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Russian Journal of Economics 1 (2015) 257–272

Russian Journal of Economics

www.rujec.org

# A theoretical interpretation of the oil prices impact on economic growth in contemporary Russia ☆

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**Abstract**

This article analyzes the impact of global oil prices on Russia's economic growth and its growth rate in terms of output. It also reviews the mechanics of the long-term and short-term impacts on output resulting from changes in oil prices. The authors argue that the effect of oil prices on output has decreased dramatically under current economic conditions ever since the period of recovery growth in the early 2000s. The main conclusion of the paper is that, on the basis of classical models, a constant increase in oil prices cannot influence the long-term economic growth rate and only predetermines short-term transitional trends from one long-term equilibrium to another.


*JEL classification*: E32, E47, E52, F41, O41.
*Keywords:* oil prices, economic growth, small open economy.

## 1. Introduction

Global oil prices are the most important external economic factor for the Russian economy. The contemporary academic literature lacks consensus on the nature and extent of the impact that oil prices have on Russia's economic growth and the correlation between the GDP growth rate and oil prices.

In the 2000s, before the global financial crisis of 2008 and 2009, explosive economic growth coincided with dramatic increases in global oil prices. This

☆ The updated English version of the article published in Russian in *Ekonomicheskaya Politika*, 2014, No. 5, pp. 150–171.

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Peer review under responsibility of Voprosy Ekonomiki.

http://dx.doi.org/10.1016/j.ruje.2015.12.004

observation served to form the common opinion that higher oil prices boost economic growth. However, in the current economic situation in 2013 and 2014, when oil prices are higher than the long-term annual average over the past decade, the growth rate in output is critically low; consequently, a simple extrapolation of the events of the early 2000s may lead to a misinterpretation of the current economic situation, to conceptually controversial forecasts of future economic development and, as a result, to inefficient economic policy.

Discussion of the correlation between output growth in the Russian economy and oil prices should be based on a formal economic and mathematical construct and built upon basic models of economic growth. Otherwise, a purely qualitative and empirical analysis of current events over a very short time span may produce conclusions and econometric dependencies that are inconsistent with economic theory.

The goal of this paper is to discuss the theoretical basis for the correlation between the Russian economy's output and global oil prices from both a short-term and long-term perspective. Understanding this correlation and identifying the basic mechanics of the impacts that oil prices have on economic development will allow for a reconsideration of the reasons for the current slowdown in GDP growth and for a plan to accelerate it (or to hold back the slowdown) to be developed.

The mechanics of the negative impacts that increasing global commodity prices have on the economic development of resource-rich countries in the context of the Dutch disease have been described in detail in both the Russian (see e.g., Gaidar, 2012, Ch. 3; Guriev and Sonin, 2008; Knobel, 2013; Mau, 2005) and international (see e.g., Bruno and Sachs, 1982; Gylfason, 2001; Mehlum et al., 2006; Sachs, Warner, 1995, 1997; Sala-i-Martin, 1997) literature. The mechanics of oil prices impact on macroeconomic dynamics are also studied in detail and described in the literature. In particular, a number of studies show how the short-term positive effect of oil prices growth is combined with the long-term negative one (see, e. g., Céspedes, Velasco, 2012; Lescaroux, Mignon, 2008; Korhonen, Ledyaeva, 2010; Collier, Goderis, 2008). In spite of the existence of both positive and negative effects of the terms of trade impact on the economy, this paper focuses on describing the logic behind the positive correlation between the Russian economy's output and global oil prices.[1]

## 2. Economic growth due to capital accumulation in the Solow model

When considering the potential impact of global oil prices on GDP in the context of Solow's (1956) neoclassical model of economic growth, one should bear in mind that a long-term dependency of Russia's GDP on global oil prices can only be proven through the mechanism of capital accumulation. This approach was used in the following works: (Kazakova et al., 2009; Kazakova and Sinelnikov-Murylev, 2009; Kazakova, 2009).

The basic Solow model assumes a constant growth rate in the population (labor) and in labor productivity. It also assumes that an exogenously determined share of

[1] The results of a number of empirical papers (see e.g., Aivazyan and Brodsky, 2006; Aivazyan et al., 2013; Kazakova et al., 2009; Kazakova and Sinelnikov-Murylev, 2009; Suni, 2007; Ito, 2009; Kuboniwa, 2012; Rautava, 2004, 2013) are evidence of a positive relationship between global oil prices and the output of the Russian economy. Benedictow et al. (2010) reveal considerable vulnerability of the Russian economy to changes in the terms of trade as well as a major potential of its growth in the absence of oil prices growth.

output is saved and — after amortization — allocated to accumulating fixed capital. The main effect of the model is the existence of a steady-state path of economic growth with a constant capital–labor ratio per worker[2] in the economy.

On a steady-state path, physical capital and output increase at a constant rate equal to the sum of the growth rate of labor productivity and the population growth rate. Savings on this path are fully spent to cover the amortization of capital and to supply new capital to sustain a constant capital–labor ratio per worker.

According to the Solow model, this means that the long-term economic growth rate is only affected by the growth rate in the population and that of technological progress. Changing the saving rate will not affect the long-term economic growth rate but will have an impact only on the stationary capital–labor ratio and on the short-term output trend regarding the transition to a new stationary state in specific indicators. If an economic system is on a steady-state growth path and the saving rate is constantly increasing, when the transition is complete, the system will settle into a new equilibrium growth path, where output will undoubtedly be higher than in the case of a low saving rate,[3] but its growth rate will remain the same.

By hypothetically expanding the Solow model and pretending that the economy consists of two sectors — oil and non-oil — we will assume that the economy is on a steady-state path of economic growth at a rate equal to the sum of the population and labor productivity growth rates. We will further assume rising global oil prices. On the whole, this increase can be interpreted as a transfer of wealth from abroad, which can be spent either on consumption or on investments. Thus, increasing oil prices provide an additional source of investment funding, which may have a positive impact on accumulated capital within the domestic economy and, consequently, on the physical output of products and services. At the same time, it is important to answer the following question: does an increase in oil prices change the long-term growth rate or long-term GDP level?

Assuming that part of the extra income from the increasing oil prices is invested in the domestic economy, the mechanics of the impact on the rate of change in the real GDP will be similar to the growth of the saving rate in the basic Solow model without dividing the economy into sectors. To keep it simple, we will first consider the case where the population is not growing and technological progress is non-existent (i.e., a zero economic growth rate in the long term). Thus, investments will be exactly equal to capital amortization on an equilibrium path.

With rising global oil prices, savings will increase and exceed the retirement of capital. Capital will thus begin to grow. As capital is accumulated, the economy will increase the output of its oil exports and other sectors, leading to extra growth in savings and an additional contribution to increasing capital on a steady-state path. Due to the declining marginal productivity of capital, each additional unit of capital will provide an increasingly smaller contribution to output growth and to incremental savings. Accordingly, the capital accumulation process will follow a certain new path where amortization and investments will converge. This means

[2] For the sake of simplicity and brevity, this paper interprets the capital–labor ratio per worker as a specific indicator reflecting the ratio of physical capital to the number of workers and to the productivity (efficiency) per worker.

[3] This is due to population growth during the transition and as a result of increased output per worker on a new steady-state growth path.

that rising oil prices will lead to a change in output while leaving its long-term growth rate constant.

In a more general case, when the population is growing at a certain rate and there is technological progress, the increase of savings from rising global oil prices will lead to an improvement in the capital–labor ratio per worker. In other words, on a new equilibrium path, with higher oil prices, the level of capital per worker and the level of output will increase, whereas the economic growth rate will remain the same and equal the sum of the population and productivity growth rates. At the same time, from a short-term perspective, i.e., during the transition from one steady-state path to another, we will indeed observe an accelerated rate of economic growth (due to increased specific indicators).

## 3. Returns on investments in fixed capital in an open economy

The above — quite simple — mechanics of the impact that increasing oil prices have on short-term and long-term output are a gross oversimplification, particularly due to the assumption that (a) a fixed, exogenously determined share of income of economic agents is saved and (b) completely allocated for accumulating domestic capital. Accordingly, based on those assumptions, rising global oil prices will lead to investing part of the extra revenues in physical capital and output growth due to physical capital growth. In a small open economy with free capital flows,[4] where domestic economic agents can gain access to the global financial market, these assumptions seem quite disputable.

In a small open economy with free capital flows and with returns and risks determined by the market, economic agents should not care about which assets to invest in, whether foreign or domestic securities or domestic physical capital, and, accordingly, risk-adjusted returns on investments in domestic physical capital should converge with risk-adjusted returns on investments in foreign assets.[5] This leads to the conclusion that an increase in capital and output in the long term against increasing global oil prices will only happen if the growth in oil prices exceeds the rate of return from investments in the domestic economy.[6]

[4] The Feldstein–Horioka paradox (Feldstein and Horioka, 1980) can question high mobility of global capital. According to the authors, if the assumption of high mobility of global capital is met, the correlation between the saving rate and the investment rate should be insignificant for a particular economy, as domestic investments may (if necessary) be funded with foreign capital, whereas the surplus of domestic savings may be invested in the global financial market. However, empirical data from a large sample of countries point to a close correlation between those variables (Feldstein and Horioka, 1980). For more on the modern aspects of the Feldstein–Horioka paradox, see e.g., (Zubarev and Trunin, 2013).

[5] The reasoning in this part of the paper will also be true in the case of a slight expansion of the Solow (1956) model to a model for an oil-exporting, small open economy with free capital flows, in which the savings of economic agents are determined exogenously, as well as in the case of a slight expansion of the Ramsey model (Ramsey, 1928), where the savings of economic agents are not determined exogenously but by economic agents inside the model, maximizing anticipated discounted utility.

[6] Assuming that rising oil prices do not lead to an improvement in returns on domestic capital, investing an additional unit of money in domestic capital at the same rate of return will increase its size, which will decrease the marginal product and reduce the returns of the domestic economy below the global interest rate. In this case, the best choice for economic agents would be to allocate additional funds in the global financial market (which has large enough capacity to allow investments without reducing global returns). However, assuming that an increase in oil prices leads to an increase in the rate of return on domestic capital, economic agents will find it profitable to invest in the domestic economy and, possibly, even withdraw their investments from the global market until the rates of return converge again.

The potential for increase of the rate of return for the national economy due to rising oil prices is easily interpreted: the growth of commodity prices (e.g., crude oil or petroleum products) in particular sectors of the economy in relation to the prices of investment goods will increase the real returns on investments in those sectors of the economy.

In the case of the standard assumption of declining marginal product from using the factors of production, such additional investment will lead to a lower marginal product of capital and, accordingly, to a lower rate of return on investments in the real sector. In other words, if the increase in global oil prices leads to growth in relative prices of end products in a particular sector, then capital will continue to increase in that sector until the marginal product of capital falls to a level where the real return on capital converges with the real global interest rate. For example, an increase in global oil prices directly leads to an increase in the prices of end products in the oil-producing sector, while higher oil prices may make new fields with higher production costs profitable, leading to additional investment in the sector.[7]

Thus, in a long-term equilibrium, higher oil prices will correspond to a higher level of capital and production in the oil-producing sector. Returns may also increase in industries closely connected with the oil-producing process, including those engaged in oil transportation, pipe manufacturing, etc. If the increase in global oil prices is accompanied by rising prices for all other energy resources, we will witness an increase in the output of respective industries, such as natural gas and coal.

Rising global oil prices will indirectly cause an increase in the ratio of domestic non-tradable goods prices to those of imported products, assuming that these two types of products are imperfect substitutes. This will happen as a result of rising global oil prices through household expenses, leading to an increase in the demand for domestic as well as imported goods. The supply curve for imported products in the case of a small open economy is horizontal, while the supply curve for domestic non-tradable goods is positively inclined due to the limited nature of certain factors of production, particularly labor. Thus, the growth of aggregate demand by households will lead to an increase in the relative prices of non-tradable goods compared with imports.

If a significant share of investment goods consists of imports, the rise in prices for non-tradable goods relative to imported goods will also lead to growth in prices for non-tradable goods compared with investment products, which will cause an increase in real returns on investments in the non-tradable sector. Thus, in the new long-term equilibrium, the marginal product of capital in the non-tradable sector should decline, and capital in that sector should increase.

Assuming that products in the tradable sector (except for energy resources) are complete substitutes for imported products on both the global and domestic market, then the prices of those products will not change as a result of rising oil

[7] The oil export duty and the mineral extraction tax in Russia reduce, to a certain extent, the effect of improving returns in the oil production sector in the case of rising global oil prices. It should be noted that, in the opinion of the paper's authors (Idrisov and Sinelnikov-Murylev, 2012), the oil export duty has led to an unprecedented long-term subsidization of the inefficient Russian oil refining sector, and the cancellation of the oil export duty is a necessary measure for increasing the energy efficiency of the Russian economy and eliminating the backwardness of its oil refining industry.

prices and will be equal to the prices of imported products. At the same time, an increase in the price of investment goods in this sector is possible, which will lead to a reduction in capital within it.

From the above it follows that with the assumption of a fixed volume of labor in each sector and with the quite standard assumption of a small open economy with free capital flows, in a long-term equilibrium with higher oil prices, we will see a higher level of capital and output in the oil-producing sector and in non-tradable sectors. In the tradable goods sector, except for energy resources, capital and output are both likely to decline.

It should be noted that if in the arguments above we abandon the assumption that the volume of labor is fixed in each sector and assume the possibility of re-distributing labor between particular sectors, then statements such as "the volume of capital will increase/decrease" can be replaced with statements such as "the capital–labor ratio per worker will increase/decrease," given standard assumptions for the type of production function. In other words, the assumed absence of labor mobility does not influence the generality of the discussion and is provided here only for the sake of simplicity.

It should be noted that in the general case, a significant redistribution of labor between particular sectors of the economy is possible. At the same time, we will observe an increase in the capital–labor ratio per worker in the oil-producing and non-tradable goods sectors and, possibly, a certain reduction in the capital–labor ratio in the tradable goods sector, except for energy resources. The most likely is the transfer of labor to the oil-producing and non-tradable sectors of the economy, provided the elasticity of substitution between imported goods and non-tradable goods is not high.

On the whole, if labor productivity is improving at the same rate in all sectors, then with sufficiently realistic assumptions higher oil prices will correspond to a higher level of real GDP at a constant aggregate volume of labor due to the increase of the capital–labor ratio in the oil-producing and non-tradable goods sectors.[8] Thus, in the model of a small open economy with free capital flows, we can see a positive correlation between global oil prices and the GDP in a long-term equilibrium.

In the case where labor productivity in the tradable goods sector (except for energy resources) grows more rapidly than in other sectors of the economy, higher global oil prices may have the adverse effect of Dutch disease on the long-term development of an oil-exporting economy due to the diversion of production factors from that sector.

## 4. The impact of global oil prices on the trajectory of recovery growth following a transformational recession

As noted above, for accumulated capital to be allocated to a small open economy with free capital flows, its returns on investment should not exceed the rate of re-

[8] A conceptually greater transfer of wealth from abroad may discourage domestic economic agents from working, i.e., households may decrease their labor supply because of the income effect (see, for example, the results of a quantitative simulation analysis in the following papers: (Polbin, 2013; Polbin and Drobyshevsky, 2014), which will have a negative impact on output in the future.

turns on investment in foreign assets. In practice, the returns on investment in physical capital for the Russian economy during the first half of the 2000s, i.e., during the period of recovery growth after the transformational recession, significantly exceeded the rate of return abroad (even with greater investment risk).

High rates of return could be explained, for example, by the low volume of capital effectively involved in the production process. The total volume of capital in the economy may have been sufficiently high in the first half of the 2000s, but it was obsolete and inefficiently distributed between specific industries and companies. Strictly speaking, with a low volume of effectively deployed capital the marginal product of capital is high and the rate of return on investment in the domestic economy is high as well. According to the basic models of growth in a closed economy, this situation will feature a certain transitional trend towards a long-term rate of capital accumulation (constant capital–labor ratio per worker). On this transitional path, we will observe accelerated (as compared with the long-term) GDP growth rates declining over time towards a long-term level determined by the growth rates of labor productivity and the population.

In the case of an open economy with free capital flows, domestic economic agents could borrow scarce capital from abroad and make a faster transition to the long-term level of capital. However, in reality this source of funding is significantly limited because foreign investors may impose an excessive risk premium when investing in Russian assets.

This means that an increase in oil prices leads to the emergence of an additional investment-funding source. Thus, price growth may accelerate the transition to a long-term level of capital and result in higher economic growth rates during the transition period (recovery growth). On this transitional path, the return on capital will decline until it reaches a level where domestic investors are indifferent between investing in domestic or foreign assets. Upon completion of the transition, the economy will grow at a moderate pace corresponding to that of labor productivity growth. At the same time, upon completion of the transition, returns on investment in the domestic economy may also significantly exceed returns on investment in foreign assets as a result of higher risk. In this case, to further narrow the interest rate gap against the need to accelerate growth, institutional reforms should be carried out to reduce the systemic risk in the domestic economy.[9]

On the path of recovery growth (transition from one equilibrium path to another), there is also the important factor of the imperfect nature of financial markets, forcing companies to fund a significant share of their investments at their own expense rather than with borrowed funds. For example, the imperfect nature of the financial market may lead to the very real situation in the economy where companies can only take out loans to fund investments against the collateral of their own existing capital. In other words, the existence of financial imperfections in the market may significantly slow down recovery growth.

In turn, in a situation with imperfections in financial markets, the ongoing rise in global oil prices may largely accelerate the recovery of the Russian economy

[9] The need to carry out institutional reforms to stimulate the growth of the Russian economy has been noted in the following papers: (Vedev and Kosarev, 2012; Drobyshevsky and Sinelnikov-Murylev, 2012; Idrisov and Sinelnikov-Murylev, 2014; Mau, 2007, 2013; Radygin and Entov, 2005).

after the transformational recession. First, the price of equity capital of companies positively influenced by increasing global oil prices should rise quite rapidly and the value of native capital and potential collateral should grow, improving the opportunity to fund investments with borrowed funds.

Second, rising oil prices may be accompanied by growth in revenues for domestic companies. These include both companies in exporting sectors, where product prices have risen on the international market, and businesses operating in the domestic market, whose products may have grown in demand (primarily from the government and households due to increased revenues as a result of rising global oil prices, and from sectors expanding their production). Revenues for domestic companies may increase in the short term due to higher prices for their products and to sales growth — if the factors of production in the economy are not fully utilized, which was characteristic of the Russian economy in the early 2000s. Consequently, companies may allocate these extra revenues to self-financing investment, further growing their equity and improving opportunities to fund investments with borrowed funds.

Third, the very increase in global oil prices may decrease the national risk premium applied by foreign investors to investments in Russian assets, and thus reduce the cost of foreign loans for companies to fund their investments.

Thus, the increase in global oil prices in the 2000s may have had a substantial positive effect on the very pace of economic recovery following the transformational recession and predetermined the close correlation between the growth rate and oil prices. Consequently, the current positive correlation between changes in real GDP and oil prices may be mistaken in the empirical papers in terms of a long-term dependency in retrospect, even though it may not exist at the theoretical level at all. In a more general case, when there is an actual long-term correlation between global oil prices and real GDP, econometric estimates made during the observed recovery growth period will very likely yield inflated ratios in that correlation.

To sum up, we should say that regression estimates throughout the historical period of correlation between domestic GDP and global oil prices will produce a certain mean value for the impact of global oil prices on output that ranges between a stronger effect during recovery growth, and a weaker effect under economic conditions once that recovery growth is complete. A more precise econometric model would have time-varying ratios for the impact of oil prices on the growth rate in output.

## 5. Keynesian aspects of the impact of global oil prices on GDP

Before continuing our review of the impact of the theoretical assumptions for the correlation between oil prices and output, we should take time to describe the short-term mechanics. If the factors of production are not fully utilized in an economy, theoretically, output may change simultaneously with an increase in oil prices, due to a greater capital deployment and more hours worked. In the basic Keynesian model of aggregate demand and supply, the aggregate supply curve is flat, which corresponds to the situation where nominal prices and wages are completely rigid and the economy has a high volume of idle factors of production: capital and labor. Accordingly, output in the Keynesian model may be determined to a greater extent by changes in the aggregate supply than by fluctuations in oil prices.

The monetary policy pursued by the Bank of Russia in the 2000s, before the global financial crisis, may be characterized as a policy of a controlled nominal ruble exchange rate with certain steps towards inflation targeting, and as a floating ruble exchange rate after the 2008 crisis (see e.g., Drobyshevsky, 2010; Drobyshevsky et al., 2011; Ulyukaev et al., 2008; Yudaeva et al., 2010). We will now consider a hypothetical situation where nominal exchange rate is fixed, nominal indicators are completely rigid, the economy has a high volume of unused (or underutilized) factors of production and global oil prices are constantly rising. The increase in oil prices would correspond to the growth in aggregate income for domestic economic agents and to an increase in demand for imported as well as domestic goods. At the same time, aggregate demand between those groups of goods would be distributed depending on preferences and relative prices.

In the case of a floating nominal exchange rate and rising global oil prices, the nominal exchange rate in an oil-producing economy strengthens rapidly, leading to an increase in the real exchange rate, relative prices for domestic goods compared with imported goods, and aggregate demand — largely due to imported goods.

In the case of a fixed nominal exchange rate, relative prices will not change in the short-term (assuming their rigidity) and, accordingly, we will see significant growth in demand for domestic goods which, assuming a flat supply curve, will lead to growth in the output of domestic goods. Output growth will occur to the extent determined by unused factors of production. It will cause an increase in the income of economic agents while also raising demand for domestic goods, and, accordingly, providing a multiplier effect for the increasing income on output.

Another growth mechanism in the demand for domestic goods in the short run is investor demand, which will increase in the current period to enable the opportunity for transitioning to the optimal level of capital in the future. In other words, growth in "short-term" investor demand will additionally increase output in the current period, as investment goods must actually be produced, whereas an increase in "long-term" investor demand will lead to a more efficient utilization of production factors over a certain period. At the same time, more intensively utilizing factors of production, i.e., an increase in hours worked, will subsequently lead to an increase in the marginal product of capital, which may multiply the growth in investments.

If, in addition to the above, domestic economic agents expect inflation to accelerate in the future because from a short-term perspective nominal prices and wages will adjust to a higher level of equilibrium, then the real interest rate will decrease against a fixed nominal exchange rate and a realized uncovered parity of interest rates.[10] This, in turn, may provide an even greater incentive for consumer and investor demand in the short term and, accordingly, increase output.

In other words, in the Keynesian model, a significant increase in output is possible due to the utilization of production factors in the short term, whereas the short-term contribution from the change in global oil prices to the real GDP may far exceed the long-term contribution under an expansionist monetary policy.

On the whole, it should be noted that the assumption of a flat aggregate supply curve is quite unrealistic from a short-term perspective. In more general assumptions, the supply curve will have a positive incline whose magnitude will

[10] This corresponds to the equality of Russian and global nominal interest rates, with a possible adjustment for the risk premium on investments in Russian assets.

depend on the rigidity of wages and prices and on how quickly companies are able to intensify the utilization of production factors. The angle of the aggregate supply curve largely determines the quantitative effect of changes in oil prices on the output of the Russian economy from a short-term perspective.

The magnitude of short-term changes in aggregate demand against rising oil prices may also be highly limited, e.g., due to certain intertemporal consumption habits of households and due to capital adjustment costs. In the first case, households may see a disadvantage in an excessively rapid increase in their consumption to a level corresponding to permanent income and will begin to adjust their consumption to the long-term level gradually, thereby reducing the effect of increasing oil prices on consumer demand. In the second case, the excessively rapid transformation of investments into fixed capital and the excessively rapid growth in investment expenses may be accompanied by significant costs and losses in the efficiency of their spending. Accordingly, companies may prefer a more gradual capital accumulation.

## 6. An illustration of the impact of oil prices on basic macroeconomic variables in the dynamic model of general equilibrium

The above reasoning leads us to conclude that the trajectory of response by domestic output to shocks in the terms of trade (permanently rising oil prices) may take quite a remarkable shape. The mechanics of impact and the assumptions that would produce a given effect are rather diverse. In this case, the answer to the question regarding which mechanism for correlating between rising oil prices and output would have the most substantial effect appears to be more of an ideological than economic matter at a theoretical level. For a quantitative illustration or verification of hypotheses, scholars normally turn to empirical studies or to quantitative simulation analysis within adjusted models of general equilibrium. We will do the same.

To illustrate the short-term and long-term effects of changing oil prices on basic macroeconomic variables, we will consider a rather stylized dynamic stochastic general equilibrium model (DSGE). This model is an extension of a model built in Polbin (2014) to a steady-state growth model with a stochastic trend in labor productivity and with randomly floating prices of exported goods in relation to imported goods (we will associate those prices with oil prices for the sake of simplicity).

The model distinguishes between goods in the export-oriented sector (EOS) and the domestic-oriented sector (DOS) of the Russian economy. The output volume of the export-oriented sector is determined exogenously, which, to a certain extent, reduces the utility of the model but enables us to obtain a permitted, time-invariable model of steady-state growth and to analyze the impact of an increase in permanent income due to the appreciation of exported goods on the output of the domestic-oriented sector of the economy and other macroeconomic variables.

The model has a broad range of tools for describing the short-term behavior of macroeconomic variables within the Keynesian mechanisms described above. In particular, the model assumes that nominal prices and wages are not completely rigid in the short run; there is also the assumption of endogenous capital utilization and an endogenous supply of labor, intertemporal consumption habits of households, and investment adjustment costs. The behavior of the macroeconomic system is determined based on the optimizing activity of households and companies.

The numeric simulation analysis was carried out based on the assumption that the central bank is pursuing a fixed nominal exchange rate policy.[11]

Now we will describe the impact of changes in global oil prices within the framework of the suggested model. The functions of impulse responses to a 10% rise in global oil prices in the DSGE model of the basic macroeconomic variables are presented in Fig. The time period along the X-axis is one quarter. The Y-axis represents the percentage contribution of the oil price shock to the trend of the given variable (described above). Thus, the first (top left) graph demonstrates that the simulated shock in oil prices represents a permanent 10% increase.

As the figure shows, many macroeconomic variables demonstrate a dome-like response during the transition to a new long-term equilibrium, i.e., in the beginning we can see the effect of "missing" this new long-term equilibrium. Thus, the con-

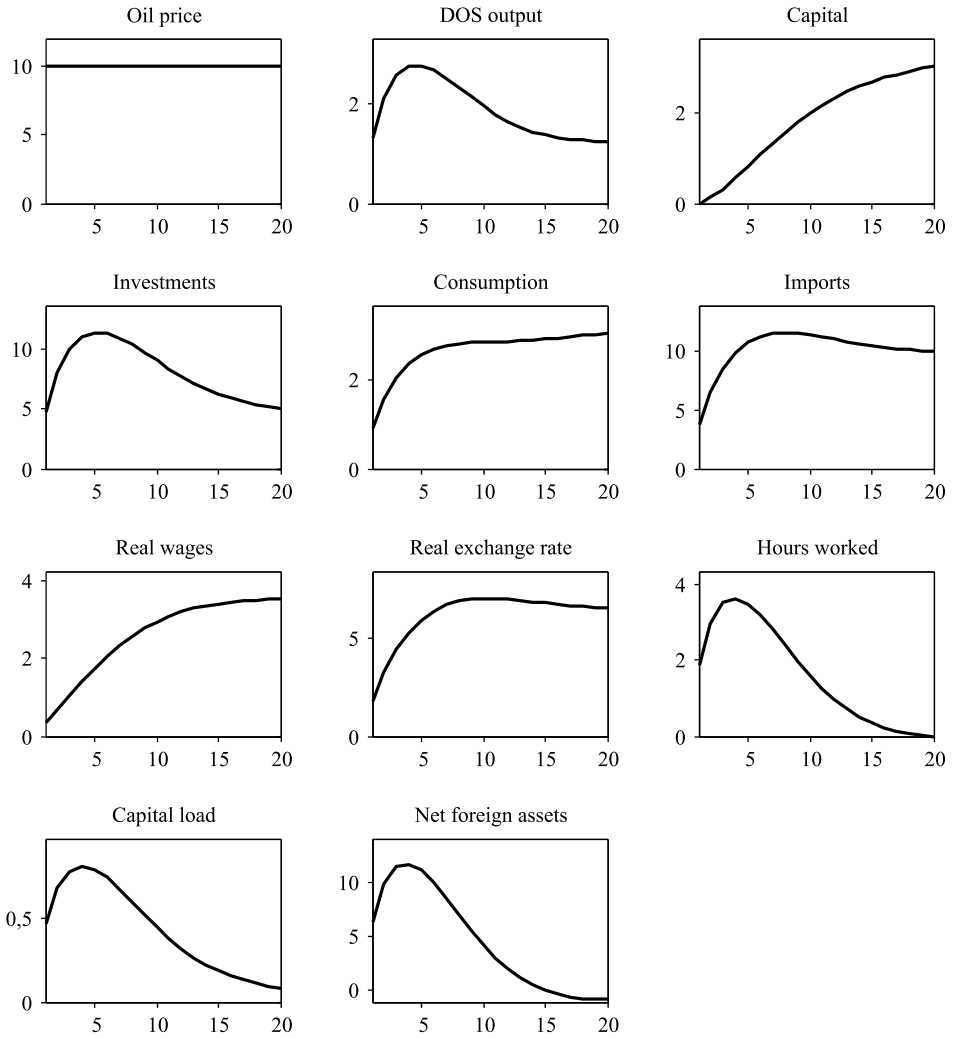


**Fig.** The functions of impulse response to a 10% increase in global oil prices, obtained based on a simulation analysis using the DSGE model with a broad range of real and nominal rigidities.

[11] A detailed description of the model can be found in Polbin (2014).

tribution to the increase in output by the domestic-oriented sector in response to the 10% positive shock of oil prices reaches the level of approximately 3% a year, following which the contribution to output growth begins to decline towards the long-term level of approximately 1%. The long-term impact on the output of a given sector is determined by the various mechanisms described in section three of this paper, namely increases in relative prices within the sector in a long-term equilibrium, improving its returns and encouraging capital accumulation. Accordingly, the contribution of permanently rising global oil prices to the growth rate in a given sector's output will be positive during the first year, after which we will see a negative contribution to the output growth rate.

The output trend shown in the figures is determined by the following factors. In the short term, in response to increasing consumer and investor demand for domestic goods, businesses expand their production capacity through more intensive capital utilization and increasing hours worked. At the same time, the increases in the components of demand will only become noticeable after a certain period of time due to the gradual adjustment of consumption and investments to rising oil prices, determined by intertemporal consumption habits and capital adjustment costs.

Real wages, domestic goods prices and the real exchange rate will adjust over time to a new long-term level, resulting in rising relative prices for domestic goods compared with imported goods, leading to a redistribution of the increased demand in favor of imported goods over the long term. Capital utilization and hours worked will return to an old level, and long-term growth in output will be achieved through increased physical capital.

Assuming that economic agents perceive rising global oil prices as temporary and realize only later that, in fact, the change in global oil prices is permanent, the magnitude of short-term responses will be reduced for all variables. This happens because, according to household perceptions, their permanent income increases more slowly in the case considered, and accordingly, they will increase current demand more slowly and save more on foreign markets. Businesses, in turn, are inclined to believe that the flow of marginal products of capital is not so significant under a temporary increase in oil prices, thereby reducing investment incentives.

Indeed, if businesses consider currently rising global oil prices to be a temporary situation, the question arises as to the expediency of building a refinery or drilling a new oil well, as they expect oil prices to return to an old level at the moment their newly built facilities are put into operation.

Moreover, rising global oil prices may lead to an increase in costs for companies, resulting from the appreciation of resources. Against such an unfavorable shock in prices for intermediate products used in production, costs will increase at any volume of output. This, in turn, may lead to price increases and a decrease in production[12] (Kazakova et al., 2009).

An aspect requiring a more thorough review is the transition of the Bank of Russia to an inflation targeting regime and a floating nominal exchange rate for the ruble. This regime of monetary policy may substantially deteriorate the short-term impact of global oil prices on the Russian economy. Specifically, increasing oil prices will

[12] An example of such a shock is the energy crisis of the 1970s (as well as the rise in global oil prices from 1978 to 1980), when soaring oil prices led to a substantial increase in costs for businesses, mainly in the oil and gas sector, resulting in accelerated inflation.

lead to a rapid improvement in the nominal exchange rate for the ruble and, accordingly, to fast strengthening of the real exchange rate and to growth in real wages, resulting in increased demand (due to the rising incomes of economic agents), to a greater extent for imported goods than for those produced domestically.

## 7. Conclusion

In this paper, we conducted a theoretical analysis of and considered the mechanics behind the positive correlation between the output of the Russian economy and global oil prices. We provided theoretical considerations in the context of basic neoclassical models of economic growth in favor of a positive correlation between the real GDP and global oil prices, i.e., higher oil prices will correspond to a higher level of production of goods and services by the domestic economy, as well as greater wealth for Russian economic agents.

At the same time, long-term economic growth rates do not depend on oil prices but are determined by the growth rate in the efficiency of production factors. The effect of oil prices on the output growth rate may be observed only from a short-term perspective, during the transition from a long-term equilibrium at one level of oil prices to a long-term equilibrium at another level of oil prices.

Accordingly, an increase in oil prices will lead to an accelerated economic growth rate only in the short term. Thus, a rather close correlation between the real GDP growth rate for the Russian economy and oil prices during their explosive growth in the 2000s, which may be perceived as a dependency of the output growth rate on global oil prices, was actually the result of a certain transitional change.

The paper puts forward theoretical arguments proving that the impact of changing global oil prices was greater during the recovery growth period, when the factors of production were not fully utilized, compared with their impact in the current economic environment. This means that the influence of changes in global oil prices on output has substantially diminished over time.

The paper also contains a detailed analysis of the Keynesian mechanics of the impact of global oil prices on the output of the Russian economy from a short-term perspective. Given a controlled nominal rate for the ruble, in the short term, we may see an economic boom caused by the improvement in terms of trade and the transfer of income to the Russian economy, and the short-term contribution of changing global oil prices to the trend in real GDP will far exceed the long-term contribution.

At the same time, we will observe a positive contribution of increasing oil prices to the GDP growth rate from a short-term perspective, during the cyclical rise and overheating of the economy, i.e., output will be above the potential level during a certain period of time. Accordingly, we may observe a negative impact on the GDP growth rate from rising global oil prices in the medium term, as the economy returns to the potential level of output. Accordingly, the slowdown of growth in the current economic environment is partly the result of the inertial adjustment of the economy after overheating, caused by the upsurge in global prices during the 2000s.

In the case of inflation targeting, the short-term impact of global oil prices on the output of the Russian economy may decrease significantly. Under conditions of high volatility in global oil prices, transition to the inflation targeting regime

and floating exchange rate will lead to a decrease in the short-term impact of changing oil prices on output and other macroeconomic indicators which, no doubt, is a positive aspect of the monetary policy that may encourage a reduction in the volatility of the Russian economy and result in improving public well-being. At the same time, however, it should be noted that following the tradition of Lucas' (1976) critique, a change in economic policy will lead to changes in the correlation between macroeconomic indicators. In other words, using estimates of empirical correlation between domestic output and oil prices based on historical data under the controlled nominal ruble rate regime is incorrect when forecasting under a monetary policy taking shape as the inflation targeting and floating rate regime. This approach may lead to incorrect forecasts of changes in the Russian macroeconomic system and to an inefficient macroeconomic policy.

Based on the above results in estimating the impact of global oil prices on economic growth in Russia, we can also formulate a conclusion on the need to reduce the Russian economy's dependence on the global trade environment and to develop an economic policy aimed at achieving steady growth rates over a long-term perspective. In this regard, considerable attention should be paid to growth factors in the context of supply, including improvements in the institutional environment and in the investment attractiveness of the Russian economy, the development of infrastructure, the reduction of market monopolization, increases in the mobility of production factors, the encouragement of innovative activities and improvements in human capital.

## Acknowledgements

The authors would like to express their gratitude to Sergey Sinelnikov-Murylev and Sergey Drobyshevsky for their constructive criticism and fruitful discussions.

## Reference

Ayvazyan, S., Brodsky, B., Sandoyan, E., Voskanyan, M., & Manukyan, D. (2013). Macroeconometric modeling of Russian and Armenian economies. II. Aggregated macroeconometric models of the national economies of Russia and Armenia. *Prikladnaya Ekonometrika, 31* (3), 7–31 (In Russian).

Ayvazyan S., & Brodsky B. (2006). Macroeconometric modeling: Modern trends, problems, an example of the econometric model of the Russian economy. *Prikladnaya Ekonometrika, 2* (2), 85–111 (In Russian).

Benedictow, A., Fjærtoft, D., & Løfsnæs, O. (2010). Oil dependency of the Russian economy: An econometric analysis. *Statistics Norway, Research Department Discussion Papers, 617*.

Bruno, M., & Sachs, J. (1982). Energy and resource allocation: A dynamic model of the "Dutch disease". *Review of Economic Studies, 49* (5), 845–859.

Céspedes, L. F., & Velasco, A. (2012). Macroeconomic performance during commodity price booms and busts. *NBER Working Paper, 18569*.

Collier, P., & Goderis, B. (2008). Commodity prices, growth, and the natural resource curse: Reconciling a conundrum. *OxCarre Research Paper, 2008-14.*

Drobyshevsky, S., & Sinelnikov-Murylev, S. (2012). Macroeconomic preconditions of realization of a new growth model. *Voprosy Ekonomiki, 9*, 4–24 (In Russian).

Drobyshevsky, S. (2010). The landmarks of monetary policy. *Ekonomicheskaya Politika, 2*, 27–30 (In Russian).

Drobyshevsky, S. M., Sinelnikov, S. G., & Trunin, P. V. (2011). G20 resolutions on a coordinated anti-crisis economic policy and the Russian experience. *Rossiyskiy Vneshneekonomicheskiy Vestnik, 6*, 12–23 (In Russian).

Feldstein, M., & Horioka, C. (1980). Domestic saving and international capital flows. *Economic Journal, 90* (358), 314–329.

Gaidar, Y. T. (2012). *Collected Works* (Vol. 4). Moscow: Delo (In Russian).

Guriev, S., & Sonin, K. (2008). Economics of the resource curse. *Voprosy Ekonomiki, 4*, 61–74 (In Russian).

Gylfason, T. (2001). Natural resources, education, and economic development. *European Economic Review, 45* (4), 847–859.

Idrisov, G., & Sinelnikov-Murylev, S. (2014). Forming sources of long-run growth: How to understand them? *Voprosy Ekonomiki, 3*, 4–20 (In Russian).

Idrisov, G., & Sinelnikov-Murylev, S. (2012). Modernization vs preservation: The role of the export duty on oil and petroleum products. *Ekonomicheskaya Politika, 3*, 5–19 (In Russian).

Ito, K. (2009). The Russian economy and the oil price: A co-integrated VAR approach. *Transition Studies Review, 16* (1), 220–227.

Kazakova, M., & Sinelnikov-Murylev, S. (2008). The environment of the global energy market and Russian economy growth rates. *Ekonomicheskaya Politika, 5*, 118–135 (In Russian).

Kazakova, M. V. (2009). The impact of the oil and gas sector on Russia's economic performance and in the global practice. *Rossiyskiy Vneshneekonomicheskiy Vestnik, 8*, 66–72 (In Russian).

Kazakova, M. V., Sinelnikov-Murylev, S. G., & Kadochnikov, P. A. (2009). Analysis of structural and business component of the tax burden in Russian economy (IET Research paper No. 129P). Moscow: IET (In Russian).

Korhonen, I., & Ledyaeva, S. (2010). Trade linkages and macroeconomic effects of the price of oil. *Energy Economics, 32* (4), 848–856.

Knobel, A. (2013). The risks of budgetary policy in resource-rich countries. *Ekonomicheskaya Politika, 5*, 29–38 (In Russian).

Kuboniwa, M. (2012). Diagnosing the "Russian disease": Growth and structure of the Russian. *Japan Comparative Economic Studies, 54* (1), 121–148.

Lescaroux, F., & Mignon, V. (2008). On the influence of oil prices on economic activity and other macroeconomic and financial variables. *OPEC Energy Review, 32* (4), 343–380.

Lucas, R. E. (1976). Econometric policy evaluation: A critique. *Carnegie-Rochester Conference Series on Public Policy, 1* (1), 19–46.

Mau, V. (2007). Economic policy in 2006: On the path to investment growth. *Voprosy Ekonomiki, 2*, 4–25 (In Russian).

Mau, V. (2013). Between modernization and stagnation: Economic Policy in 2012. *Voprosy Ekonomiki, 2*, 4–23 (In Russian).

Mau, V. A. (2005). The lesson of the Spanish empire, or the natural resource trap. In *Economic History: Annual, 2005*. Moscow: ROSSPEN (In Russian).

Mehlum, H., Moene, K., & Torvik, R. (2006). Institutions and the resource curse. *Economic Journal, 116* (508), 1–20.

Polbin, A. (2014). An econometric estimate of the structural macroeconomic model of the russian economy. *Prikladnaya Ekonometrika, 33*, 3–29 (In Russian).

Polbin, A. V. (2013). Building a dynamic stochastic general equilibrium model for an oil-dependent economy. *Ekonomicheskiy Zhurnal Vysshey Shkoly Ekonomiki, 2*, 323–359 (In Russian).

Polbin, A. V., & Drobyshevsky, S. M. (2014). Building a dynamic stochastic general equilibrium model for the Russian economy (IET Research paper No. 166P). Moscow: Gaidar Institute Publ. (In Russian).

Radygin, A., & Entov, R. (2005). Institutional components of economic growth. *Voprosy Ekonomiki, 11*, 14–38 (In Russian).

Ramsey, F. P. (1928). A mathematical theory of saving. *Economic Journal, 38* (152), 543–559.

Rautava, J. (2004). The role of oil prices and the real exchange rate in Russia's economy—a cointegration approach. *Journal of Comparative Economics, 32* (2), 315–327.

Rautava, J. (2013). Oil prices, excess uncertainty and trend growth. *Focus on European Economic Integration, Q4/13*, 77–87.

Sachs, J. D., & Warner, A. M. (1995). Natural resource abundance and economic growth. *NBER Working Paper, 5398*.

Sachs, J. D., & Warner, A. M. (1997). Fundamental sources of long-run growth. *American Economic Review, 87* (2), 184–188.

Sala-i-Martin, X. X. (1997). I just ran two million regressions. *American Economic Review, 87* (2), 178–183.

Solow, R. M. (1956). A contribution to the theory of economic growth. *Quarterly Journal of Economics, 70* (1), 65–94.

Suni, P. (2007). Oil prices and the Russian economy: Some simulation studies with NiGEM. *ETLA Discussion Papers, 1088.*

Ulyukaev, A., Drobyshevsky, S., & Trunin, P. (2008). Prospects of the Initiation of inflation targeting in RF. *Voprosy Ekonomiki, 1*, 14–17 (In Russian).

Vedev, A., Kosarev, A. (2012). Quantitative estimates of the impact of institutional restrictions on economic growth in Russia. *Ekonomicheskaya Politika, 1*, 50–65 (In Russian).

Yudaeva, K., Ivanova, N., & Kamenskikh, M. (2010). *What is the Bank of Russia targeting?* Moscow: Center of Macroeconomic Research, Sberbank of Russia. (In Russian).

Zubarev, A., & Trunin, P. (2013). The Feldstein-Horioka paradox: Modern aspects. *Ekonomicheskaya Politika, 4*, 54–73 (In Russian).