Assessment of Changes in International Prices for Crude Oil Amid the Global Instability of its Production and Consumption

Izabella Damdinovna Elyakova^{1*}, Alexandr Alekseevich Pakhomov², Vasilii Romanovich Darbasov², Alexandr Andreevich Khristoforov¹ and Elyakov Aleksandr Lvovich¹

¹Financial and Economic Institute of the North-Eastern Federal University named after M.K. Ammosov, Yakutsk, Russia; elyak@list.ru, edger369@gmail.com, elyakov96@mail.ru ²Department of Regional Economic and Social Research of the Yakut Scientific Center of the Siberian Branch of the Russian Academy of Sciences, Yakutsk, Russia; a.a.pakhomov@prez.ysn.ru, vrdarbasov@mail.ru

Abstract

Objectives: The article substantiates the need to assess changes in international prices for crude oil amid the global instability of its production and consumption. Methods/Statistical Analysis: The authors determined the classification of the factors influencing the pricing in the world oil market. The basic methods of research are the method of multivariate correlation and regression analysis, by means of which the main pricing factors were identified; methods of historical and empirical analysis that enabled the authors to determine the regularities of drawing up forecast scenarios of oil prices. Findings: The study presents a new consistent methodological approach to the substantiation of assessment of the impact of major macroeconomic factors on the change in the level of oil prices in the context of instable situation in the global oil market. In contrast to the modern concepts of evaluation of factors affecting the world oil market, the novelty of this approach consists in determining the classification of the main macroeconomic and geopolitical factors in each historical period of the oil market development. The advantage of this approach is the use of the method of multivariate correlation and regression analysis. Analyzing the history of the formation of oil prices in the world market influencing the economy of states, it is possible to develop in the future the most realistic forecast scenarios for the oil price level change and to evaluate its impact on the further development of the world economy and the geopolitics of the leading states. Application/ Improvements: The presented scientific approach identifies the main factors of the global oil market development, taking into account changes in the energy balance of hydrocarbons production amid global instability regarding their production and consumption.

Keywords: Assessment, Crude Oil, Price, Prognosis, World Market

1. Introduction

Historically, the Russian budget income is heavily dependent on oil and gas revenues and the level of world oil and gas prices. Crude oil is the main and one of the most popular sources of energy in the world, and this causes a constant volatility of its price. Currently, the volatility of oil prices is very high, which is caused by the pre-crisis situation in the market of hydrocarbons. Also, the high sensitivity of the Russian budget to the global market conditions implies the need for adequate oil price

*Author for correspondence

estimates. It is not possible to predict the actual level of oil prices without the analysis and assessment of historical volatility, as well as to identify factors influencing the hydrocarbon pricing¹. The objective conditions of economic development, which include alternating periods of growth and periods of crisis, necessitate the oil price forecasting. Oil market study is reflected in economic science, which deals with the factors determining crude oil prices, price dynamics analysis and pricing methods. In the present period of deterioration of the macroeconomic situation in the country due to the sanctions imposed by European countries and the USA, there has been a need for a thorough study of the history and development of the world oil market in order to determine the dynamics of the historical trend in oil prices, which will help to develop a forward-looking scenarios of their change. Given the dependence of the majority of developed economies on prices of crude oil and petroleum products, which are widely used in all areas of the industry, this will improve the macro-economic condition of both the country and the world economy as a whole.

Analysis of the results of research performed by leading scientists and specialists, shows that there have been several studies of factors affecting the prices of oil, their volatility and predicted values. The industry use of crude oil began in the early 20th century. Even before the First World War, petroleum began to increase its value due to the transition of various heavy machinery types (in the beginning of 20th century it were various seagoing vessels) from coal to oil. Back then, only Persia (modern Iran) was the main world supplier of crude oil. By the end of the century, almost all types of industry and technology in one way or another used crude oil or petroleum products: From the car manufacturing to textile industry. The spectrum of industrial use of petroleum is very wide, which ensured its distribution as the main fuel and raw material in the world. In connection with the spread of the use of crude oil as the main raw material, it began influencing the major developed world economies. The three main factors of it are distinguished: The first factor: the development of capitalism and private business. The petroleum industry is the largest and most popular business in the world. And even at the present time, there is no alternative source of energy that would cause a strong correlation of its prices with the global economy. The second factor: Crude oil is a strategic raw material related to the strategic development of the various countries, the world politics and power. The third factor: The whole world is dependent on crude oil. In fact, oil is also the raw material for a biggest part of modern production. Crude oil and petroleum products make a very significant contribution to GDP of the world countries. The literature widely described methods of forecasting. The authors studied the scientific works²⁻⁴ dedicated to the possibility of future forecasting for a wide range of goods; in particular it is shown that the energy producing material futures often have more predictable prices than other commodities futures. Most of the materials also related to the forecast methods which do not work in the case of

the oil market. Use of Gaussian data processing for the oil markets was rejected in⁵⁻⁶: Both authors found stable distributions for model asymmetries and excesses; however, the stable distribution does not restrict the variation, and thus is not attractive for modeling of financial time models. Also, the authors studied materials related to a new regression model^z, which made enabled to more accurately determine the future price of petroleum. This economic theory is based on the supposition that the number of global economic indicators such as demand and supply of oil, and derived variables, such as changes in the world crude oil reserves, may contain information about future oil prices. As for real oil prices, according to in⁸, it is found that certain intermediaries in the market of world oil consumers, i.e., global industrial manufacturers, as well as the global index of real economic activity developed by in imply a significant possibility of forecasting. At the same time, it is demonstrated in⁸ that a simple VAR model with the global oil supply can predict product price levels for short forecast periods: up to 9 months. However, despite an extensive overview of the problem in the literature, the scientific community has not reached consensus. As compared with other works, our suggestion is based on the fact that it is impossible to predict oil prices using only mathematical methods.

2. Method

In used the method of correlation and regression analysis to identify relationships between variables by means of point and interval estimation of pair (partial) correlations; calculation and verification of the significance of multiple correlation and determination coefficients; selection of factors that have the most significant impact on the effective attribute, on the basis of measuring the degree of correlation between them. Using pair correlation coefficients, the authors determined the density and strength of the connection between the main factors affecting the change in the price of oil for each period of the global petroleum market development. Paired correlation coefficients served as the basis for determining the priority factors that had the biggest influence on the change in oil prices. By means of the ordinary least squares, a quantify level of priority factors influencing the level of oil prices was determined, which made it possible to assess the closeness of the relationship between the varying variables and assess the impact of factors on aneffective attribute. Influence factor priority is presented using a regression model.

3. Results and Discussion

The oil market has gone through several stages of development. There are five periods of development of the oil market². The first period took place in 1928-1947 and was characterized by a non-competitive oil market, the oil market dominated by international oil cartel companies and "cost-plus" pricing based on the cost of crude oil production and the value added. Second period: 1947-1969. The characteristic features of this period were a non-competitive oil market, the two-base oil pricing based on the principle of "net-back replacement value" in petroleum products. Third period: 1973-1985. It was during this period that the development of competition on the world oil market took place, as well as the active development of the OPEC organization and the formation of official oil selling prices set by the OPEC member countries. The main pricing factor was the crude oil supply and demand balance in the world market. The fourth stage: 1986-2004. This was a period of use of the stockbased pricing, extensive use of petroleum in Financial Instruments and the further competition development. The fifth stage has begun in 2004 and continues to the present day. It is characterized by an active use of new IT-technologies, the use of petroleum as an investment asset, and the oil pricing that is carried out outside the oil sector. The analysis of the historical development of the oil market, the econometric assessment of the impact of various factors on the price of oil and the modern oil pricing system has shown that in addition to the global supply and demand, the oil pricing is impacted by factors, which can be classified into two categories: Internal and external. The classification of the main factors having the greatest impact on the price of oil in each historical period of development of the global oil market is shown in Table 1-Table 5. The external factors include the rate of development of the world economy (the rate of growth of GDP of states), the world's scientific and technological progress in the field of crude oil production (new technologies, materials, communications, alternative energy sources, etc.), geopolitical risks, the situation in the world market which includes a psychological value fluctuations, condition of reliable potential oil reserves and prognosis for them, as well as meteorological factors. The internal factors include the taxation and customs regime, the development of the petroleum industry in the country, the amount of crude oil reserves and production. Separately it should be noted that the influence of market factors on

Table 1. Classification of the main factors that hadthe greatest impact on the oil price in the first period(1928-1947) of the global oil market development

Periods	Main factors influencing the oil price		Pricing	Average	Price
	internal	external	memou	on price	volatility
1928-1947	- Non- competitive oil market; - Volume of oil production and consumption; - Production costs and other element of oil cost.	Dominance of "Seven Sisters" international oil cartel companies in the oil market.	Transfer pricing - "Cost- plus" or added value method.	0.9	0.9±0.25

Source: compiled by the authors

Table 2.	Classification of the main factors that
had the g	reatest impact on the oil price in the
second pe	riod (1947-1971) of the global oil market
developm	ent

Domindo	Main factors influencing the		Pricing	Average	Price
Perious	oil price		method	oil price	volatility
	internal	external			
			Two-		2.04±0.2
			base oil		
	- Non-		pricing		
	competitive oil	Dominance	based		
	market;	of "Seven	on the		
	- Volume of oil	Sisters"	"Cost-		
1047 1071	production and	International	plus"	2.04	
1947-1971	consumption;	Oil Cartel	method	2.04	
	- Production	companies	and		
	costs and other	in the oil	on the		
	element of oil	market.	principle		
	cost.		of "net-		
			back"		
			pricing		

Source: compiled by the authors

pricing is very strong and unpredictable: The impact of banking, investment and insurance sectors on the stock exchanges, behavioral changes in prices and the revaluation of geopolitical risks in the oil market. On the basis of the comparative correlation and regression analysis of oil prices in the five stages of the global oil market development, the authors assessed the relationship between levels of oil prices and its supply and demand volume. The result revealed a strong correlation between prices

Table 3.	Classification of the main factors that had
the greate	st impact on the oil price in the third period
(1971-198	36) of the global oil market development

Periods	Main factors influencing the oil price		Pricing	Average	Price
	internal	external	method	oil price	volatility
1971-1986	- amount of stocks of crude oil and oil production volume; - development of the country's oil industry; - imposition of taxes; - customs regime.	- political situation (geopolitics); - nuclear power industry development; - situation on the world oil market; - meteorological factors.	"Cost- plus" pricing formula was set by OPEC countries. Official selling prices on the basis of the "net-back" pricing system	20.5	20.5±18.33

Source: compiled by the authors

Table 4.Classification of the main factors thathad the greatest impact on the oil price in thefourth period (1986-2000) of the global oil marketdevelopment

	Main factors influencing the		Duising	A	Duine
Periods	oil price		mathod	Average	volatility
	internal	external	method	on price	volatility
1986-2000	Oil market situation: - amount of stocks of crude oil and oil production volume; - development of the country's oil industry; - imposition of taxes; - customs regime.	- pace of development of the world economy (GDP growth rate); - scientific and technical progress factor (new technologies, materials, communications, alternative energy sources, etc.); - actual condition and prognosis for reliable and potential oil reserves; - meteorological factors.	Exchange pricing for crude oil - prices were formed on the specialized trading platforms of the oil market.	18.81	18.81±9.6

Source: compiled by the authors

Table 5. Classification of the main factors thathad the greatest impact on the oil price in the fifthperiod (2000 till present) of the global oil marketdevelopment

	Main factors in	nfluencing the oil	Dricing	A.v.o.m.o.g.o	Drico
Periods	price		r neng	Average	
	internal	external	method	oil price	volatility
2000 till present	Oil market situation: - amount of stocks of crude oil and oil production volume; - development of the country's oil industry; - imposition of taxes; - customs regime.	 pace of development of the world economy (GDP growth rate); economic and financial crises; scientific and technical progress factor (new technologies, materials, communications, alternative energy sources, etc.); actual condition and prognosis for reliable and potential oil reserves; meteorological factors. 	Exchange pricing for crude oil - oil prices have been formed outside the oil market (in the non-oil financial markets).	68.7	68.7± 44.3

Source: compiled by the authors

and these factors: a change in demand by 1% leads to the price change by 23%, and when the supply is changed by 1%, the price changes by 21%. Trend analysis showed that the change in oil prices is not linear, although it shows a steady upward trend till 2013. A sharp rise in prices took place in the period from 2006 to 2013 and lasted until mid-2013¹⁰. Figure 1 shows the dynamics of global oil production and consumption in the period of 1986-2015. The levels of supply and demand in the world oil market often coincided, and there was a constant tendency of their growth, with an increase in demand for oil consumption, the supply increased as well. At the same time, changes in production and consumption volumes led to a significant price change. Historical trend analysis for the last 30 years shows that despite the current downward oil use trend, in the near future, the oil consumption and production will not decrease and will likely continue their growth. First of all, this is due to the lack of high-quality oil analogues and substitutes. Figure 2 shows the dynamics of oil prices.



Figure 1. Crude oil production and consumption in 1986-2015.



Figure 2. Oil price dynamics for the period of 1986-2015.

Over the past 30 years, the level of oil prices increased by more than three times (as of 2016). In 2012 the annual average oil price surpassed the mark of USD120 per barrel, which allows us to conclude that the volatility of oil prices was very high. Over a period of three years, the annual average price of oil rose from USD60 to USD120 per barrel, which causes difficulties in the predicted value construction using the trend historical analysis. As can be seen from the diagram in Figure 2, only in a few points the trend line coincides with the actual level of prices in the oil market. The comparative correlation and regression analysis of oil prices at the five stages of the oil market development, including correlation and regression analysis of oil prices over the period of 1994-2014 showed a strong dependence of the oil price on global demand and consumption¹¹. Also, based on multivariate correlation and regression analysis of the oil price and GDP of states being major oil producers and consumers, the following results of the correlation coefficients were obtained:

- Russia: 0.817522.
- China: 0.765638.
- USA: 0.829734.
- United Arab Emirates: 0.928556.

The results showed a strong correlation between GDP and the oil price for the United Arab Emirates; medium correlation for Russia and the United States and a relatively weak correlation for China. This study revealed a strong dependence of the oil price on the level of world consumption and production, as well as the relation between the price and the above factors based on the main factor (internal and external) classification proposed by us, taking into account the power of their influence. Short-term forecast scenarios related to oil prices were made. We have conducted a retrospective analysis of oil price history over five periods of pricing, which has revealed that the price depends a lot on the market conditions and the influence of external factors. Trend analysis has showed that oil prices will maintain the current trend, if there are not unforeseen events, to which no one is immune¹². All price changes recorded for the moment have taken place when there has been a difference between production and consumption. In 2008, the global oil price rose sharply: the average annual price amounted to almost USD100 per barrel. This was due to a contraction of the volume of oil production, while the volume of consumption remained unchanged. At present, the situation is reversed: Oil supply exceeds the demand. Market mechanisms exert a very strong influence over the market. The oil market is one of the most liquid markets in the world (only the financial and currency markets have a higher liquidity) that allows it to respond to any change in the balance of supply and demand¹². Since the middle of 2014, the volume of consumption began to decline slightly, but there was an increase in oil production, primarily due to shale oil production and new fracturing technologies. The simultaneous decline in demand and supply growth led to a very sharp fall in oil prices: The average price of oil fell during a year from USD99 per barrel to USD52.5 (2014-2015). However, if we consider the price change from the perspective of the theory of economic cycles, it can be seen that with the increase of oil influence on the world's leading economies, the cycle began to accelerate, and the prices fluctuate more actively: Before, oil prices have changed not so much as during the last two cycles. We believe that based on the results of the historical analysis of the stages of world market oil prices, classification of the major internal and external factors in each historical period of the oil market development, correlation and regression analysis of the oil price and trend analysis, it is possible to predict the scenarios of the world oil price level changes. There have been 4 scenarios of the oil prices dynamics developed: In the first scenario (base), the oil price will not be subject to major changes. Oil market participants will continue to maintain the current market conditions and will not disturb them seriously by abrupt changes in crude oil production. Oil consumption will remain at the current level, with possible small decrease in consumption by China and the European Union. In this scenario, oil prices in the near future will remain at the current level (USD45-50 per barrel), followed by gradual increase up to USD55 per barrel in 2017. In the future, we can expect a rise in prices, upon which the oil prices could stabilize at around USD60 a barrel. The changes have been predicted based on the alternation of economic cycle periods observed previously in 1995-2000, 2006-2009 and 2010-2014. In the second scenario (optimistic), by the end of the year, oil prices will stabilize at around USD55 per barrel with the subsequent gradual increase up to USD70 per barrel by the end of 2017. This scenario is possible under condition of dynamic actions of the oil market participants. Oil depletion control, decrease in oil supply on the market will lead to a significant increase in oil prices. Also, the growth in demand for oil could affect prices. This is quite possible even under condition of a growth of the economy of China, which is the world major oil consumer. The third scenario (pessimistic) is more likely than the second one. This scenario anticipates a serious dramatic change in the oil market related to a decline in demand or increase in supply, which will result in serious consequences. The price per barrel will drop to USD30 by the end of the year, with a further decrease and fixation at the level of USD25 per barrel by the middle of 2017. In the future, the prices can decrease, if the market situation remains unimproved, or increase due to active actions of the market participants. However, even after the anti-crisis solutions found by the oil companies, the oil price will remain at a relatively low level of USD30-35 per barrel. The fourth scenario (realistic) is a forecast for the oil prices based on the results of empirical analysis. By means of empirical analysis, the following oil price forecast has been made: In the coming year, there will be minor fluctuations in oil prices from USD35 to USD55 per barrel, followed by stabilization at the level of USD60-65 per barrel in 2017.

4. Conclusion

Thus, the main results of the study are:

- Justification of a consistent methodological approach to the assessment of the impact of major macroeconomic factors on the change in the oil price level amid the global oil market instability.
- Analysis of the historical development of the oil market and current oil pricing system. Development of classification of key macroeconomic and geopolitical factors in each of the five historical periods of development of the oil market.
- The identification and analyze of the main factors having the strongest impact on the oil price change in all periods of development of the oil market, carried out by means of multifactor correlation and regression analysis.
- Determination of regular pattern of drawing up predictive values of oil price in the three scenarios of its changes based on historical trend analysis and empirical analysis of drawing up a separate oil pricing scenario.
- Justification of the forecast scenarios of the fluctuation of oil prices, depending on the power of the influence of the main factors.

Taking into account the current and predicted oil price level in Russia, it is necessary to promptly develop the processing industry in order to move away from resource-based economy, which will significantly reduce its dependence on global oil prices. We also believe that by means of analysis of the oil pricing system in the world market, which has a positive and negative influence on the economy of states, it is possible to develop in the future more realistic forecast scenarios of the fluctuation of oil prices and to evaluate its impact on the further development of the global economy and geopolitical position of the leading states.

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