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# Discovering the signs of Dutch disease in Russia ☆

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ABSTRACT

This paper examines the problem of Dutch disease in Russia during the oil boom of the 2000s, from both the theoretical and empirical points of view. Our analysis is based on the classical model of Dutch disease by Corden and Neary (1982). We examine the relationship between changes in the real effective exchange rate of the ruble and the evolution of the Russian economic structure during the period 2002–2013.

We empirically test the main effects of Dutch disease, controlling for the specific features of the Russian economy, namely the large role of state-owned organizations. We estimate the resource movement and spending effects as determined by the theoretical model and find the presence of several signs of Dutch disease: the negative impact of the real effective exchange rate on the growth in the manufacturing sector, the growth of the total income of workers, and the positive link between the real effective exchange rate and returns on capital in all three sectors. However, the shift of labor from manufacturing to services cannot be explained by the appreciation of the ruble alone.


## 1. Introduction

With a share of 13% of the world market, Russia remains one of the major global suppliers of oil. Russian exports of goods and services currently account for approximately 30% of GDP, with exports of raw materials representing about 80% of the total value of goods exports. Four fifths of these raw materials consist of just two products: oil (together with oil products) and natural gas. The export structure has stayed remarkably stable since 2000 (see Fig. 1).

In the 2000s, the Russian economy developed under extremely favorable external conditions. Oil prices soared after the crisis of 1998, reaching the fifty-year linear trend by 2004 and they stayed high above the trend until autumn 2014 (see Fig. 2).

In spite of this, Russia's economic growth rate has been very volatile during this period. After growing by an average of 7% a year during the period 2000–2008, the economy plummeted by 7.8% in 2009 when the oil price decreased. The recovery of oil prices did not bring back the former growth rate. On the contrary, it has continued to decline: from 5.0% in the third quarter of 2011 to 1.3% in 2013 (Fig. 3). In manufacturing, the economic slowdown was even worse, with almost zero growth in 2008 and a negative −15.2% in 2009. After a rebound in growth in 2010, it started to slow down rather rapidly, practically back to zero in 2013 (Fig. 3). In 2002–2013, the share of the manufacturing sector in GDP in the current market prices has shrunk by 2.2% (see Table A.1 in Website-Based APPS), while the share of mining in GDP has risen by 3.0%.

In literature, these stylized facts often refer to the signs of Dutch disease (see, for example, Egert (2012)). Dutch disease is an economic phenomenon which implies that an increase in export revenues leads to a decline in the manufacturing sector. The mechanism for this is the following: high revenues from the trade in natural resources create a balance of payments surplus due to the rising prices and/or volumes, which induces a substantial appreciation of the real effective exchange rate of the national currency. This renders local non-primary goods uncompetitive and leads to an outflow of resources from manufacturing. The loss of competitiveness in manufacturing represents the essence of Dutch disease. It is important to note that this negative impact can be extrapolated to the other tradable sectors, for example agriculture (see Davis (1995) for more details). However, in this study we

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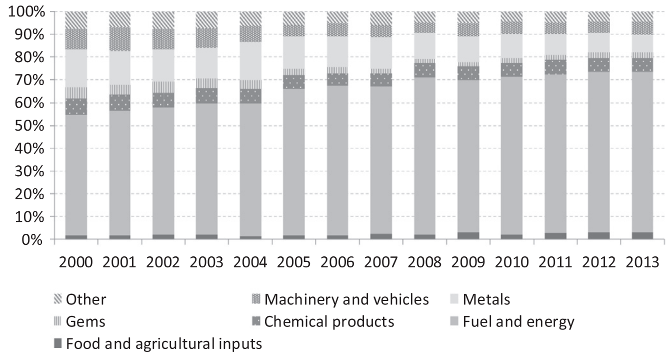


**Fig. 1.** Structure of Russian exports, 2000–2013, %. Source: Rosstat.

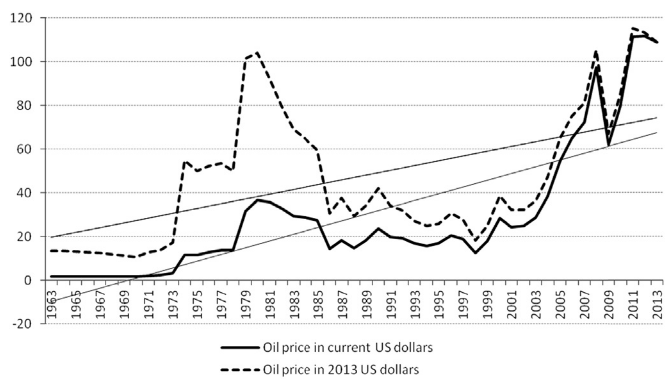


**Fig. 2.** Oil price (in US Dollars per barrel) and its linear trend, 1963–2013. Source: BP Statistical Review of World Energy, authors' calculation. *Note*: 1963–1983 Arabian Light posted at Ras Tanura. 1984–2013 Brent dated.

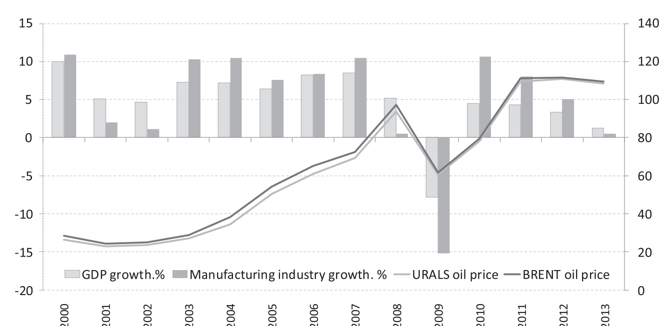


**Fig. 3.** GDP and manufacturing growth rates in Russia (left axis) and crude oil current price (in US dollars per barrel, right axis). Source: Rosstat, Reuters, authors' calculation.

focus primarily on manufacturing since the share of agricultural production in Russian GDP is far less than the share of manufacturing (about 3% versus 13%, see Table A.1 in Website-Based APPS).

The term "Dutch disease" is itself a paradox since its onset is marked by an inflow of wealth into an economy, followed by a rapid rise in domestic expenditures. Thus, in some sense, a change in the industrial structure cannot be considered a 'disease' in the direct meaning of the word. The result of the shrinking of the manufacturing sector is an optimal reaction to the growth of easy wealth (although it is certainly perceived as a disease by workers and enterprise owners in the affected industries). Davis (1995) shows that Dutch disease is just a transition of an economy from one equilibrium state to another when the boom in exports lasts for an infinitely long period of time. However, when the boom is temporary (which is usually the case), the consequences of a shock will be more deteriorating when the resource tradable sector (that produces gas and oil) is more developed than the non-resource tradable sector (see Sheng (2011)).

For this reason, in the economic literature the term "Dutch disease" is regarded mainly as a structural problem: the deprivation of resources from the manufacturing sector reduces its capacity to generate basic innovations and the expertise favoring steady long-term economic growth.[1] Besides, the focus on the exports of raw material and the lack of output diversification renders an economy less stable vis-à-vis the external economic shocks.[2]

Broadly speaking, Dutch disease is one of the causes of the so-called Resource Curse.[3] We will not discuss the concept of the Resource Curse in detail, but it is important to mention its manifestations. Van der Ploeg (2011b) points to three main groups of this phenomena: the over appreciation of the national currency, de-industrialization and low growth rates; rent grabbing, corruption and civil conflicts; difficulties in arranging the process of transformation of depleting resource assets to non-resource ones. Also, the distortion of economic motivations because of the struggle for raw material rents results in a high level of poverty, authoritarian rule, underinvestment in education, an undermined quality of institutions and even higher risks of a civil war (see Collier and Hoeffler (2002), Elbadawi and Sambanis (2002), Ross (2004) and Pegg (2010)). In the case of Russia these problems can be aggravated by the transformation process that it has had to go through, from planning to market economy.

Taking into account the devastating problems of the Resource Curse, it is important to identify whether one of its possible causes – Dutch disease – is present in an economy. The purpose of this paper is to study whether Russia is suffering from Dutch disease, in other words, whether the poor performance of the manufacturing sector in Russia is due to its low price competitiveness and to the abundance of export revenues that lasted for a "fat decade" in the 2000s. The decreasing share of manufacturing and the fast growth of the real effective exchange rate of the ruble (rising by approximately 60% during the period 2001–2013), as well as a persistently positive current account (see Fig. 4) are the first alarm signals. Even though the manufacturing growth rate in 2000–2014 has always been higher than GDP growth rate, except for 2008, 2009, 2013, it is likely that this visibly excellent performance is related to the rebound effect of the deep crisis of the 90's when manufacturing was declining much worse than the GDP (by 59% and 29% in 1992–1998, respectively), as well as to the intensive transformation from the state economy to the market economy.

We verify the hypothesis of Dutch disease comprehensively, comparing the theoretical results of the particular type of the widely used model by Corden and Neary (1982) to the empirical evidence. We find that the existence of Dutch disease in Russia cannot be rejected.

[1] Van der Ploeg and Venables (2012) believe that the presence of Dutch disease must be considered only if the sectors squeezed out by the resource boom have an external effect on the economy. According to van Wijnbergen (1984) and Sachs and Warner (2000), the tradable sectors are considered to have positive external effects by increasing returns to scale or "learning-by-doing". Polterovich et al. (2010) also indicate a positive externality for the long-term growth originated by the human capital accumulation in the traded non-resource sector.

[2] Frankel (2012) also mentions that in the case when a resource exporting country has a significantly negative current account, the underlying international debt may be "difficult to service when the commodity boom ends".

[3] Among the other causes are, for example, a high volatility of income from external trade, the pro-cyclical pattern of macroeconomic fiscal and monetary policy (Frankel (2012)). Van der Ploeg (2011b) also mentions the high volatility as the quintessence of the negative manifestations of the resource curse, especially when the financial sector is underdeveloped.

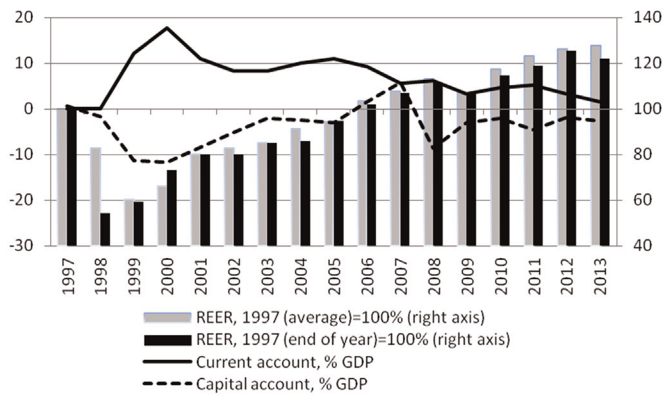


**Fig. 4.** The dynamics of the balance of payment and the real effective exchange rate of the ruble (REER). Source: Rosstat, The Bank of Russia, authors' calculation.

The paper is organized as follows. In the second section, we briefly review the papers on Dutch disease in Russia as well as papers where the analysis is based on the same theoretical model that we apply here. In section 3, we discuss the theoretical model and its assumptions. In Section 4, on the basis of a cointegration model, we test the relationship between oil exports and the real effective exchange rate of the ruble – the key channel between oil revenues and the decline in manufacturing. In Section 5, we compare the results of the theoretical model to the actual dynamics of selected economic indicators, seeking to detect the signs of Dutch disease. We make our conclusion in Section 6.

## 2. Literature review

To detect Dutch disease in an economy based on raw materials is not a trivial undertaking. In addition to Dutch disease, other factors may cause a decline in the manufacturing sector. For example, it can be a decrease in the cost competitiveness of national producers due to the rise in relative unit labor cost (RULC), linked to the growth in relative wages or the decrease in labor productivity, or the deteriorating quality of institutions, which renders the administrative costs of running a business cumbersome. Similarly, apart from high export revenues, there may be other reasons for currency appreciation, such as the endogenous rise of relative labor productivity. The analysis by Pegg (2010) of the economy of Botswana is a good example which shows the complexity of the issue. The author shows that, on the one hand, many symptoms of Dutch disease are present, such as the poor diversification of the economy (poorly developed manufacturing and agricultural sectors). On the other hand, the real exchange rate of the national currency does not seem to be overvalued, neither have we observed the movement of resources to diamond mining. The author states that, although Dutch disease is suspected, the true reasons for the low growth rate in non-tradable sectors are the excessive growth of wages (compared to labor productivity), the underdevelopment of the infrastructure and persistent drought and high income inequality.

As the same factors are likely to be present in the Russian economy, there is no consensus on the diagnosis of Dutch disease in Russia in the literature. In their literature review of 15 empirical studies on the real exchange rate appreciation and the de-industrialization symptoms for Russia, Dülger et al. (2013) note that, according to most researchers, “Russia … exhibits symptoms of the phenomenon” but there is disagreement “on whether Dutch disease itself is apparent for Russia”. In this section, we review some papers that present opposing points of view to Dutch disease in Russia, motivate our choice of the model, and describe some of the details of it, leaving a more thorough presentation for the following section.

In general, we can distinguish two types of studies on Dutch disease in Russia. The results of the first type acknowledge the presence of the first signs of Dutch disease at the initial stage. The examples of this type are the papers by Ahrend et al. (2007) on the analysis for Russia and Ukraine, where the author concluded that the application of the term “Dutch disease” to describe the situation in Russia was an open question but that the Russian manufacturing sector would have grown far more substantially had the ruble not appreciated to the same degree; Egert (2012) on the short and long-term Dutch disease in Russia and 24 other post-Soviet countries, where it is established that higher oil prices lead to the appreciation of the real and nominal exchange rate and have a negative long-term (but not short-term) impact on the growth rate of the economy; Tabata (2013), where the author finds that Dutch disease is present but is subdued substantially by differences in internal and external prices for energy and massive interventions of the central bank, which constrained the growth of imports and caused deceleration in manufacturing.

The second type of papers find that the symptoms similar to those of Dutch disease are in fact the manifestation of other processes induced by the transition character of the economy and the recovery from the deep depression of the 90s, as we mentioned before. Among the papers of this type are Ollus and Barisitz (2007) on the comparison of industrial import growth with the industrial production growth; Beck et al. (2007) on the competitiveness of the Russian economy relative to the Baltic states and Poland; Dobryanskaya and Turkisch (2010) and Oomes and Kalcheva (2007) on the search of an alternative to Dutch disease causes of the appreciation of the ruble; Van der Marel (2012) on the structure of Russian exports. Dobryanskaya and Turkisch (2010) and Oomes and Kalcheva (2007) state that the appreciation of the ruble were caused not by Dutch disease, but by the rise in productivity and entry into new markets after the collapse of the USSR. Also, Oomes and Kalcheva (2007) concluded that the currency has never been overvalued. Van der Marel (2012) attributed the deterioration of the structure of Russian exports after the beginning of the oil boom in 2004 not to Dutch disease (in particular, not to the appreciation of the ruble), but to the ongoing weakening of institutions and the undermined supremacy of law in Russia after the “Yukos” case.

As the empirical evidence is contradictory, we attempt to get the answer from the theory. In this study, we use the classical model of Dutch disease from the seminal paper by Corden and Neary (1982). They consider the theory of Dutch disease from the standpoint of a market failure that occurs when excessive resources harm the economy rather than open it up to new opportunities for development.

We motivate the choice of the model by the fact that it offers a general framework that can be adjusted to the realities of a particular economy by modifying the set of assumptions on the mobility of resources and capital intensiveness. Notwithstanding the fact that the theory dates back to 1980s, it has been applied in a number of recent papers, such as those by Dülger et al. (2013) for the analysis of the impact of real oil prices and relative labor productivity in manufacturing and services in Russia on the real exchange rate and economic structure, Goderis and Malone (2011) on the effect of the resource price boom on inequalities, Rajan and Subramanian (2009) on the impact of foreign aid on the manufacturing sector, Brahmbhatt et al. (2010) on discovering the channels through which Dutch disease affects the economic structure, and Beine et al. (2012) on the analysis of the mitigation effect of migration for Canada. Ismail (2010) developed a similar static model and used it for the structural detection of Dutch disease in oil exporting countries. The core model of Corden and

Neary (1982) has been extended in several directions, which would be interesting to apply in the future studies of the Russian economy. As an example, Van der Ploeg (2011a, 2013) combines the core model with the model of absorption of export revenues.

Oomes and Kalcheva (2007) used the model to identify the directions of the effects of Dutch disease in Russia from the theoretical point of view and then tried to detect similar processes in the Russian economy. Our approach is quite similar to theirs, although we use a more specific type of the basic model and attempt to quantify the effects of the appreciation of the real effective exchange rate.

## 3. Theoretical framework

The theoretical model of Dutch disease proposed by Corden and Neary (1982) examines the consequences of a raw material boom for real economic variables, the distribution of income and labor resources, as well as the relative size and profitability of sectors. Although this model is rather a systematic graphical mode of analysis than a formalized set of equations, it allows us to track the directions of structural changes in an economy with Dutch disease.

Let us assume that the economy consists of two tradable goods sectors, mining (energy) and manufacturing, and one non-tradable sector, services. The prices of tradable goods are exogenous, while the price of services is determined by the supply and demand in the domestic market. For simplicity, the monetary factors are excluded from the model, so all prices are relative and are expressed in terms of the given prices of tradable manufacturing goods. The internal demand consists of household consumption only, the foreign trade is balanced, the labor market is flexible, and there is no unemployment. The economy possesses only two production factors, labor and capital, which can be assigned different degrees of mobility between sectors. Also, the sectors differ in the capital-to-labor ratio for technology. Following Corden and Neary (1982), we also assume that the real foreign exchange rate, defined as the ratio of prices of non-tradable goods to prices of tradable goods, is not fixed.[4]

Broadly speaking, the mechanism, proposed by Corden and Neary (1982), is the following. As oil export revenues rise, the mining sector receives a large inflow of foreign currency, making it very profitable. The overall effect can be separated into two parts, the resource movement effect and the spending effect. The resource movement effect is the shift of labor and capital (if these are mobile) to the energy sector due to the growth of marginal gains in mining. This leads to a number of consequences including further changes in the real foreign exchange rate, with the outcome depending on the capital-to-labor ratios in different sectors and the degree of the mobility of resources. The spending effect means that the higher income from the export of raw materials leads to a higher demand in all sectors including services (since the income is equal to expenditures), causing a surge in their relative price, and therefore contributing to the real appreciation of the national currency. The latter depends, among other factors, on the marginal propensity to consume services in an economy.

The overall effect on the economy is determined by the sum of the resource movement effect and the spending effect. The directions of these effects under various assumptions are presented in Table A.1 of the Appendix. The simplest specification of Dutch disease model is the Model No. 1 (see Table A.1), where labor is mobile in all three sectors, but capital is sector-specific. This model has been applied in many papers, for example in Oomes and Kalcheva (2007).

For our analysis we adopt a different specification, which assumes the complete mobility of labor, but a *partly limited* inter-sector mobility of capital. The motivation for this choice is the following. In our opinion, capital in Russia is mobile (and thus not sector-specific) only between manufacturing and services. The static (sector-specific) character of capital in the energy sector is due to its monopolization by the government, which began in the second half of the first decade of the 2000s with the nationalization of Yukos, thus setting the entrance cost (including administrative cost) of the industry at a very high level relative to the other sectors. Also, we assume that the relative intensity of capital is the highest in mining, less in services, and the least in manufacturing. Indeed, according to our calculations, the capital to labor ratio is almost two times higher in services than in manufacturing[5] (see Fig. 5).

Under the given assumptions, the impact of the oil price rise is the following:

1. the mobile resource – labor – shifts to the more profitable mining sector, making labor scarce in the manufacturing and service sectors;
2. according to the Rybczinsky theorem, given current relative prices, the manufacturing sector will suffer more, as this shift causes the more labor intensive sector (in this case, manufacturing) to be crowded out by less labor intensive sector (here, services);
3. more services are produced, and their relative price declines. According to the Stolper–Samuelson theorem, since the price of the manufacturing good is fixed, this will lead to a decrease in price for the more intensively used resource (capital) and an increase in the price of the other resource (labor). Real wages rise in all sectors as the labor is mobile.

Therefore, the resource movement effect leads to an increase in real wages, de-industrialization, and the weakening of the real foreign exchange rate.

The spending effect works as follows:

1. the higher income raises the demand for services, increasing their price and the total amount produced, which further crowds out the manufacturing sector;
2. the increase in prices of services causes further appreciation of the national currency and a decline in real wages.

The total effect of the oil boom on the level of real wages and real foreign exchange rate is not pre-determined. Instead, it depends on the ratio of the effect of the resource movement to the effect of the spending. Some economists have argued that in Russia the latter is far more evident than the former. Firstly, the share of employment in mining is low and changes rarely – merely from 1.5% to 1.7% in recent years (see Table A.2 in Website-Based APPS).[6] Secondly, we can assume that the mobility of labor in

[4] This definition of the real effective exchange rate is equivalent to the classical definition (the nominal exchange rate adjusted to the local inflation and the inflation in the rest of the world) under some assumptions. More specifically, when the market of tradable goods is perfectly competitive and the law of one price holds, the inflation in the rest of the world can be approximated by the price index of tradable goods. When the domestic prices of tradable goods are determined by the world market and the exchange rate, the price index of non-tradable goods is the only relevant price for describing domestic competitiveness. Under the additional assumption on the fixed nominal exchange rate (which is relevant for the Russian economy, only 30% of the appreciation of the real effective exchange rate was due to the changes in the nominal exchange rate in 2000s), the real effective exchange rate is just the price index for non-tradable goods in terms of tradable ones. This definition is classical for models of Dutch disease.

[5] See the comments on the composition of sectors in Section 5.

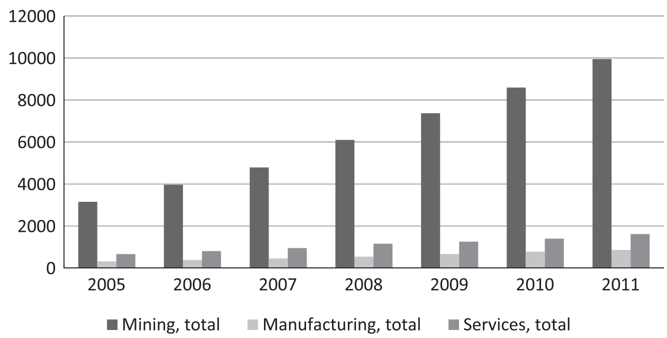


**Fig. 5.** Capital to labor ratio in the Russian economy, without adjustment for depreciation of fixed assets, current prices, 1000 rubles/employee. *Note*: Rosstat data on available fixed assets at full value in current prices. The estimates for the service sector are obtained as arithmetic average for all relative industries weighted by the number of employees. Sources: Rosstat.

Russia is relatively low, at least across different regions. Thus, taking into account the high capital to labor ratio in services and the prevalence of the spending effect, the model predicts that an increase in oil prices brings with it an appreciation of the real exchange rate, a decline in real wages, and the shrinkage of the manufacturing sector.

Interestingly, when the capital intensity of manufacturing is greater than that of the service sector, the resource movement effect stimulates the pro-industrialization of economy. This happens because manufacturing suffers relatively less than services when labor shifts to mining. Being more profitable, the manufacturing sector retrieves its labor resources, and its output is likely to increase. However, for the total effect to be positive, the negative impact of the spending effect must not eliminate the positive impact of the resource movement effect.

The Corden–Neary (1982) model describes the changes in the short run, i.e. capital being fixed. However, we assume that the high export revenues are distributed widely in the economy through the increase in real wages of state-employed workers, which then propagates to the real wages in the private sector as the share of state-employment in Russia is large and the labor is mobile. This leads to the higher capital accumulation. Therefore, we expect that this medium term effect will have a positive influence on all three sectors, so that the overall impact on output growth in manufacturing is determined by the relative sizes of the short-term resource movement, the spending effects and a medium term capital accumulation effect. In this sense, the growth of the stock of capital in the country is due to the favorable changes in terms of trade but not to the activation of the internal business processes.

Let us list again the possible effects of Dutch disease when export prices drift upwards:

1. De-industrialization of the economy (decline in the share of manufacturing output in total economic activity);
2. Structural change in the labor market. Shift of employment from manufacturing and services into the mining sector.
3. Neutral or weak impact of a real effective exchange rate on real wages;
4. Heterogeneous returns on capital in different sectors. Returns on capital may rise only in mining, or in all sectors (if the impact of the resource movement effect is limited).

In the following two sections we discuss the link between the real exchange rate of the ruble and the oil price, and attempt to identify outcomes 1–4 in order to draw a conclusion on the presence of Dutch disease in Russia.

[6] The limited mobility of resources in Russia is not an exception. Pegg (2010) also points to the low resource movement effect in Botswana due to the capital intensive nature of mining and the low number of employees in the sector.

## 4. Oil price and real effective exchange rate: is there a reason to suspect Dutch disease?

There may be various reasons for the appreciation of the real effective exchange rate, the oil price boom being only one of them. Thus, the existence of a positive relation between export revenues (and oil price in particular) and the real effective exchange rate is a necessary condition for the presence of Dutch Disease, as it is the channel through which the excessive oil revenues affect local producers. In this part of our paper we verify the null hypothesis of the existence of such a link. In order to capture the long-term relationship between the economic variables, we estimate the Vector Error Correction model and test the significance of the impact of oil revenues on the ruble's real effective exchange rate, controlling for the other factors of appreciation.[7]

### *4.1. Description of the model*

The dependent variable in our model is the real effective exchange rate (REER). The explanatory variables can be divided into two categories: exogenous variables and control variables. The first category includes the oil price (OILP); the physical volume of exported oil (Q), and the differential in labor productivity (DIFF) in Russia versus its trade partners. The second category includes government expenditures as a share of GDP (EXPG) and net international reserves (RES). All variables are seasonally adjusted (taking into consideration the significant level shift of series during the crisis of 2008–2009[8]), and converted to logs. The period under consideration is from January 1997 to April 2013.

Data sources and comments on the variables are given in Table B.1 in the Appendix. Their dynamics and descriptive statistics are presented in Figs. B.1 and B.2 and Table B.2 in Website-Based APPS. The correlation matrix is provided in Table B.1 in Website-Based APPS. In Table B.2, we present the results of ADF, KPSS and Ng–Perron unit root tests for each variable under consideration. On the basis of the results of the tests, we conclude that all variables are integrated of order 1 (see the comment under Table B.2. for more detailed analysis). This permits us to proceed with the search of a cointegrating relation.

The results of the Johansen System Cointegration tests are presented in Table B.3. We choose the specification which takes into account the linear trend in the data. More specifically, we include an intercept in the cointegrating equation in order to consider the level of REER not captured by explanatory variables. The VAR also includes a constant, as the sample averages of the variables are not null. The VAR contains two autoregressive lags,

[7] VECM is a popular instrument for the estimation of the equilibrium real effective exchange rate, since the time series that are often considered as fundamental determinates the real effective exchange rate are cointegrated. The estimation of a regular VAR on the same (stationarized beforehand) series is not correct in this case, and moreover, stationarization always implies a loss of information. VECM has also been used in other papers on the estimation of the equilibrium real effective exchange rate in Russia. Among these are papers by Sossounov and Ushakov (2009), Spatafora and Stavrev (2003), Oomes and Kalcheva, (2007), Habib and Kalamova (2007). The fundamentals considered in these papers include the difference in productivity, terms of trade, net capital outflow, government spending, net international reserves, oil price and others.

[8] Bessonov and Petronevich (2013) showed that the common seasonal adjustment procedures (X-11 family, TRAMO/SEATS) are likely to generate spurious signals that deteriorate the seasonally adjusted series in the neighborhood of crises. To avoid this effect, we exclude the 2008 crisis from the sample, and perform the adjustment on pre-crisis and post-crisis periods separately.

**Table 1**
Results of the VECM estimation.

| | Model (1) | Model (2) | Model (3) |
|---|---|---|---|
| First observation | April 1997 | April 1997 | February 2005 |
| Last observation | April 2013 | January 2005 | April 2013 |
| Number of observations | 193 | 94 | 99 |
| Log(OILP) | 0.42*** | | 0.34*** |
| | [2.38] | | [2.81] |
| Log(OILP*Q) | | 1.61*** | |
| | | [5.93] | |
| Log(EXPG) | 1.5*** | 0.77 | 0.83*** |
| | [4.1] | [1.44] | [5.13] |
| Log(RES) | −0.10 | −0.81 | −0.12* |
| | [−1.04] | [−1.25] | [−1.65] |
| D1(−1) | −0.48*** | −0.34*** | |
| | [−2.1] | [−2.08] | |
| D2(−1) | −0.28*** | | −0.15* |
| | [−3.77] | | [−1.86] |
| C | −1.93 | −15.44 | −1.28 |
| Error correction | −0.04*** | −0.02* | −0.07* |
| | [−3.45] | [−1.69] | [−1.81] |

Note: The table shows the estimated cointegration equations from the VECM and the coefficients of the error correction term in the equation for LOG(REER) in the VECM ("Error correction"). The results are selected as the best results according to AIC and BIC information criteria. The VECM contains 2 autoregressive lags for each model. The t-statistics are given in brackets. The symbols *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively.

which maximizes the likelihood and minimizes the information criteria AIC and BIC. We test the whole group of series listed above, as well as smaller subgroups in case we encounter any coefficients of the cointegrating relation which are insignificant and should be excluded from the list. Finally, we test the relations for the whole sample, as well as for the two subsamples (the use of two subsamples and the choice of the splitting date are described below). As confirmed by the Trace-test and Rank test (Max-Eig), at the 5%-level of significance, the hypothesis of the presence of at least 1 cointegrating relation is not rejected by any test for all groups and samples. Consequently, the long-term relationship exists and is identifiable in the whole sample, as well as in the subsamples.

### 4.2. *Estimation results*

Table 1 presents the estimated cointegration equation from the VECM, where the coefficient of the real effective exchange rate of the ruble is normalized to 1. In addition to the variables described above, we add exogenous regressors: the corruption index (variable CORR; see the description in Table B.1 in the Appendix and Tables B.1 and B.2 and Fig. B.1 in Website-Based APPS) and two dummy variables to account for the substantial weakening of the ruble after the crises of 1998 (variable D1) and 2008 (variable D2). Both dummies are constructed to model the level shift in September 1998 and February 2009, respectively.[9] Note that the specification with 2 lags drops down the first three observations, so the sample begins in April 1997.

This studied period can be described as a time of deep transformations, both in the structure of the Russian economy and in its relations with trade partners. One may expect that the rule defining the dynamics of the exchange rate could have undergone significant changes, up to a complete change in the pattern of dependence. We thereby test the stability of the cointegrating equation for this time period.

[9] The dates for the level shift are determined by the first month of negative change in the industrial production index. The first date is very close to the one identified by Dülger et al. (2013) with the help of Arai and Kurozumi (2007) test for cointegration with structural break.

In this concern, we compare the estimates calculated for the whole sample (Model (1) with estimates calculated on its segments (Models 2 and 3). The splitting date is not random. Taking into account both the hypothesis on the importance of the magnitude of oil prices for the real effective exchange rate of Oomes and Kalcheva (2007), on the one hand, and the effects of the sheer volume of exported oil, emphasized by Sosunov and Zamulin (2006), on the other, we divide the period under examination (January 1997–April 2013) at February 2005. Although the value of crude oil exports increased in both periods, the driving forces of growth varied. From January 1997 to April 2005, oil export volumes increased remarkably while the export price of oil increased only modestly. By the end of 2004, the volumes of oil exports reached the level of 21 million tons per month, and stayed roughly at the same level throughout the entire second period of our sample. Therefore, the influx of oil dollars to Russia was driven primarily by increases in the volume of oil exports in the first subsample, but by increases in oil prices in the second (see Fig. 6).

The choice of the final specifications for all three models was made on the basis of the Akaike and Schwarz information criterion (AIC and BIC) and values of the log likelihood. The table contains only statistically significant coefficients, resistant to variations in the number of lags and the introduction of additional variables, as well as relatively robust to small changes in the sample size. The distribution of residuals is close to normal and passes heteroscedasticity and autocorrelation tests. The values of the coefficients are reasonable.

The results for the whole sample (Model 1) indicate that the real effective exchange rate depends positively on the oil price and government expenditures, whereas the changes in monetary reserves does not play a big role. At the same time, the level of REER dropped after the crises of 1998 and 2008.

The estimates of the cointegrating equation during each of the time periods confirm our hypothesis – indeed, the values of coefficients are different before and after February 2005. The Zivot–Andrews and Perron tests do not reject the presence of a structural shift in the data, and the Chow test validates the division of the sample into two sub-samples in February 2005. The above-mentioned differences in the driving factors of oil exports are modelled as the product of oil price and physical volume in Model (2).

Comparing values of coefficients in cointegrating equations of Models (1), (2) and (3), we note the following:

- It is the total amount of oil revenues that affects the REER, not just the price or the volume of the exported oil. Indeed, the

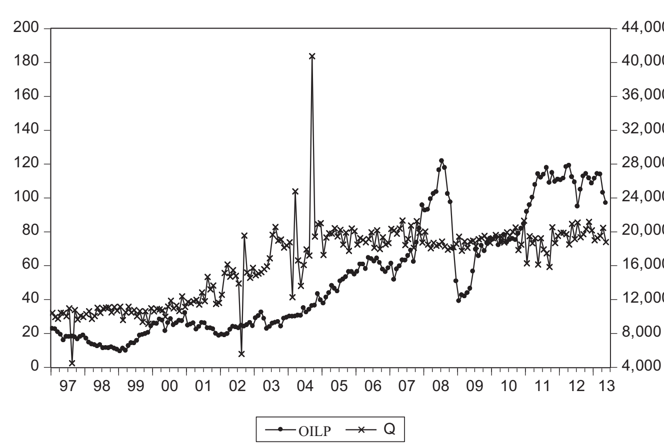


**Fig. 6.** Dynamics of prices (OILP) and volumes (Q) of oil exports in Russia. *Note*: oil price ($/bbl) is marked on the left axis, volumes of exported oil (1000 t) – on the right axis.

quantity played a large role in the first subsample, whereas prices prevailed in the second.

- The influence of the total amount of export revenues on the real effective exchange rate changed. The 1% growth in exports results in the appreciation of the ruble by 0.42% for the whole sample. During the second period, the real exchange rate is less sensitive, and grows by 0.34% when the price of one barrel of oil rises by 1%. This small decrease in elasticity can be explained by the introduction of the new tax system aimed at collecting the major part of the changes in oil revenues in the state budget. The new tax policy turned out to be not very efficient (mainly as it did not concern the gas extraction and metallurgy), as the elasticity still remains relatively high.
- The elasticity of government expenditures is higher than the elasticity of oil export revenues in the whole sample on average and in particular, in the second subsample. Contrary to the oil revenues, which can be partly saved and spent for imports, the government usually consumes local goods, and a considerable part of them are non-tradable. This creates an effect similar to the Balassa–Samuelson effect, and pushes the inflation and the real effective exchange rate up.
- The size of net international reserves is an additional significant factor in the second time period. In particular, a 1% increase in net international reserves weakens the real exchange rate by 0.12%. This implies that the Central Bank may operate the real effective exchange rate, accumulating or releasing foreign currency, although the effect of such manipulations is far lower than the effect of government expenditures. The nominal exchange rate targeting turned out to be not very efficient as the ruble was depreciating in real terms due to the inflation which was higher in Russia in comparison to its trade partners. The insignificance of net international reserves in Model (2) can most likely be explained by the low volumes of foreign exchange intervention operations conducted by the monetary authorities in the period from January 1997–January 2005, although this conclusion does not coincide with the results of Oomes and Kalcheva (2007) for the same period (which can probably be explained by the fact that we do not subtract Russia's commitments to the IMF from the net international reserves, as well as different seasonal adjustment methods).[10] The insignificance of net international reserves for the entire time period (in Model 1) may also be interpreted as due to the long-term neutrality of monetary policy.[11]
- The error correction coefficients are very small, indicating that the return to the equilibrium is very slow. This result is close to the findings of Algieri (2011) who studies Dutch disease in Russia and finds that the economy needs about 20 months to get back to the equilibrium after a shock.

Following the example of Spatafora and Stavrev (2003) and Oomes and Kalcheva (2007), we sought to include in our regression an indicator of the differential of labor productivity in Russia versus its trade partners (USA and EU). However, the coefficient of this indicator is unstable, showing either insignificant or negative values. The negative influence of the differential of labor productivity is hard to interpret, but its sign may be wrong since labor productivity is highly correlated with oil price (coefficient of correlation is 0.93). It is no surprise that the correlation is high: labor productivity in the mining sector increases automatically along with the oil price; the other sectors follow. This problem was also encountered by Spatafora and Stavrev (2003), who mentioned that part of the impact of differential of labor productivity (the elasticity of 1.3) can be in fact associated with the oil price dynamics. The diversity of results can be associated to different methods of construction of the differential of labor productivity (for example, the use of the number of employees or the number of hours worked as a basis for computation of labor productivity).

It is notable that the coefficient of the corruption indicator, included as an exogenous variable in VECM, also appeared to be insignificant – perhaps because the monthly proxy of its annual series does not work well. Coefficients of other control variables such as external demand (exports to the EU countries) and the index of industrial production, are also insignificant.

In summary, we have identified the first symptom – the positive significant correlation between REER and oil exports, which is the necessary, but not sufficient, condition for the presence of Dutch disease. We underline that for all three models, the elasticity of REER with respect to oil price is non-zero, positive and statistically significant.

Our quantitative estimates of the impact of oil price on the development of Dutch disease in Russia are broadly in line with the findings of other authors. While our estimate of the oil price elasticity of the real effective exchange rate of ruble is 0.42 for the whole sample and 0.34 for the second part of the sample, the estimates of Algieri (2011), Oomes and Kalcheva (2007) and Spatafora and Stavrev (2003) are at the level of 0.4, 0.49–0.58 and 0.31, respectively. The estimates of Dülger et al. (2013) differ depending on the method of assessment of structural changes, but in general are also close to ours. Merlevede et al. (2009) have obtained the estimate of the long-term elasticity equal to 0.19, however it is calculated for the nominal exchange rate, whereas, in our opinion, in the case of the Russian economy it is important to account for its high level of inflation.

We have shown that the oil price influences the economy through the REER. In the following part of the paper we study the impact of changes in REER, but not the oil price boom itself, as this is done in the theoretical part.

## 5. Comparison: theoretical results vs empirical evidence

In this section, we compare the theoretical results with the empirical evidence. The comparison is given for each of the theoretical outcomes one-by-one as listed above: the appreciation of the real effective exchange rate, relative growth rate in sectors, labor market structure and real wages, and finally returns to capital.

It is important to comment on the composition of sectors that we adopt for our analysis. Following the majority of the literature, we assume that mining constitutes the entire mining sector (the extraction of both fuel and non-fuel minerals); manufacturing as it is currently accounted in Russia; and the service sector, as encompassing all other industries of Russian national accounts (except agriculture and electricity, gas and water distribution). Therefore, we assume implicitly that the dynamics are similar in the oil-extracting and the mining sectors.[12] A different approach

[10] Oomes and Kalcheva (2007) find that the increase in net reserves of the Bank of Russia (including gold, but excluding obligations to the IMF) by 1% weakened the real effective exchange rate of ruble by 0.18%.

[11] This is true only under the assumption that the Russian economy functioned under conditions of full utilization of its production capacity during this period. However, this question requires further study.

[12] Therefore, in our study we consider the dynamics of the following sectors in the Russian economy (in new Russian Classification of Types of Economic Activity – OKVED): C – Mining; D – Manufacturing, total; and also services as non-tradable goods: F – Construction, G – Wholesale and retail trade, repair of automobiles, motorcycles and durable consumer goods; H – Hotels and restaurants; I – Transportation and communications; J – Finance; K – Real estate and rental services; L – Public administration, defense, mandatory social insurance; M – Education; N – Public health and social services; O – Other municipal, social and personal services.

**Table 2**
OLS regression results: the impact of changes in the real effective exchange rate of the ruble on the output, employment, real wages and returns on capital (all in growth rates) in manufacturing, mining and services.

| | Dependent var | | | | | |
|---|---|---|---|---|---|---|
| | Output growth rate in: | | | Employment growth rate in: | | |
| Explanatory var | Man | Min | Serv | Man | Min | Serv |
| Intercept | 14.45<br>[1.46] | −1.35<br>[−0.93] | 3.10**<br>[2.95] | −13.66**<br>[−2.70] | −4.46<br>[−1.59] | −0.11<br>[−0.15] |
| REER | −0.29***<br>[−3.22] | | | 0.02<br>[0.40] | | |
| @PC(REER) | | | 0.46**<br>[2.88] | | −0.03<br>[−0.17] | 0.16*<br>[1.79] |
| @PC(SG) | −6.52***<br>[−3.70] | | | −2.7*<br>[−2.03] | −1.03<br>[−0.71] | |
| @PC(CAP) | 0.24**<br>[2.40] | | 0.19**<br>[2.71] | 0.10<br>[0.14] | | |
| @PC(Q)*D2007 | | 0.63***<br>[3.94] | | | | |
| @PC(OILP) | | 0.08*<br>[2.00] | | | | |
| N obs | 14 | 14 | 14 | 14 | 14 | 14 |
| R sq | 0.87 | 0.63 | 0.86 | 0.63 | 0.1 | 0.24 |
| | Real wages growth rate in: | | | Returns on capital growth rate in: | | |
| Explanatory var | Man | Min | Serv | Man | Min | Serv |
| Intercept | 6.48***<br>[12.00] | 3.88*<br>[1.83] | 23.41**<br>[2.90] | 0.13<br>[0.07] | -0.16<br>[-0.02] | 14.96***<br>[4.52] |
| REER | | | | 0.15***<br>[7.50] | 0.21*<br>[1.79] | |
| @PC(REER) | 0.54**<br>[2.45] | 0.72**<br>[2.88] | 0.91**<br>[2.39] | | | 0.47<br>[1.24] |
| @PC(SG) | | | 7.56*<br>[1.93] | | | |
| @PC(CAP) | | | | | | |
| @PC(Q)*D2007 | | | | | | |
| @PC(OILP) | | | | | | |
| N obs | 14 | 14 | 14 | 14 | 14 | 14 |
| R sq | 0.37 | 0.42 | 0.44 | 0.82 | 0.24 | 0.13 |

Note: @PC stands for percent change. Only the best-fit specifications are given. The numbers in brackets are the corresponding t-statistics. The symbols *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively.

was used in Solanko and Voskoboynikov (2014), where the mining sector ('extended oil and gas sector' in their paper) comprises mining and quarrying, fuel and wholesale trade, in order to account for the vertical integration of mining companies with their partners in oil treatment, finance and transportation. However, since the estimation of the share of mining in other sectors is a different problem and worth a separate study, we take the mining and manufacturing sectors as they are. Also, in some part of the literature on the Resource curse there is a tendency to distinguish petro-states and other resource-rich states, as the Resource curse may take different forms in this case (see Karl (1999), Petermann et al. (2007), Ross (2001, 2004)). We leave the analysis of this aspect in the case of Russia for future research.

We examine the total impact of changes in the real effective exchange rate (REER) and we try to identify its component effects – the resource movement effect and the spending effect. We estimate the resource movement effect by changes in the idiosyncratic components of the employment growth rates in service, manufacturing and mining sectors, respectively (variables L_SERV, L_MAN and L_MIN).[13] The spending effect is approximated by the growth rate of disposable income of the population (INCOME_POP), as we assume that the savings rate is constant.

**Table 3**
OLS regression results: the resource movement and spending effects in manufacturing, mining and services.

| | Dependent var<br>Output growth rate in: | | |
|---|---|---|---|
| Explanatory var | Manufact | Mining | Services |
| Intercept | −176.61**<br>[−2.79] | 4.16<br>[0.10] | −67.8**<br>[−2.59] |
| L_MAN | | 0.36<br>[1.24] | |
| L_MIN | | | 0.60<br>[1.76] |
| L_SERV | −2.80<br>[−1.79] | | |
| INCOME_POP | 1.68**<br>[2.85] | −0.02<br>[−0.05] | 0.68***<br>[9.71] |
| N obs | 14 | 14 | 14 |
| R sq | 0.51 | 0.2 | 0.48 |

*Note*: Only the best-fit specifications are given. The numbers in brackets are the corresponding t-statistics. The symbols *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively.

(*footnote continued*)
The broad definition of the mining sector comes from our choice to adopt the definition of sectors from the statistics on the production of the GDP, which does not offer disaggregated statistics on separate industries. The statistics of the new classification OKVED is available from 2003. To obtain longer series, we used the data of the previous classification OKONH (All-Russian Classification of Branches of the National Economy) translating the classes to OKVED in terms of industrial statistics.

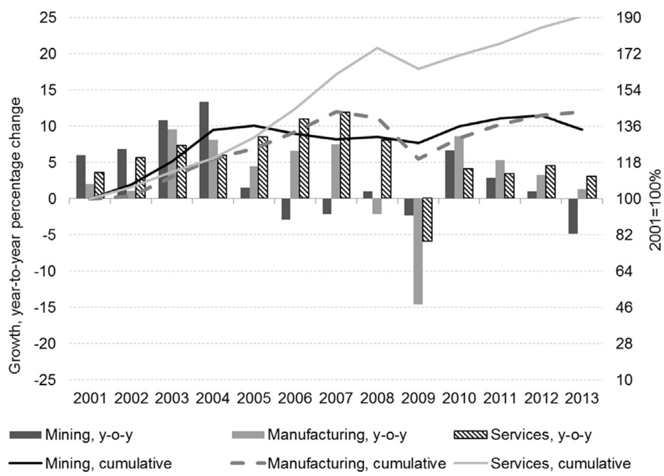


**Fig. 7.** Output growth in real terms, by sector, 2001–2013, % (left axis); cumulative growth (right axis). *Note*: the dynamics of output was taken from the National Accounts, production approach, according to the new Russian Classification of Types of Economic Activity (OKVED), except for 2001–2002, where we used data on industrial production for Mining and Manufacturing. For Services we used the National Accounts, production approach (services, total), according to the previous All-Russian Classification of Branches of Economy (OKONH). Sources: Rosstat.

We also control for the share of employees in state-owned companies (SG) in order to account for the transition from planned to market economy, capital accumulation (CAP),[14] and the financial crisis with the help of dummy D2007, which takes the value 1 after 2007. In the equation for the growth rate of mining, the coefficient of the real effective exchange rate turned out to be insignificant, so we model the growth via two components, changes in the oil price (@PC(OIL)) and the volume of exported oil after 2007 (@PC(Q)*D2007)), where @PC (X) stands for percentage change in X. The sample spans the period 2000–2013, starting with the year when the first data on the share of state employees becomes available.

The graphs and descriptive statistics for dependent and explanatory variables are given in Figs. B.3 and B.4 in Website-Based APPS, Table B.4 in Appendix, Tables B.3 and B.4 in Website-Based APPS. Table 2 below shows the results of the OLS regression estimates for each of the macroeconomic sectors under examination. Table 3 contains the OLS estimates of resource movement and spending effects. The models are very parsimonious due to the limited number of observations, as there is no quarterly information on the returns on capital. Although all the estimates proved to be quite robust to the changes in sample size, they should be considered with great caution. We use these regressions to show the signs and relative sizes of the effects, rather than to obtain the qualitative estimates.

Although the regressions are simplistic, the explanatory power of the models is high in several cases, especially in the output growth rates, employment and capital growth rate in manufacturing. The coefficients of variables INCOME_POP and L_SERV (Table 3) and of the variable REER (Table 2) in the regression for manufacturing growth rate, corresponding to spending effect, resource movement effect and the overall effect of the rise in real effective exchange rate are significant and have correct signs. We discuss the model specifications and estimation results below.

[13] Here and afterwards, we use the idiosyncratic components of the employment growth rate, i.e. we exclude the common component from these series in order not to take into consideration the 'normal' cyclical movements of employment, inherent to the whole labor market.

[14] We use the residuals of the regression of CAP on REER as a proxy for the capital accumulation not associated with the oil revenues

### *5.1. Output growth rates and the GDP structure*

The data confirms the deindustrializing effect of the real appreciation of the ruble. When we control the changes in capital and the share of state employment, the correlation between the real effective exchange rate and manufacturing growth is negative (see Table 2 – the coefficient of the variable REER in the regression for the manufacturing output is significant and negative). To verify the finding, we estimate the direct impact of the oil price by substituting the variable REER by the variable OILP and obtain a negative correlation again. We therefore detect the first and the most important symptom of Dutch disease.

For the service sector, the increase in the real effective exchange rate is positively correlated with the acceleration of the growth rate. For the mining sector, we did not identify the link between the real effective exchange rate and the growth rate but we did detect a weak positive link with oil prices (see Table 2).

A somewhat surprising result is a relatively higher impact of changes in REER in the service sector than in mining. Indeed, the share of the service sector grew from 62% to 69% during 2005–2013 (Fig. 2), and it far outperformed both the mining and manufacturing sectors in terms of production growth rates in fixed prices (Fig. 7). At the same time, the cumulative growth rates in manufacturing and mining are strikingly close, which does not correspond to the theoretical results which are supposed to indicate that mining grows much faster. We suggest the following reasons for this.

Firstly, the growth of mining in real terms is limited by the lack of new extraction fields and transportation facilities. More precisely, by 2004 oil production and transportation capacities had reached full utilization rates, but the construction of new capacities was complicated due to the unfavorable investment climate. As pointed out by Dobryanskaya and Turkish (2010), the Russian Government became an active player in the market of raw materials in the first decade after 2000 and imposed limitations on the inflow of foreign investments, even creating a list of so-called strategic enterprises. At the same time, the worsening investment climate in the domestic economy as well as the equivocal Russian public opinion on the results of the privatization process and mortgage auctions in particular forced the largest Russian mining corporations to be more aggressive in their investments overseas (in proportion to GDP compared to other BRIC countries; see Fig. A.1 in Appendix). This outward foreign direct investment is naturally not part of the domestic statistics.

Secondly, a relatively high growth rate in manufacturing may be due to the positive capital accumulation effect, which offsets the negative resource movement effect, so that indirect de-industrialization is dominated by the capital inflow provided by high export revenues.

Thirdly, the expansion of the service sector can be related to the overcoming of the so-called Soviet disease.[15] The transition from planned to the market economy promoted the rise of efficiency in manufacturing and services. We tried to capture this effect by introducing the variable SG, the share of labor employed by the state organizations. It turned out that the ownership structure plays a very important role here. During the past 15 years, it has been decreasing gradually from 37.8% in 2000 to 28% in 2013, giving more space to private businesses. Apparently, the decrease in the share of inefficient state companies contributed to the growth of manufacturing: the correlation between the manufacturing growth rate and the share of state employment is strongly negative, according to the estimation results.

Finally, the explosion of the service sector may be partly a statistical phenomenon, because a considerable part of employment and output in mining is included in the service sector. Pipeline transportation and exports of raw materials are a striking example. A significant segment of the Russian service sector is linked to the exports of raw materials,

[15] For example, see Oomes and Kalcheva (2007).

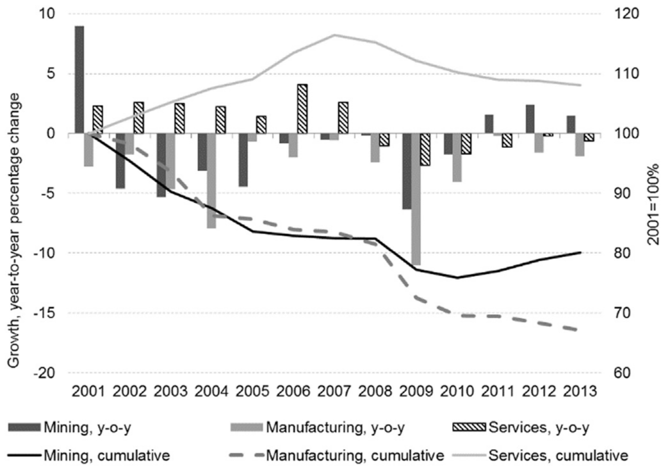


**Fig. 8.** Employment growth rate by sector of the economy in 2001–2013, % (left axis); cumulative growth (right axis). *Note*: the two points 2012–2013 are the estimates based on statistics of job replacement.Sources: Rosstat.

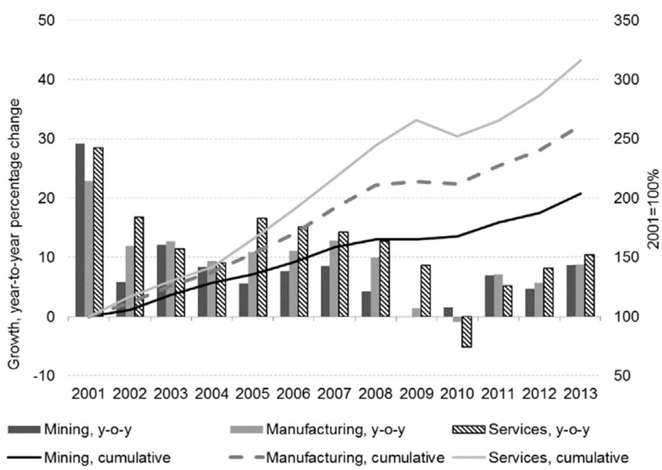


**Fig. 9.** Growth rate of real wages in rubles by sector of the economy, 2001–2013, % (left axis); cumulative growth (right axis). *Note*: CPI-deflated. Sources: Rosstat.

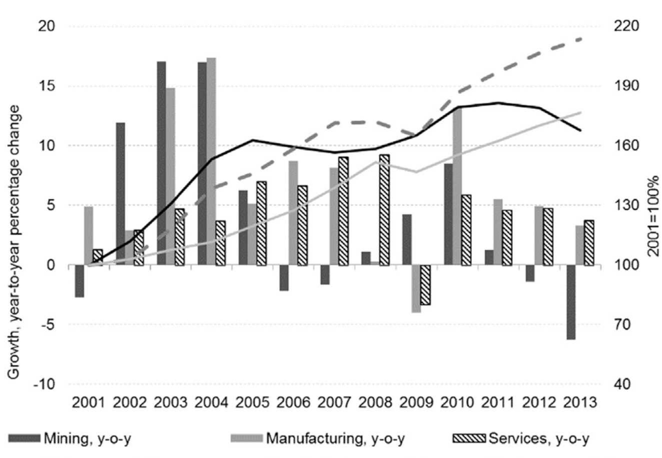


**Fig. 10.** Labor productivity by sector of the economy in 2001–2013, growth rate, % (left axis); cumulative growth (right axis). *Note*: calculated on the basis of comparison of time series for output and average annual employment. Sources: Rosstat.

with the growing share of pipeline transportation, trade and especially finance, where export revenue is accumulated.[16] In 2003–2013,

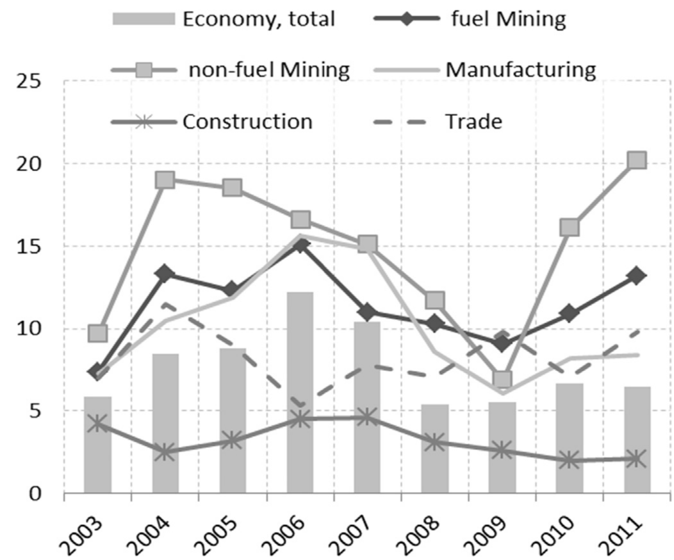


**Fig. 11.** Profitability of assets of organizations in main sectors of the economy, %. *Note*: Profitability of assets is computed as a ratio between balanced financial result (profits minus losses) and the value of assets belonging to organizations. Source: Rosstat.

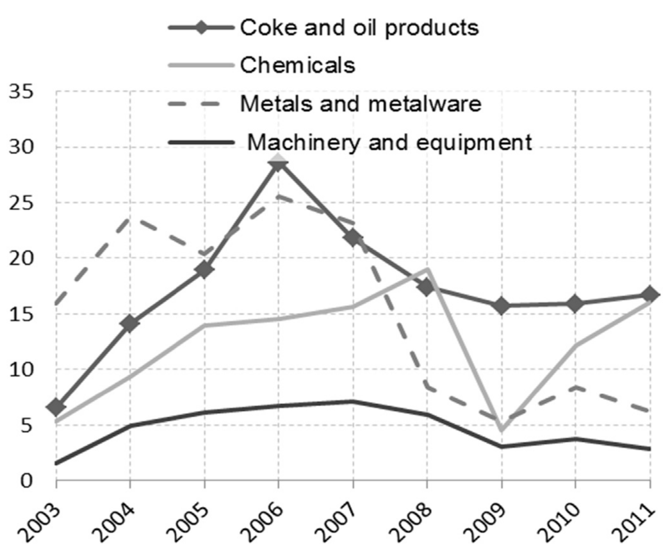


**Fig. 12.** Profitability of assets of organizations in some sectors of manufacturing, %. *Note*: Profitability of assets is the correlation between the balanced financial result (profits minus losses) and the value of assets belonging to organizations. Source: Rosstat.

wholesale and retail trade grew by 112%, transportation and communication – by 54%. Thus, some part of this tremendous growth should actually be credited to the mining sector. This problem is certainly very important and requires specific in-depth research, so we leave it out of the scope of this paper, and take the mining sector as it is determined in the official OKVED classification. The assessment of the actual growth in the mining sector was done by Solanko and Voskoboynikov (2014). According to the authors' estimates, the extended energy sector (mining and quarrying+fuel+wholesale trade) was growing at a rate of 4.6% on average during 1995–2008.

We also confirm that there is a positive impact of capital accumulation, as we suggested in Section 3. Since both capital accumulation and REER are dependent on the oil price, in order to avoid the endogeneity problem we use the residuals of the regression of CAP on REER as a proxy for the capital accumulation not associated with the oil revenues. This variable thus shows the investment processes that were activated by the inflow of oil

[16] For details, see World Bank (2005), Berezinskaya and Mironov (2006).

revenues, but were not directly funded by them. For both service and manufacturing sectors, its impact is highly positive and significant, being slightly more visible in manufacturing. Although this effect, together with the increase in labor productivity, enabled positive growth in manufacturing, its impact is relatively small and thus cannot be the driving force of manufacturing.

To sum up, the reorganization of ownership together with the positive capital accumulation effect overcomes the negative impact of the appreciation of the ruble on manufacturing, resulting in the overall weak positive growth rate. This is why the de-industrialization process might seem to be missing at first glance. However, according to our estimations, the link between the real effective exchange rate and the growth rate in manufacturing is negative, which is one of the signs of Dutch disease.

### 5.2. Employment, resource movement and spending effects

According to the estimates (see Table 2), the total effect of the real effective exchange rate on the employment growth rates[17] in manufacturing and mining is negligible: in the regressions for employment in both manufacturing and mining the coefficient corresponding to the real effective exchange rate is insignificant. This effect is statistically important (and positive) only for the service sector.

When examining the correlation between the employment growth rates in three sectors, one observes the highly negative link between the mining and the service sectors (correlation id −0.54), and only a weak link between the manufacturing and the mining sectors (insignificant correlation). For manufacturing and services, the correlation is not negligible and is equal to −0.34. We therefore observe some movement of labor from the mining and manufacturing sector, which however was not caused solely by the inflow of the export revenues, as we have not identified any direct link between REER and the reduction of employment in manufacturing.

Let us illustrate these correlations. Indeed, the Russian labor market has gone through a great transformation during the decade that we consider in our study. In 2001–2013, the employment in manufacturing decreased by more than one third, while the employment in services rose by 9% (see Fig. 8, Table A.2 in Website-Based APPS). However, contrary to the predictions of the theoretical model, the employment in mining decreased by almost 20% in the same period. Instead of moving towards a more lucrative energy sector, the labor moved out of it. The massive dismissal of employees in mining (−13% or −161,000 employees in 2001–2008 only!) and manufacturing (more than −1 million during 2000–2008) made all the redundant employees search for positions in the service sector – in total, more than 7 million people joined the service sector in 2000–2008. Apparently, a substantial part of them joined mining-related service companies, as, according to the estimates of Solanko and Voskoboynikov (2014), the labor input in the extended oil and gas sector grew at a 2.7% rate on average during 1995–2008.

The first reason for this observation may be the emergence of a service sector that was underdeveloped during the late Soviet and early post-Soviet period. At the end of the period under consideration, the total share of labor in the service sector was 73%, which is the level of highly developed economies. On the contrary, the percentage in manufacturing fell to 15.6%, which is 8–10 percentage points lower than in developed economies. The second reason may be caused by the resource movement effect as determined by the theoretical model and as confirmed by our estimations.

Whatever the reasons for the shift in the labor market, it has consequences for the output growth rates in manufacturing. According to our estimates, the surge of labor in services has a strong negative impact (the elasticity is about −2.8, see Table 3) on manufacturing. This effect is supported by the spending effect in services and manufacturing – in both cases the impact of changes in the total disposable income of the population on production is positive but also unstable. Therefore, we find that the manufacturing sector suffers from the transformation of the labor market. However, such restructuring may be partly attributed to the transition to the market economy and not only to the inflow of export revenues.

### 5.3. Real wages

At the first glance, the dynamics of real wages does not match the predictions of the theoretical model – instead of being moderate or zero, the impact of REER in all three sectors is positive (see Table 2).

During 2001–2013, real wages in all sectors increased twice or threefold (Fig. 9), which led to a sharp rise in unit labor costs. Furthermore, the highest increased rates of both real wage and unit labor costs were observed not in mining (as the model expected), but in the service sector.

We suggest that the high rate of growth in real wages is related to the factor disregarded in the construction of a standard model of Dutch disease: namely, to a certain “rebound effect” after the crisis of 1998. Another version may be traced to the gradual rejection of shadow schemes of remuneration.

Finally, the mismatch between the theory and the practice comes from the fact that in the theoretical model household earnings are divided into real wages (which decline) and rental incomes (which rise), whereas in reality a household receives real wages only. However, for the state-employed, the oil income constitutes a part of real wages, which rises when the oil price rises. This increase then propagates to real wages in private companies, as the labor is mobile. Therefore, the actual behavior of the total household income (as depicted in Fig. 9) generally follows the predicted trajectory of the sum of real wages and rental income – it grows.

Although the values of the coefficients are not very reliable in our estimations, we can see that the largest effect is in services, while the smallest is in manufacturing. This implies that the manufacturing sector is again not favored, which could be another reason for labor to shift to the more attractive service sector. In this sense, the difference in real wage growth may also be an indirect sign of Dutch disease.

The excessive rates of growth in real wages over productivity may represent a threat to the manufacturing sector. Growth rates in labor productivity are high but are always lower than wage growth rates (see Fig. 10 and Table A.5 in Website-Based APPS) due to the demographic and structural problems of the Russian economy, which leads to the loss of competitive power. Thus, there is a danger that Dutch disease will develop into a more pronounced form.

### 5.4. Returns on capital

The model assumes that the returns on assets should rise in mining due to both the resource movement effect and the spending effect. At the same time, the returns on capital invested in manufacturing and services are indefinite due to the uncertain combination of the negative impact of the resource movement and spending effects. Under the assumption of the weak resource movement effect in Russia, the profitability might rise both in the manufacturing and service sectors, though to a less degree than in mining.

The estimates show a positive dependence on the returns of capital on the real effective exchange rate for all three sectors, though the sign of the link is ambiguous for services (see Table 2). Therefore, from the point of view of returns on capital, the presence of Dutch disease cannot be rejected either.

[17] Here again we use the idiosyncratic components of the employment rates to exclude the effect of the common cyclical unemployment movement of the internal conjecture.

The dynamics of the profitability of assets in the Russian economy over the first decade after 2000 indicate that mineral mining and drilling, particularly the mining of non-fuel minerals, occupies an advantageous position in the Russian economy. This may impede the diversification of the Russian economy, as it is based on the intersectorial redistribution of capital in response to market signals.

Interestingly, in 2011 the mining of non-fuel minerals with more than a 20% rate of returns (due to more favorable taxation) was the absolute leading sector (when compared to the fuel extraction with its 13% rate of return). Meanwhile, manufacturing, which should in principal be a vanguard of modernization by attracting capital with its high profits, returned only 8% on investments (ahead of services with its average rate of about 5% (see Table A.3 in Website-Based APPS and Fig. 11)). If we deduct oil refining, with its more than 15% rate of return to capital from manufacturing, it becomes the sector with the lowest profitability. In the same time, returns in investment in machinery engineering is less than modest-below 5% (see Fig. 12 and Table A.4 in Website-Based APPS) despite the fact that the Russian Government believes it to be the industry that should be the leader of “new Russian industrialization”. Afterwards, high returns attract higher investment. According to Solanko and Voskoboynikov (2014), the average growth rate of capital inputs for the extended oil and gas sector was about 3.4% during 1995–2008 (with a 5.1% rate after 2001). Humble returns in manufacturing insured only a slightly positive average growth.

## 6. Conclusions

Our findings suggest that the Russian economy is affected by a combination of “Soviet” and “Dutch” diseases. Comparing our findings with the existing literature on Dutch Disease in Russia, we agree with the authors that show not only the risks of its occurrence but also some clear symptoms. This view can be traced mainly to the works written after the crisis of 2008–2009 (see Dulger et al. (2013), Tabata (2013), Egert (2012), Algieri (2011)). After the crisis of 2008–2009, due to the long-term appreciation of the real effective exchange rate of the ruble, the manufacturing sector (and the whole economy with it) started to lose its competitiveness and the rate of growth notwithstanding high oil prices. On the other hand, the services sector continued to grow, although transformation processes associated with the transition to a market economy were basically completed. These processes can be the sign of the transition of Dutch disease in Russia to the new more pronounced form, where the economy decelerates even when the oil market is stable.

By applying the theoretically based approach by Corden and Neary (1982) in the specification corresponding to the Russian economy, we analyzed the dynamics of the main economic indicators of the principal economic sectors (mining, manufacturing and services) for the presence of tendencies inherent in an economy with Dutch disease. Although at first glance the dynamics of most indicators do not correspond to the conclusions of the base model, a more thorough analysis reveals some signs of Dutch disease.

Eruptive flows of export revenues have resulted in the significant appreciation of the real effective exchange rate. The econometric analysis based on the cointegration model has shown that an increase in export revenues by 1% yields an appreciation of the real effective exchange rate by 0.2%. Evidence of this relationship suggests that the real exchange rate serves as a channel through which oil prices affect economic structure.

The Corden and Neary (1982) framework provides us with outcomes that should entail currency appreciation if Dutch disease is present: one is to expect a boom in the mining sector, expansion in the service sector and a contraction of the manufacturing sector, with corresponding changes in the labor market structure. At the same time, profitability should increase in all sectors, especially in the mining sector. According to the model, the level of real wages should also decline, although the overall level of income should increase. We conducted a careful analysis of each indicator, comparing the theoretical outcome to the empirical result.

The manufacturing industry exhibited weak but positive growth during the period, contrary to the model's prediction. This may have been due to the eradication of the so-called “Soviet disease”, with its paucity of manufacturing and service enterprises during the Soviet period and the following rebound effect. This effect, together with the positive effect of capital accumulation, overcomes the negative influence of the real effective exchange rate, resulting in a moderate total expansion in the sector. However, the growth rate was much less than in services and especially wholesale trade, which finally led to a shrinkage in the share of manufacturing in GDP from 15.6% to 13%. As this finding confirms the results of the theoretical model, we consider it to be a symptom of Dutch disease.

The mining and service sectors have expanded, as predicted by the theoretical model, however due to the methods of statistical accounting and aggregation it is difficult to disentangle the effective growth rates of the sectors. Also, much of the growth may be hidden in the outflow of direct foreign investment of mining companies, which can be observed in the relatively higher share of direct foreign investment in Russia in comparison to other BRIC countries.

We detected a positive significant impact of the real effective exchange rate on employment rates in the services sector only. Therefore, we suppose that the sizeable transformation of the labor market, with a shift from manufacturing and mining sectors to services, is linked not only to the appreciation of the real effective exchange rate but also to the “Soviet disease”, implying the reorganization of enterprises and a rapid expansion of the underdeveloped service sector. Whatever the reason of this resource movement is, it has a negative effect on the output growth rate in manufacturing. This effect is partly offset by the positive spending effect, as the theoretical model predicted.

Wage dynamics, as the sum of labor and rental (oil) income, correspond to the model's predictions. Salaries have grown unevenly in the different sectors, but the productivity of labor has improved everywhere. The abundant oil revenues are not the only reason for this growth. Other effects are present as well, such as state policy in respect of real wages.

The behavior of the return on assets further corresponds to the model's predictions: the impact of REER is positive for all three sectors, albeit almost insignificant in services.

In spite of the fact that our findings do not permit us to make an ultimate claim that Russia is sick with Dutch disease, we find a number of symptoms and thus we cannot reject the hypothesis of Dutch disease in Russia. Therefore, the development of an optimal strategy for the government and the central bank is a key issue. In our opinion, one of the possible directions of future studies of this topic could be an analysis of the transition from exchange rate targeting (the focus of the first decade after 2000 until the crisis of 2008–2009) to inflation targeting. The reason for this is that the major structural problem in the Russian economy in the last decade has been the significant differentiation in the dynamics and levels of return on assets between the mining and manufacturing sectors. Due to the relatively higher returns to capital in mining, the redistribution of capital towards the manufacturing sector is complicated. We might suppose that a switch to inflation targeting would lower the price of loans (by reducing the inflation itself and bank deposit interest rates) and thus enhance their availability for the manufacturing sectors. The other interesting direction of studies would be the analysis of the optimal diversification of the economy that faces sharp changes of relative prices, depreciation of the ruble on the one hand, and weak institutions and corruption on the other hand, which renders the traditional selective industrial policy inefficient.

## Appendix A.

See Table A.1
See Fig. A.1

**Table A.1**
Consequences of Dutch disease from the viewpoint of the resource movement effect and spending effect, results of Corden and Neary (1982).

| Mobility of labor<br>Mobility of capital<br>Capital/labor ratio K | Model #1<br>in Mining, Manufacturing and Services<br>Fully sector specific | | | | | Model #2<br>in Mining, Manufacturing and Services<br>Specific in Mining, Mobile between Manufacturing and Services | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $K_{Man} > K_{serv}$ | | | | | $K_{Man} < K_{serv}$ | | | | |
| Indicators | output | prices | Real wages | Return to capital assets | employment | output | prices | Real wages | Return to capital assets | employment | output | prices | Real wages | Return to capital assets | emplyment |
| Resource movement effect | | | | | | | | | | | | | | | |
| Mining sector (MIN) | + | exog | + | + | + | + | exog | + | + | + | + | exog | + | + | + |
| Manufacturing sector (M) | - | exog | + | - | - | + | exog | + | - | - | - | exog | + | - | - |
| Services sector(S) | - | + | + | - | - | - | + | + | - | - | + | - | + | - | - |
| Spending effect | | | | | | | | | | | | | | | |
| Mining sector (MIN) | - | exog | + | - | - | + | exog | + | + | none | + | exog | - | + | none |
| Manufacturing sector (M) | - | exog | + | - | - | - | exog | + | - | none | - | exog | - | + | none |
| Services sector(S) | + | + | + | + | + | + | + | + | - | none | + | + | - | + | none |
| Total effect | | | | | | | | | | | | | | | |
| Mining sector (MIN) | n. a. | exog | + | n. a. | n. a. | + | exog | + | + | + | + | exog | n. a. | + | + |
| Manufacturing sector (M) | - | exog | + | - | - | n. a. | exog | + | - | - | - | exog | n. a. | n. a. | - |
| Services sector(S) | n. a. | + | + | n. a. | n. a. | n. a. | + | + | - | - | + | n. a. | n. a. | n. a. | - |

Model #1 – full mobility of labor and capital between manufacturing (M), Mining (MIN) and services (S); Model #2-full mobility of labor and limited mobility of capital (between manufacturing (M) and services (S) only). Source: classification and tabulation made by authors on the base of Corden and Neary (1982)

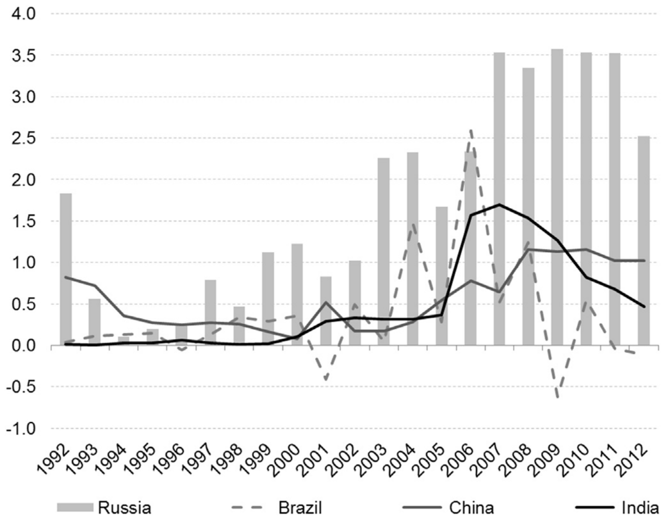


**Fig. A.1.** Outflow of foreign direct investments from BRIC countries in 1992-2012, % of GDP. Source: UNCTAD, IMF, calculations by the HSE Institute "Development Center".

According to our estimates, since the mid-1990s, Russia has moved far ahead of the other BRIC countries in the outflow of direct investment overseas relative to GDP. For example, in 2012 the outflow of direct investments was practically equal to its inflow – 2.5% of GDP, a far higher proportion than in China, which only invested 1% of its GDP aboard (UNCTAD, 2013). By the beginning of 2012, the accumulated foreign direct investments (FDI) in the Russian economy reached $508.9 billion, while accumulated outflow of FDI from Russia was about $413.1 billion.

## Appendix B. Description of variables used in the econometric models

See Tables B.1–B.4

**Table B.1**
Names and sources of variables.

| Variable | Name | Source | Frequency | Description |
|---|---|---|---|---|
| Real effective rate of the ruble | REER | BIS | monthly | CPI-based, monthly average, 2010=100 |
| Exports of oil from the Russian Federation | Q | State Customs Committee | monthly | Exports of crude oil, thousand tons |
| Price of URALS oil | OILP | REUTERS | monthly | Average monthly, $/bbl. |
| Government expenditures | EXPG | Ministry of finance of the Russian Federation | monthly | Consolidated budget, expenditures less interest payments, % of GDP (GDP interpolated) |
| Net international reserves | RES | Central Bank of the Russian Federation | monthly | International reserves of the Central Bank of the Russian Federation (end of period; since May 1998 – average monthly), $ billion. |
| Differential of labor productivity | DIFF | Rosstat, BLS, Eurostat | monthly | Ratio of labor productivity in Russia to equally weighted labor productivity in the USA and EU, manufacturing sector |
| Corruption | CORR | IMD | yearly | Index based on surveys; the higher value corresponds to lower level of corruption. monthly dynamics reconstructed by authors by simple linear interpolation |

**Table B.2**
Unit root tests.

| | ADF test (H0: Unit root) | | | KPSS test (H0: No unit root) | |
|---|---|---|---|---|---|
| | Intercept | Intercept and trend | No intercept and trend | Intercept | Intercept and trend |
| log(REER) | −1.35 | −3.22* | 0.25 | 1.20*** | 0.14* |
| log(OILP) | −1.29 | −3.51** | 0.88 | 1.61*** | 0.08 |
| log(Q) | −1.38 | −0.76 | 2.10 | 1.48*** | 0.37*** |
| log(EXPG) | −1.84 | −3.62** | 0.25 | 1.33*** | 0.19** |
| log(RES) | −0.71 | −1.77 | 1.40 | 1.66*** | 0.23*** |
| log(DIFF) | −0.49 | −2.66 | 3.43 | 1.69*** | 0.18** |
| critical values | | | | | |
| 1% | −3.46 | −4.01 | −2.58 | 0.74 | 0.22 |
| 5% | −2.88 | −3.43 | −1.94 | 0.46 | 0.15 |
| 10% | −2.57 | −3.14 | −1.62 | 0.35 | 0.12 |

| Ng–Perron test (H0: Unit root) | Intercept | | | | Intercept and trend | | | |
|---|---|---|---|---|---|---|---|---|
| | MZa | MZt | MSB | MPT | MZa | MZt | MSB | MPT |
| log(REER) | −5.10 | −1.51 | 0.30 | 5.04 | −7.78 | −1.96 | 0.25 | 11.75 |
| log(OILP) | −0.01 | −0.01 | 0.64 | 26.90 | −7.37 | −1.92 | 0.26 | 12.37 |
| log(Q) | 0.47 | 0.51 | 1.09 | 72.54 | −3.87 | −1.29 | 0.33 | 22.30 |
| log(EXPG) | −2.98 | −1.15 | 0.39 | 8.08 | −4.22 | −1.44 | 0.34 | 21.50 |
| log(RES) | 0.69 | 0.74 | 1.06 | 73.21 | −7.39 | −1.85 | 0.25 | 12.49 |
| log(DIFF) | 1.46 | 3.04 | 2.08 | 306.7 | −12.74 | −2.50 | 0.20 | 7.27 |
| critical values | | | | | | | | |
| 1% | −13.8 | −2.58 | 0.17 | 1.78 | −23.8 | −3.42 | 0.14 | 4.03 |
| 5% | −8.10 | −1.98 | 0.23 | 3.17 | −17.3 | −2.91 | 0.16 | 5.48 |
| 10% | −5.70 | −1.62 | 0.27 | 4.45 | −14.2 | −2.62 | 0.18 | 6.67 |

*Note*: The table shows values of test-statistics of the Augmented Dickey–Fuller test, Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test and Ng–Perron test. The ADF test rejects the null for the specification with trend and intercept for variables log (REER), log (OILP), log (EXPG) at 10% of confidence probability, and rejects the null for all variables for the other two specifications. The KPSS test strongly rejects the null for all variables for the specification with the intercept at 10%, but accepts it for log (OILP) at 10% and for log (REER) and log (EXPG), log (DIFF) at 5% and 1%, correspondingly. Finally, the Ng–Perron test, which has good size and power properties, accepts the null of the unit root for all variables and all test statistics at conventional significance levels. On the basis of these results we conclude that the series are not stationary. The number of lags (not reported here) are selected according to AIC, allowing a maximum number of 14 lags. The bandwidth length for the KPSS tests is $T^{(1/3)}$. The symbols *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively.

**Table B.3**
Johansen tests for the presence of cointegration. Number of cointegrating relations chosen by the Model on the 5%-level of confidence probability. Specification: Intercept in CE and test VAR. Number of lags: 2.

| Period | April 1997–April 2013 | April 1997–January 2005 | February 2005–April 2013 |
|---|---|---|---|
| Number of observations | 193 | 94 | 99 |
| LOG(REER) LOG(OILP) LOG (EXPG) LOG(RES) | | | |
| Trace | 3 | 2 | 4 |
| Max-Eig | 1 | 2 | 1 |
| LOG(REER) LOG(OILP) LOG (EXPG) LOG(RES) LOG(DIFF) | | | |
| Trace | 2 | 3 | 2 |
| Max-Eig | 1 | 3 | 1 |
| LOG(REER) LOG(URL) LOG (RES) LOG(EXPG) LOG(DIFF) LOG(Q) | | | |
| Trace | 2 | 4 | 2 |
| Max-Eig | 2 | 3 | 2 |

**Table B.4**
Variables and sources.

| Variable | Name | Source | Frequency | Description |
|---|---|---|---|---|
| Output in manufacturing | Y_MAN | Rosstat | yearly | growth rate, in value, y-to-y |
| Output in mining | Y_MIN | Rosstat | yearly | growth rate, in value, y-to-y |
| Output in services | Y_SERV | Rosstat | yearly | growth rate, in value, y-to-y |
| Number of employees in manufacturing | L_MAN | Rosstat | yearly | year-to-year growth rate |
| Number of employees in mining | L_MIN | Rosstat | yearly | year-to-year growth rate |
| Number of employees in services | L_SERV | Rosstat | yearly | year-to-year growth rate |
| Real wages in manufacturing | W_MAN | Rosstat | yearly | in rubles, y-to-y growth rate |
| Real wages in mining | W_MIN | Rosstat | yearly | in rubles, y-to-y growth rate |
| Real wages in services | W_SERV | Rosstat | yearly | in rubles, y-to-y growth rate |
| Return to capital in manufacturing | K_MAN | Rosstat | yearly | end of the year, y-to-y |
| Return to capital in mining | K_MIN | Rosstat | yearly | end of the year, y-to-y |
| Return to capital in services | K_SERV | Rosstat | yearly | end of the year, y-to-y |
| Share of labor employed in state-owned organizations | SG | Rosstat | yearly | percent |
| Total fixed assets | CAP | Rosstat | yearly | beginning of the year, trillion rubles |

## Website-based Appendix. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.resourpol.2015.09.007.

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