimed at supporting the country's economic resources and income by creating industries that generate added value while preserving the environment and the rights of future generations. Where economic growth is measured by real income per capita, this indicator is calculated using the following equation: average real income per capita = real gross national product / population.

The rate of economic growth depends on the increase in real income per capita, which means that economic growth depends on data from the other side of the equation. So, the higher the real GDP, the higher the rate of population growth, and given the average real income per capita, the rate of economic growth increases. This shows that population growth is one of the main problems facing the economic development of countries, especially developing countries.

However, the previous equation states that the "population" component is used as a quantitative indicator (Indicator Quantative). In this regard, it is necessary to take into account other quantitative and qualitative variables. For example, an increase in the population leads to an increase in the labor force, that is, the population able and willing to work, which affects labor productivity and the rate of economic growth. Economic growth is ensured by activating a number of key elements that determine its characteristics. Accordingly, three types of economic growth can be defined and described:

automatic economic growth (Automatic Growth), which is one of the most important types of economic growth, because it occurs automatically using the method of economic freedom, thanks to the high flexibility of the economic structure of the country, which automatically grows due to its economic variables, without relying on economic plans prepared by this country, and therefore automatically and quickly builds connections between sectors. In fact, similar processes took place in developed countries after the industrial revolution;

- transit Growth, which occurred in many developing oil-exporting countries after the rise in oil prices in the 1970s. It is related to the increase in oil prices, which occurs due to the emergence of urgent and temporary factors, primarily external, such as: high oil prices and positive growth rates (for example, in the last century in the Persian Gulf countries) (Kohut, 2015);

- the planned growth, that is, economic growth caused by the intervention of the state through the development of a complex process of planning resources and needs of society.

Although the above-mentioned types of economic growth seem at first glance to be unrelated, they can be implemented in an integrated manner in oil-producing and exporting countries that seek to achieve economic growth using oil as a means of doing so. When oil prices rise in the oil markets, developing countries seek to use this sudden change to achieve automatic growth that can lead to transitional growth. In order to maintain the achieved growth rate, the state must take a number of measures to support this growth through strategies to promote the development of economic sectors, use available resources and use labor reserves, both local and foreign.

Oil plays an important role in the economic development of most countries-producers and exporting countries, as they largely depend on export earnings to finance their own development projects. It should be noted that the drop in oil prices allows many countries to reduce energy subsidies and use the resulting savings to increase remittances, increase energy taxes, and reduce other taxes.

It is important to mention that these price fluctuations are mainly explained by the different level of taxes imposed by

the major oil countries. These can range from relatively modest levels, such as in the USA, to very high levels in Europe and Asia/Pacific.

For example, in the UK, the government in 2017 earned about 64.6% of the price charged for each liter of fuel sold to consumers. On the other hand, oil-producing countries (in particular, OPEC) earned about 22.8% of the total cost of fuel (OPEC-IEA cooperation and the international oil market outlook, 2023).

There are three main channels through which low oil prices affect importing countries. Firstly, this is the effect of increasing real profits from consumption, secondly, the low cost of production of finished products and its impact on profits and investments. For example, the real income impact in the United States, which now produces more than half of the country's oil consumption, is lower than in the European Union or Japan. The impact of real incomes also depends on the intensity of energy use in the respective country. The intensity of energy use in China and India is still much higher than in developed economies, which makes these countries more favorable to take advantage of lower energy prices. The average ratio of oil consumption to GDP is 3.8% in the USA, compared to 5.4% in China and 7.5% in India and Indonesia (World Bank. Energy. Statistics, 2023).

In general, the decrease in oil prices will lead to a reduction in the income of the exporting countries, which will have a negative impact on their budgets and current accounts, as well as on the exchange rates of some of these countries (Iran, Algeria, Venezuela, and Nigeria). Financial stability risks exist in this area. In this context, oil-importing developing countries can benefit enormously from falling oil prices. In the event of an increase in oil prices, the importing countries feel a negative impact, as it increases the rates of inflation and the balance of payments and can also lead to crises for the currencies of some financially weak countries. Rising oil prices may affect the economy and consumer spending, but the impact will be mixed. For example, Europe has the weakest position, and China, the world's largest supplier of oil, is experiencing rising inflation.

High oil prices make it possible to immediately transfer wealth from importing countries to exporting countries, which has a positive effect on the volume of production in these countries. However, this impact depends on what producing countries do with this additional income. If it is used to purchase manufactured goods and services, higher oil prices will cause a higher level of activity in the economy, thereby increasing national wealth and demand.

Developing nations will be the biggest winners, but countries such as Saudi Arabia, Nigeria and Colombia could also be beneficiaries of this growth. As the increase in revenue will support budget reform in these countries, it will enable governments to increase spending and support investment. India, China, Taiwan, Turkey, Egypt and Ukraine will be among the hardest hit countries as rising prices squeeze the current account, prompting some countries to raise interest rates.

Falling oil prices often result in wealth transfers from oil-exporting countries to developing countries with high savings rates, as well as to many other countries, including large developed countries, some of which are subject to a declining marginal trend. From a global perspective, this means low global savings rates and higher interest rates.

According to this standard, oil-producing countries can be divided into three groups:

1. Countries with foreign exchange reserves that have large foreign assets (Saudi Arabia, the UAE and Norway), which can finance their budgets in the event of low oil prices;

2. Countries with cash reserves and small financial assets, such as Mexico, Malaysia, Oman, Bahrain and Colombia, should resort to budget savings and external borrowing;

3. Countries with low liquidity and low borrowing capacity, such as Venezuela and Nigeria, are more sensitive to lower oil prices, this can cause the collapse of the local currency and the flight of capital managers, which will lead to an economic crisis in these countries.

In the early stages of the decline in oil prices, most countries took appropriate measures to use their savings to cover the shortfall in oil revenues. As this decline became apparent, oil-exporting countries cut spending significantly.

1. Restrictions on government spending. Public spending in most countries is growing year by year, but relying on effective public spending rationalization programs, the country takes care of financial security, which requires limiting unnecessary spending and economic prioritization of public spending.

2. Restructuring of financial systems in oil-exporting countries, especially in developing countries. Most of the financial systems of these countries should develop the structure and operation of the banking system in such a way as to encourage long-term credit operations and pay little attention to the tax awareness of individuals.

3. Strengthening the role of the private sector. Freedom of private sector investment and production. Considering the reduction of the governmental role of all sectors, which should take place in the field of providing investment conditions suitable for economic activity, and the reduction of state and bureaucratic procedures for small and medium-sized economic institutions.

4. The development of securities markets and the activation of the sphere of issuance of state securities, the need to increase the level of transparency and disclosure of information in new financial markets, the increase in the efficiency of their markets will contribute to the provision of real savings to finance the budget deficit.

5. Search for new sources of income. Where the creation of new sources of income is another important element, a number of forward-looking plans have been launched, particularly in the GCC countries, to introduce VAT.

6. Encouraging foreign direct investment, increasing competition between investors, and assisting devel-

Table 1. Dynamics of global oil and gas prices in 2017-2022, USD.

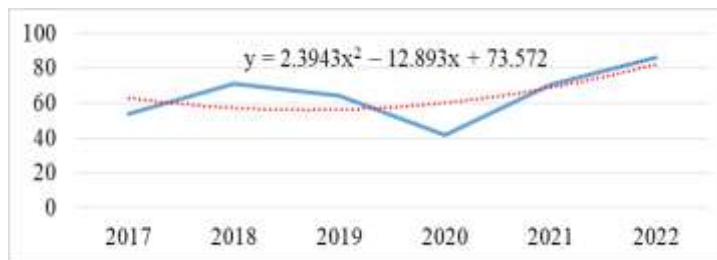| Year	2017	2018	2019	2020	2021	2022
Oil	54,19	71,31	64,31	41,84	70,91	85,99
Gas	2,53325	2,91125	3,0085	2,41786	3,23245	8,69543

Source: (Gutium, 2019).

Fig. (1). Theoretical and empirical trend line of the world oil price.
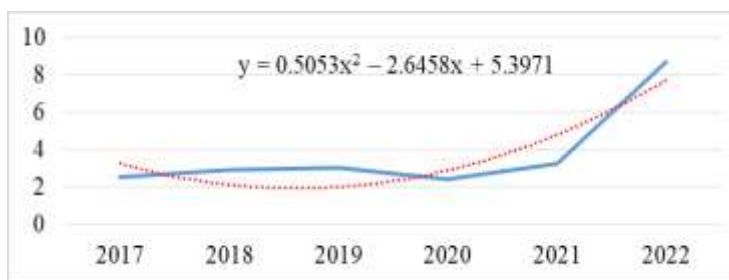Source: (Gutium, 2019).

Fig. (2). Theoretical and empirical trend line of the world gas price.

Source: (Gutium, 2019).

oping countries that are oil exporters in financing their budgets.

7. Investment funds or sovereign wealth funds. The creation or expansion of various types of investment funds (open, closed, sovereign, Islamic) contributes to the reduction of financial liquidity during periods of low oil prices. International oil prices increase the inflow of foreign currency into the country, and therefore this opportunity should be used to develop and increase financing of investment funds. This experience is practiced in developed countries, for example, in the Norwegian fund, and from now on, such sovereign funds are being created in the countries of the Persian Gulf.

Many oil-exporting countries use surplus money from their oil sales to build sovereign wealth funds to take advantage of during periods of financial difficulty. By dividing the total value of the country's sovereign wealth fund by its budget deficit, we can estimate within how many years this fund can cover its budget deficit. If these countries are unable to cover their deficits through their sovereign wealth funds, they may resort to borrowing to cover this deficit. If the ratio of total debt to GDP is too small for the country, it can resort to issuing new debts to cope with the deficit in the balance sheet. The dynamics of global oil and gas prices in 2017-2022 are shown in Table **1**.

To forecast the world oil price, we will construct a theoretical and empirical trend line (Fig. **1**).

The equation of the world oil price trend is as follows:

$$y = 2{,}3943x^2 - 12{,}893x + 73{,}572 \quad (1)$$

Using the equation, we will make a forecast of the world oil price:

Year 2023 – 82,4088 USD, year 2024 – 100,6417 USD, year 2025 – 123,6632 USD.

This prognosed increase in the world oil price is caused by the war in Ukraine and sanctions against Russia.

To forecast the world gas price, we will construct a theoretical and empirical trend line (Fig. **2**).

The equation of the world gas price trend is as follows:

$$y = 0{,}5053x^2 - 2{,}6458x + 5{,}3971 \quad (2)$$

Using the equation, we will make a forecast of the world gas price:

Year 2023 – 7,7131 USD, year 2024 – 11,6362 USD, year 2025 – 16,5699 USD.

To forecast the impact of world oil and gas prices on the electricity industry of Ukraine, we will consider a system of econometric equations containing five behavioral equations and two identities:

$$\ln(cs_t) = c_1 + c_2\ln(cs_{t-1}) + c_3\ln(y_t) + c_4q_{1t} + c_5q_{2t} + c_6q_{3t} + u_{1t}, \quad (3)$$

$$\ln(i_t) = c_7 + c_8\ln(i_{t-1}) + c_9\ln(b_t) + c_{10}\ln(y_t) + \ln(y_{t-4}) + c_{11}q_{1t} + c_{12}q_{2t} + c_{13}q_{3t} + u_{1t}, \quad (4)$$

$\ln(xp_t) = c_{14} + c_{15}\ln(ep_{t-1}) + c_{16}\ln(b_t) + c_{17}\ln(e_t) + c_{18}q_{1t} + c_{19}q_{2t} + c_{20}q_{3t} + u_{1t}$, (5)

$\ln(m_t) = c_{21} + c_{22}\ln mi_{t-1}) + c_{23}\ln(e_t) + c_{24}\ln(y_t) + u_{1t}$ (6)

$\ln(e_t) - \ln(e_{t-1}) = c_{25} + c_{26}\ln(b_t) + c_{27}(\ln(b_t) - \ln(b_{t-1})) + c_{28}(\ln(i_t) - \ln(i_{t-1})) + u_{1t}$ (7)

$tb_t = xp_t - m_t$ (8)

$y_t = cs_t + i_t + tb_t$ (9)

where y – electricity production in real terms; cy – consumption in real terms; i – investments in real terms; xp – export in real terms; m – import in real terms; tb – net export in real terms; b – world oil price and gas price; e – exchange rate to the US dollar; q_1, q_2, q_3 – dummy variables to denote the first, second and third quarters; t – index to indicate the quarter.

This method previously was used to analyze the energy market of Kazakhstan (Moldabekova, 2022).

Fluctuations in the price of oil and gas on world commodity markets are considered as the main exogenous variable that determines the dynamics of an open economic system. Endogenous variables determined inside the system include electricity production, as well as the exchange rate of the Ukrainian hryvnia to the US dollar.

Equation (3) sets the consumption function using the specification of the partial adjustment model, when real consumption gradually "adjusts" to changes in the level of real GDP caused by changes in net exports and the volume of investments, which, in turn, depend on exogenous factors (primarily on the price of oil). To account for seasonal fluctuations, dummy variables are introduced into the equation to denote individual quarters.

Equation (4) reflects the dependence of investment activity in the economy of Ukraine on the level of oil and gas prices and previous real GDP growth (accelerator effect). It is assumed that the level of oil prices affects the volume of investment activity through several channels: firstly, high oil prices directly expand the investment opportunities of the budget and system-forming Ukrainian companies operating in the oil and gas sector. Secondly, if the expectations of oil and gas prices in the future are mainly formed on the basis of the current price level, then during the growth of oil prices, the forecast estimates of the prospects for the generation of operating cash flows from projects, not only implemented in the energy sector and oriented on external demand, but also aimed at meeting domestic demand in connection with the expected growth in the purchasing power of the population and easing of financial constraints for business and the public sector.

Thirdly, due to the fact that the main channel for the formation of the monetary base in the Ukrainian economy is the replenishment of the NBU's gold and currency reserves at the expense of the purchase of a part of the foreign exchange earnings of exporters, high oil prices are accompanied by a softening of monetary policy, i.e. an increase in growth rates money supply and a decrease in interest rates, which has a favorable effect on investment activity.

The reverse processes take place when oil and gas prices fall: investments are "squeezed" as a result of a reduction in the current financial capabilities of the budget and large companies, the formation of pessimistic expectations about the prospects for the implementation of new investment projects, and the strengthening of monetary policy.

To account for seasonality, quarterly dummy variables are introduced into the equation. The gradual nature of the adaptation of economic agents to the new level of oil and gas prices determines the need to introduce the level of investments in real terms into the equation.

Both equations are written in the form of a partial adjustment equation. We consider the level of oil prices and the exchange rate of the Ukrainian hryvnia to the US dollar as the main factors in the formation of the export volume (under the assumption that the weakening of the Ukrainian hryvnia stimulates exports). We consider the level of real GDP and the exchange rate of the Ukrainian hryvnia to the US dollar as the main factors in the formation of the import volume (under the assumption that the growth of real GDP and the strengthening of the Ukrainian hryvnia against the US dollar stimulates imports). Quarterly dummy variables are introduced into equation (5) to account for the seasonality of export deliveries.

In terms of the main factors affecting the dynamics of the exchange rate of the Ukrainian hryvnia to the US dollar, according to equation (7), we consider the level and dynamics of oil and gas prices, as well as the change in the volume of investments in real terms. The current level of oil and gas prices reflects the inflow of foreign currency into the country along the lines of current operations. The change in the level of oil and gas prices is considered as a key variable reflecting devaluation or revaluation expectations. Thus, the decline in oil prices causes economic agents to doubt the NBU's ability to ensure a stable level of the exchange rate and creates prerequisites for a speculative attack on the Ukrainian hryvnia. On the contrary, the increase in oil and gas prices strengthens the confidence of economic agents in the stability of the Ukrainian hryvnia. The change in the volume of investments in real terms is considered as a proxy for the inflow of capital into the Ukrainian economy, which contributes to the strengthening of the Ukrainian hryvnia against the US dollar.

Macroeconomic identities (8) and (9) complete the system and ensure the consistency of forecast estimates of electricity production.

In the process of evaluating the system (3)-(7) by the three-step method of least squares using the tools of the EViews 6.0 package, the parameters of the behavioral equations were obtained, presented in the Tables **2-6**.

Table 2. Estimates of the parameters of the consumption function (dependent variable – ln (cs_t), $R^2 = 0{,}9945$).

Variables	Coefficient	Standard error	t-statistics	P-value
Constant	-0,1948	0,0857	-2,2747	0,0249
ln (cs_t)	0,7166	0,0494	14,5444	0,0000

ln (y_t)	0,2994	0,0496	6,0465	0,0000
q_{1t}	-0,0701	0,0112	-6,2542	0,0000
q_{2t}	-0,0094	0,0072	-1,2900	0,1984
q_{4t}	-0,0217	0,0072	-2,9955	0,0040

Source: the results of author's research.

The obtained values of the coefficients for the explanatory variables have the expected indicators and are statistically significantly different from zero (except for the coefficient for the dummy variable for the second quarter). In the long term, the share of consumption in electricity production turns out to be stable, but in the short term, the reaction of consumption to changes in GDP is much weaker — the elasticity of consumption by GDP is about 30%.

Table 3. Estimates of the parameters of the investment function (dependent variable — ln (cst), R2 = 0,9945).

Variables	Coefficient	Standard Error	t-statistics	P-value
Constant	1,8587	0,4544	5,2596	0,0000
ln (it-1)	0,5040	0,0644	7,8457	0,0000
ln (bt)	0,4252	0,0740	4,4941	0,0000
ln (yt) - ln (yt-1)	0,8898	0,4705	1,8911	0,0598
q1t	-0,1656	0,0714	-2,4205	0,0211
q2t	0,1699	0,0826	2,0584	0,0406
q3t	0,6260	0,0745	8,4058	0,0000

Source: the results of author's research.

The results of the assessment confirm the proposed hypothesis about the close connection between investment activity in the Ukrainian economy and the level of oil and gas prices. In the long run, a 10% increase in oil and gas prices leads to a 6.5% increase in investment in real terms. Judging by the value of the regression coefficient, the reaction of investments to the dynamics of electricity production is somewhat higher (the short-term value of the elasticity coefficient is 0.89), however, this conclusion is not completely unambiguous due to the high level of the standard error of the coefficient. As expected, investments react much faster to changes in the macroeconomic situation compared to consumption.

Table 4. Estimates of export function parameters (ln (xpt), R2=0,9661).

Variables	Coefficient	Standard error	t-statistics	P-value
Constant	1,4499	0,4979	4,4670	0,0009
ln(xpt−1)	0,7728	0,0754	10,2514	0,0000
ln (bt)	0,0740	0,0414	2,4244	0,0210
ln (bt)	0,0495	0,0162	2,4462	0,0156
q1t	-0,2692	0,0224	-12,018	0,0000
q2t	-0,0961	0,0210	-4,5680	0,0000

q3t	-0,1145	0,0208	-5,4562	0,0000

Source: the results of author's research.

The obtained results confirm the proposed hypotheses about the dependence of the level of export on the level of oil prices and the exchange rate. In addition, there is a clearly expressed seasonality of export receipts with a peak in the IV quarter and a minimum in the I quarter of the calendar year.

Table 5. Estimates of the parameters of the import function (dependent variable – ln (mt), R2=0,9190).

Variables	Coefficient	Standard error	t-statistics	P-value
Constant	-6,0604	0,7795	-7,7750	0,0000
ln (mt-1)	0,4289	0,0629	5,2295	0,0000
ln (et)	-0,0897	0,0404	-2,9607	0,0044
ln (yt)	1,4440	0,1411	9,4489	0,0000

Source: the results of author's research.

The results of the assessment confirm the proposed hypotheses about the dependence of the volume of imports on the volume of electricity production and the exchange rate. At the same time, the high elasticity of imports from electricity production, even in the short term, deserves attention. The speed of adaptation of imports to changes in the foreign economic situation and macroeconomic situation in the country is significantly higher, compared to the speed of adaptation of exports.

Table 6. Estimates of parameters of the exchange rate function (dependent variable – ln (et) – ln(et–1), R2 = 0,5194).

Variables	Coefficient	Standard Error	t-statistics	P-value
Constant	0,2202	0,0646	4,4096	0,0008
ln (bt)	-0,0509	0,0284	-2,7822	0,0058
ln (bt) – ln (bt-1)	-0,2862	0,0746	-2,5289	0,0222
ln (it) – ln (it-1)	-0,0942	0,0298	-4,7546	0,0000

Source: the results of author's research.

The obtained results show that the dynamics of oil and gas prices significantly determine the dynamics of the exchange rate. This conclusion is also confirmed by the Granger causality test, which almost clearly indicates that oil and gas prices are the cause of the change in the exchange rate. The inflow of capital into the economy also significantly affects the fluctuations of the Ukrainian hryvnia exchange rate.

Of particular interest is the model's ability to predict the reaction to an external shock, which led to a sharp increase in the price of oil from $42 per barrel in the II quarter of 2020 to $73 per barrel in the first quarter of 2021.

The results of the calculations, presented in Table **7**, show that the model quite accurately predicts the consequences of an external shock, manifested in a sharp reduction in electricity production, investment and consumption, the volume of export and import operations, as well as in the devaluation

Table 7. Dynamic forecasts according to the model for the period from the III quarter of 2020 to the II quarter of 2021.

Quarter	Electricity Production, kV/h, year 2017		Realconsumption, mlnUAH, year 2017		Real Investments, mln UAH, year 2017	
	Fact	Prognosis	Fact	Prognosis	Fact	Prognosis
2020q3	5497	5590	3656	3653	1805	2267
2020q4	5233	4853	3786	3727	1355	1112
2021q1	3826	4072	3155	3345	407	619
2021q2	4063	4192	3292	3319	590	648

Source: the results of author's research.

Table 8. Considered scenarios of oil price dynamics in 2023-2024, US dollar per barrel.

Scenario\Quarter	2023q1	2023q2	2023q3	2023q4	2024q1	2024q2	2024q3	2024q4
Expected	75	75	75	75	75	75	75	75
Optimistic	80	85	90	95	100	102	104	106
Pessimistic	70	65	60	55	50	48	46	44

Source: the results of author's research.

of the Ukrainian hryvnia against the US dollar. At the same time, the model somewhat underestimates the actual scale of the decline in electricity production, consumption and investments.

In order to assess the possible consequences of various options for changes in the foreign economic situation for the main macroeconomic indicators of the Ukrainian economy in the near future (2023-2024), we will determine several probable scenarios for changes in the price of oil and gas (Table **8**).

Within the expected scenario, we will assume that the price of a barrel of oil stabilizes at the level of $75. In the context of an optimistic scenario, let's assume that during 2023 the price of a barrel of oil will grow at a rate of $5 per quarter, by the beginning of 2024 it will reach the $100 and will continue to grow at a more moderate rate of $2for the quarter.

In the pessimistic scenario, let's assume that during 2023 the price of a barrel of oil will decrease at a rate of $5 per quarter, by the beginning of 2024 it will reach the mark of $50 per barrel and will continue to decline at a more moderate rate of $2for the quarter. Quantitative parameters of these scenarios are given in Table 8, the results of simulation calculations based on the model, according to each of the considered scenarios – in Table 9.

The results of simulation calculations for the expected scenario of oil and gas price dynamics indicate that the Ukrainian economy has the potential for significant recovery growth as early as 2023, while the growth rate of electricity production may be about 7%, compared to the unfavorable year of 2022. Investment, exports and imports in real terms may return to the levels achieved in 2020.

At the same time, already in 2024, the growth rate of electricity production will drop sharply: an undiversified economy will not undergo real modernization transformations (and positive structural changes are not predicted either by the form of the evaluated model or the parameters of the consid-

ered scenario), because the rates of electricity production cannot grow at sufficiently high, but stable oil and gas prices.

Simulation calculations for an optimistic scenario of oil and gas price dynamics show the possibility of significant economic growth even if the dominant raw material model of the organization of the Ukrainian economy is preserved. In this case, compared to 2022, the traditional "driver" of the growth of Ukraine's economy – a favorable foreign economic situation – ensures an increase in electricity production by 10% in 2023 and 15% in 2024. In parallel with the production of electricity, investments, exports and imports are increasing. Import growth rates are higher than export growth rates in connection with the tendency to strengthen the Ukrainian hryvnia exchange rate, which will maintain this trend in the conditions of rising world prices for oil and gas.

The main threats caused by the features of the formed structure of the Ukrainian economy and the nature of its reaction to the change in the foreign economic situation become especially obvious in the process of considering the pessimistic scenario of the world oil and gas price dynamics. In this case, in 2024, the Ukrainian economy is expected to experience a serious decline, which is accompanied by a decrease in the real values of consumption, investment, export and import. Deterioration of the trade balance and pessimistic expectations of investors in this scenario cause the fall of exchange rate.

4. CONCLUSIONS

The results of the analysis show that the Ukrainian economy is extremely sensitive to fluctuations in world oil and gas prices. Its sustainable development is impossible without the implementation of urgent measures for diversification and modernization, the transition from export-raw material to innovation-oriented model of economic development.

The raw nature of the Ukrainian economy and its high sensitivity to external shocks make the Ukrainian hryvnia a fundamentally unstable currency. The main way of securing theUkrainian hryvnia is the inflow of export foreign exchange, which depends on the conditions of foreign markets. Therefore, in the long term, the Ukrainian hryvnia is a rather risky savings instrument.

Like the Ukrainian economy in general, system-forming non-financial Ukrainian companies feel significant dependence on price fluctuations of exchange goods and exchange rates, but these risks are not sufficiently effectively measured and regulated within the companies.

Since the revenues of the consolidated budget of Ukraine, as well as the GDP, are significantly dependent on fluctuations in the prices of exchange goods on world markets, the careful analysis and monitoring of the development of the world economy and the dynamics of the foreign economic situation, as well as the formation of special stabilization funds, should be supplemented by the introduction of a system of hedging risks on levels of management of the state finances of Ukraine, which could significantly reduce the negative consequences for the country's economy from unfavorable scenarios of price changes for the main Ukrainian export goods.

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