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Discovering the signs of Dutch disease in Russia

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Contents

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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 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 growth in the manufacturing sector, the growth of total income of workers, and the positive link between the real effective exchange rate and returns on capital in all three sectors. Although also predicted by the model and clearly observable, the shift of labor from manufacturing to services cannot be explained by ruble appreciation alone.

JEL Classification: F41, F43, C32.

Key words: Dutch disease, resource curse, real effective exchange rate, cointegration model, economic policy, Russia.

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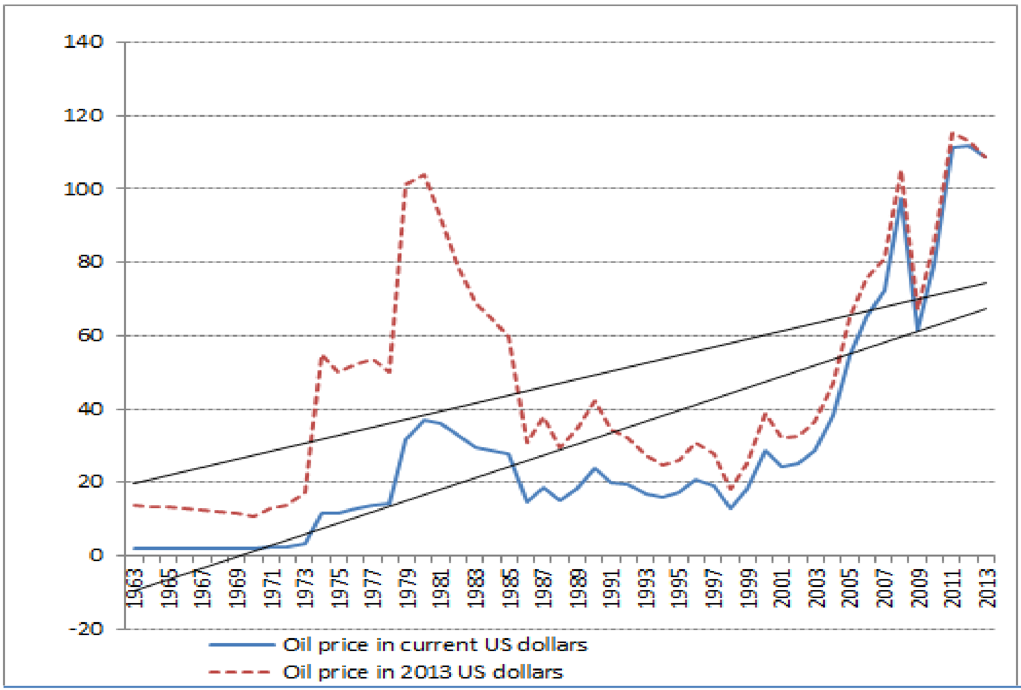
1 Introduction

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 stayed high above the trend afterwards (see Figure 1).

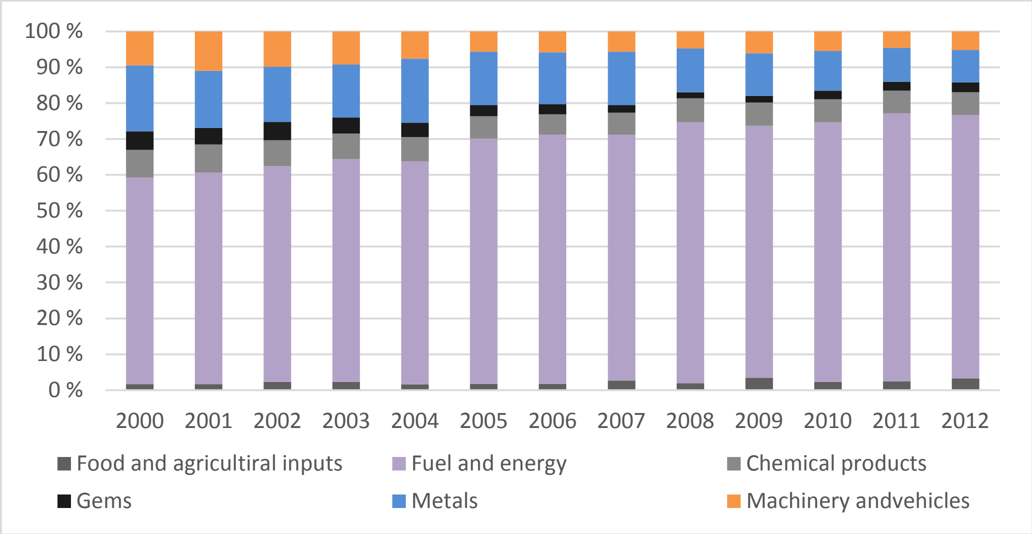
Figure 1 BRENT oil price and its linear trend, 1963–2013, US dollars per barrel.



Source: BP Statistical Review of World Energy June 2014, authors' calculation

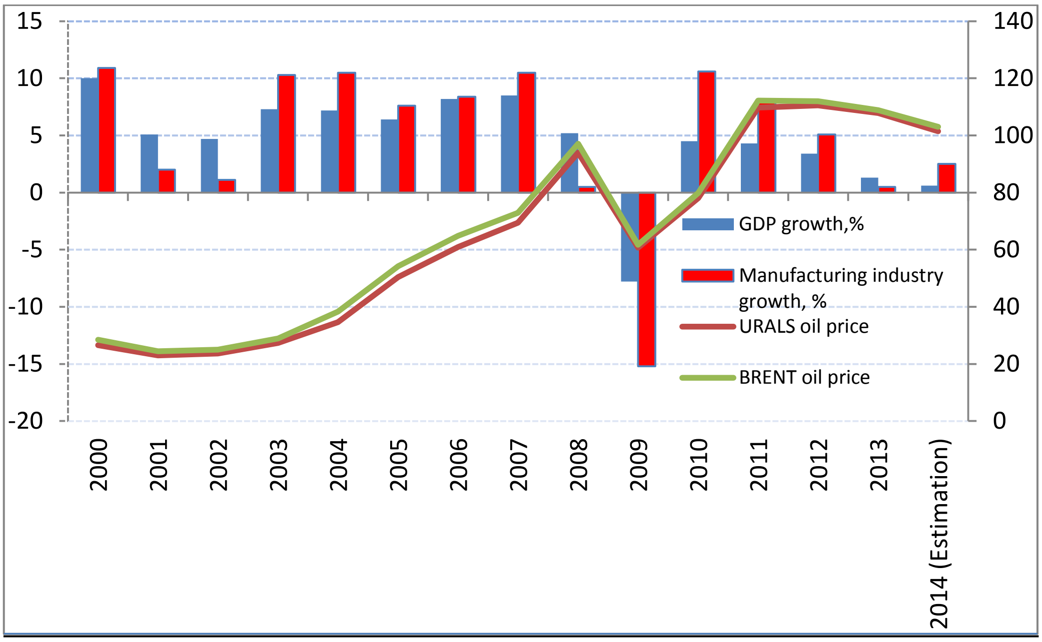
Russia remains one of the major global suppliers of oil, with 13% of the world market. Russian exports currently account for approximately 30% of GDP, with exports of raw materials representing 90% of the total value of goods exports. Two-thirds of these raw materials consist of just two products: oil (together with oil products) and natural gas. The export structure has stayed remarkably stable over the 2000–2012 period. (see Figure 2).

Figure 2 Structure of Russian exports, 2000–2012, %.



Source: Rosstat

Figure 3 GDP and manufacturing growth rate in Russia (left axis) and crude oil current price (US dollars per barrel, right axis) in 2000–2014



Source: Rosstat, Reuters

However, Russia’s economic growth rate has been volatile during this period. After growing by an average of 7% a year during the period 2000–2008, the economy plunged by 7.8% in 2009 when oil prices plunged. 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 (Figure 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 (Figure 3). In total, the manufacturing sector in GDP shrank by 2.2% in the 2002–2012 period (see Table A.1), while the share of mining in GDP rose by 3.4%.

The purpose of this paper is to study whether the poor performance of the manufacturing sector is due to its low price competitiveness, due to the abundance of export revenues that lasted for a "fat decade" in 2000s, or, in other words, whether Russia is suffering with the Dutch disease.

Dutch disease is an economic phenomenon which implies that an increase in export revenues leads to a decline in the manufacturing sector. The mechanism is the following: high revenues from 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 the Dutch disease.

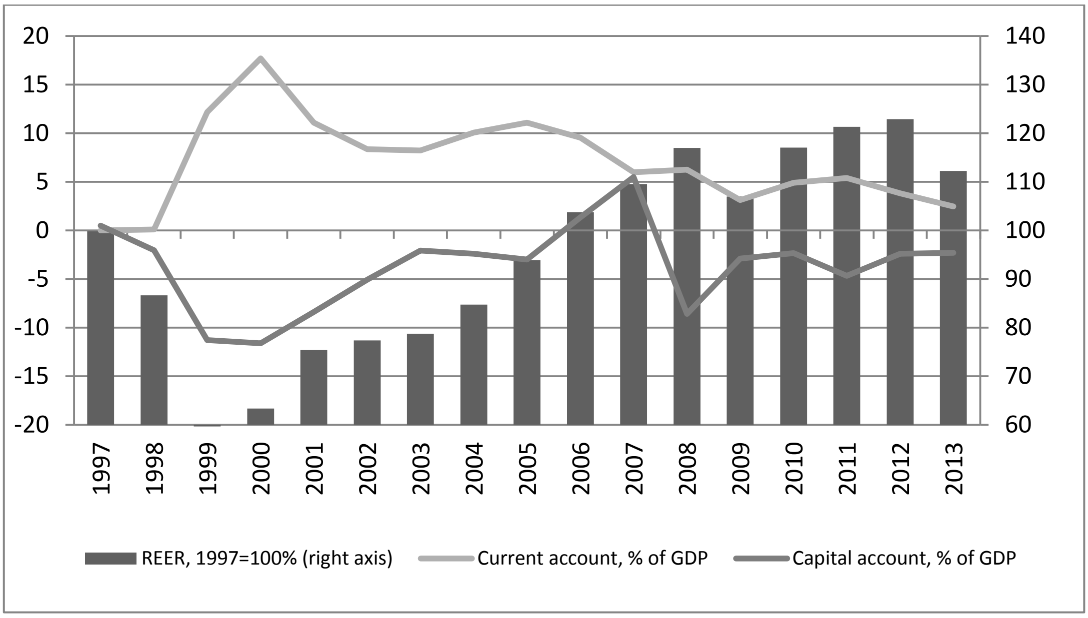
The term "Dutch disease" is itself a paradox since its onset is marked by an inflow of wealth into an economy, followed by a rapid rise in domestic expenditures. Thus, in some sense, a change in industrial structure cannot be considered a 'disease' in the direct meaning of this word. The resulting shrinking of the manufacturing sector is an optimal reaction to the growth of easy wealth (although certainly perceived as a disease by workers and enterprise owners in the affected industries). At present, however, 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 know-how favoring steady long-term economic growth[1]. Besides, the focus on raw material exports and lack of output diversification renders an economy less stable vis-à-vis external economic shocks[2].

[1] Van der Ploeg and Venable, (2012) believe that the presence of the Dutch disease must be considered only if the sectors squeezed out by the resource boom have an external effect on the economy. The tradable sectors are considered to have positive external effects by increasing returns to scale or "learning-by-doing" (as stated in van Wijnbergen 1984 and (Sachs & Warner 2000).
[2] Frankel (2012) also mentions the following problem: "sometimes a current account deficit (despite the enhanced revenue from commodity exports), thereby incurring international debt that may be difficult to service when the commodity boom ends". Fortunately, this problem does not concern the Russian economy.

Broadly speaking, the Dutch disease is one of the causes of the so-called Resource Curse. We will not discuss the concept of the Resource Curse in detail here, but we would mention that there are other causes as well. These causes include high volatility of income from external trade, the distortion of economic motivations because of the struggle for raw material rents, which also undermines the quality of institutions, and the pro-cyclical pattern of macroeconomic policy (fiscal and monetary)[3]. In the case of Russia these problems are aggravated by the transformation process that it has had to go through, from planning to market economy.

The dynamics of several economic indicators lets us suspect the presence of Dutch disease in the Russian economy. In particular, the strong upward trend in the real effective exchange rate of the ruble (rising by 60% during the period 2001–2013, see Figure 4), as well as a persistently positive capital account can be the symptoms.

Figure 4 Dynamics of the balance of payment and real effective exchange rate, annual-averaged (REER).



Source: Rosstat, The Bank of Russia

We verify the hypothesis of Dutch disease comprehensively, comparing theoretical results of the particular type of 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.

[3] See Frankel (2012).

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 itself and its assumptions. In section 4, on the basis of a cointegration model, we test the relation 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 conclude 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, 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, but not to the currency exchange rate, or 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. There is no consensus on the diagnosis for Russia in the literature. In this section we review some papers that present opposing points of view, motivate our choice of the model, and describe some of the details of it, leaving a more thorough presentation for the following section.

Ahrend et al. (2007) compared general economic dynamics and the manufacturing sector in Russia and Ukraine for the period 1992–2004. The authors concluded that application of the term “Dutch disease” to describe the situation in Russia was an open question as, on the one hand, the dynamics of the Russian manufacturing sector remained positive while, on the other hand, Russian export revenues were high; other symptoms of Dutch disease were also present. Overall, the authors concluded that the Russian manufacturing sector would have grown far more substantially had the ruble not appreciated to the same degree, and warned of the high probability of a resource curse in Russia.

Ollus, Barisitz (2007) compared Russian industrial import growth by branches of the economy with domestic industrial production growth in the period from 2002 to 2006 and found signs of deindustrialization and Dutch disease. Nevertheless, they noted that other factors could also have driven sectorial changes.

Van der Marel (2012) points out that since the beginning of the oil price boom in 2004, the structure of Russian exports has become more primitive, in both the variety of products and the range of its partner countries, which hampers the long-term growth of the economy. However the author attributed the phenomenon not to Dutch disease (in particular, not to the ruble appreciation), but to the ongoing weakening of institutions and the undermining of the supremacy of law in Russia after the “Yukos” case.

Dobryanskaya, Turkisch (2010) and Oomes, Kalcheva (2007) state that Russia’s de-industrialization and the ruble’s appreciation were not caused by Dutch disease, but by the rise in productivity and entry into new markets after the collapse of the USSR. Also Oomes, Kalcheva (2007) concluded that the rise in oil prices led to ruble appreciation but that the currency has been never overvalued. Thus, they did not find sufficient cause for Dutch disease.

Beck et al. (2007) admit the great dependence of Russian economy on oil exports, but insist that in spite of great appreciation of ruble, the economy didn’t lose its competitiveness, as the price level is still below those of the Baltic countries and Poland, which have the same level of income.

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 Dutch disease from the standpoint of a market failure that occurs when excessive resources harm the economy rather than open up 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 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 Polterovich et al. (2007) and 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 the Dutch disease affects 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 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 (2011, 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 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, as well as other processes that take place at the same time.

3 The model

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 simple and is rather a systematic graphical mode of analysis, it does allow us to track the directions of structural changes in an economy with Dutch disease.

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 demand and supply on the domestic market. The internal demand consists of household consumption only, the foreign trade is balanced, the labor market is flexible, and there is no unemployment. For simplicity, the monetary factors are excluded from the model. The economy possesses only two production factors, labor and capital, which can be assigned different degrees of mobility between sectors. Also, sectors differ in the capital-to-labor ratio for technology. The model assumes that the real foreign exchange rate (ratio of prices of non-tradable goods to prices of tradable goods) is not fixed and that it influences real wages.

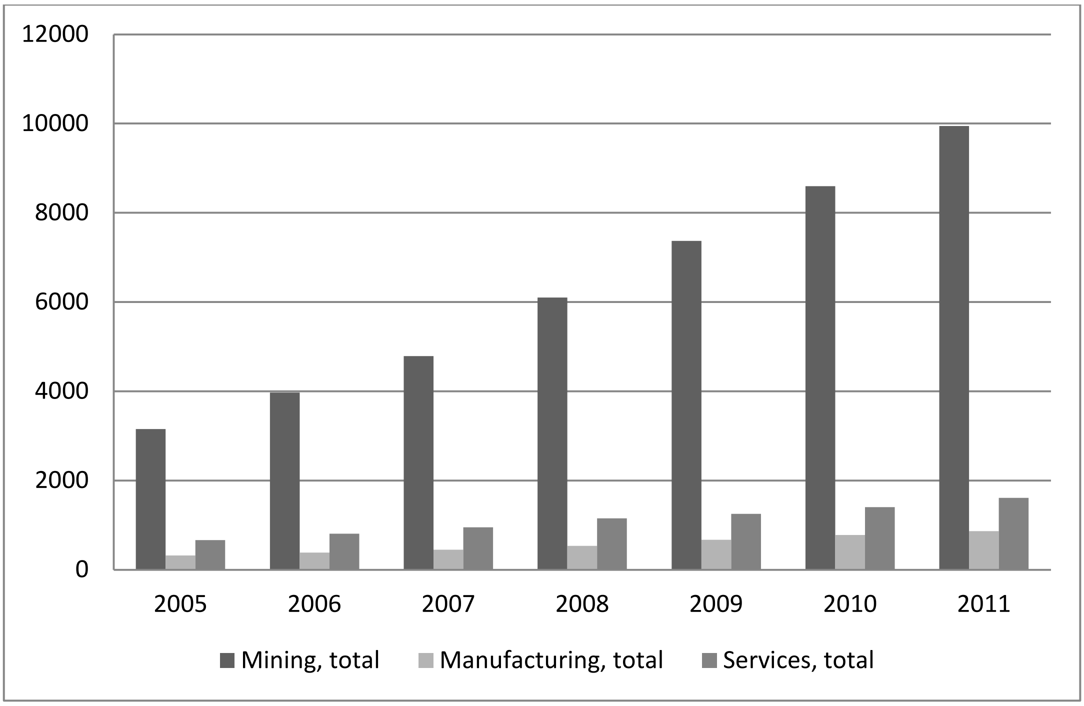
As oil export revenue rises, the mining sector receives a large inflow of foreign currency, which makes it very profitable and increases the nominal exchange rate. The overall effect can be decomposed into two parts, the resource movement effect and the spending effect. The resource movement effect is the shift of labor and capital (if these are mobile) to the energy sector due to the growth in marginal gain in mining. This leads to a number of consequences, including further changes in the real foreign exchange rate. As incomes are assumed to be always equal to expenditures, the spending effect leads to higher income from raw material exports and greater demand for services, causing a surge in prices, which also contributes to the real appreciation of the ruble. These latter depend, 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 spending effect. The directions of these effects under various assumptions are presented in Table A.2 of the Appendix. The simplest specification of Dutch disease model is Model №1 (see Table. A.2), 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, Kalcheva (2007).

However, for our analysis we adopt a different specification, which assumes complete mobility of labor, but *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 highest in mining, less in services, and the least in manufacturing. Indeed, according to our calculations, the capital/labor ratio is almost two times higher in services than in manufacturing[4] (see Figure 5).

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

Figure 5 Capital/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.

Under the given assumptions, when the energy price rises, the mobile resource – labor – shifts to the more profitable mining sector, making labor scarce in the manufacturing and service sectors. This shift, according to the Rybczinsky theorem, causes the more labor intensive sector (in this case, manufacturing) to be crowded out by less labor intensive sector (here, services), resulting in a decline in the price of services, followed by rising wages (according to the Stolper-Samuelson theorem). Therefore, the resource movement effect leads to rising wages, de-industrialization, and a weakening of the real foreign exchange rate. On the other hand, the spending effect raises the demand for services, increasing their price and the total amount produced, further crowding out the manufacturing sector. In turn, the rising prices of services again cause an appreciation of the national currency and a decline in wages.

The total effect of the oil boom on the level of wages and real foreign exchange rate is not pre-determined. Instead, it depends on the ratio of the resource movement effect to the spending effect. Some economists have argued that in Russia, the latter is far more evident than the former. First, the share of employment in mining is low and changes rarely – merely from 1.5% to 1.7% in recent years (see Table A.3). Second, we suppose that the mobility of labor in Russia is relatively low, at least across regions. Thus, taking into account the high capital/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 wages, and shrinkage of the manufacturing sector.

Interestingly, when the capital intensity of manufacturing is greater than of the service sector, the resource movement effect stimulates 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 output there 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 model describes the changes in the short run, i.e. capital being fixed. However, it is natural to assume that the high export revenues are distributed widely in the economy, leading to higher capital accumulation. Thus 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 short-term resource movement and 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 the 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 trend 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 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 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.

4 Oil price and real effective exchange rate, or 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 the 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 existence of such link. In order to capture the long-run 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[5].

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 controlling variables. The first category includes oil price (OILP); physical volume of exported oil (Q), and 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), and converted to logs. The period under consideration is from May 1997 until April 2013.

Data sources and comments on the variables are given in Table B.1. Their dynamics are presented in Figures B.1 and B.2 and Table B.2, which presents the descriptive statistics. The correlation matrix is provided in Table B.3. In Table B.4, we present results of unit root tests for each variable under consideration. As one can see, the hypothesis on the existence of a unit root cannot be rejected for any variable. All variables are integrated of order 1, which permits us to proceed to the determination of a cointegrating relation.

[5] 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 of 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, stationarizing always implies a loss of information. VECM has also been used in other papers on estimation of the equilibrium real effective exchange rate in Russia. Among these 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.

The results of Johansen System Cointegration tests are presented in Table B.5. Varying the number of lags from 2 to 4, and using different specifications of the cointegrating relation, we obtain a steady result for specification without trend and constant in both the data and the cointegrating relation. As confirmed by the Trace-test and Rank test, at the 5%-level of significance, the hypothesis of the presence of at least 1 cointegrating relation is not rejected by any test. Consequently, the long-term correlation does exist, and it has the simplest specification.

Estimation results

Table 1 presents the results of VECM estimation, where the coefficient of the real effective exchange rate of the ruble is normalized to 1. In addition to the variables described above, we set up dummy variables responsible for the substantial weakening of the ruble during the crisis of 1998 (variable D1) and in February 2009 (variable D2). The first column corresponds to estimates from the whole sample, while the second and third columns correspond to subsamples June 1997 – January 2005, and February 2005 – April 2013, respectively. The choice of final specifications for all three models was made on the basis of the Akaike information criterion (AIC) and values of log likelihood. The table contains only statistically significant coefficients resistant to variations in the numbers of lags and the introduction of additional variables, as well as relatively robust to changes in sample size (as can be seen in Table 1). The distribution of residuals is close to normal and passes heteroscedasticity and autocorrelation tests. Values of the coefficients are reasonable.

The period studied 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 would have undergone significant changes – due to the influence of certain factors, to a complete change in the pattern of dependence, and to other relevant factors. On the other hand, we cannot neglect the possibility that the long-term dependence that we found was stable throughout the transition period. We thereby test the stability of the cointegrating relation for the time sample.

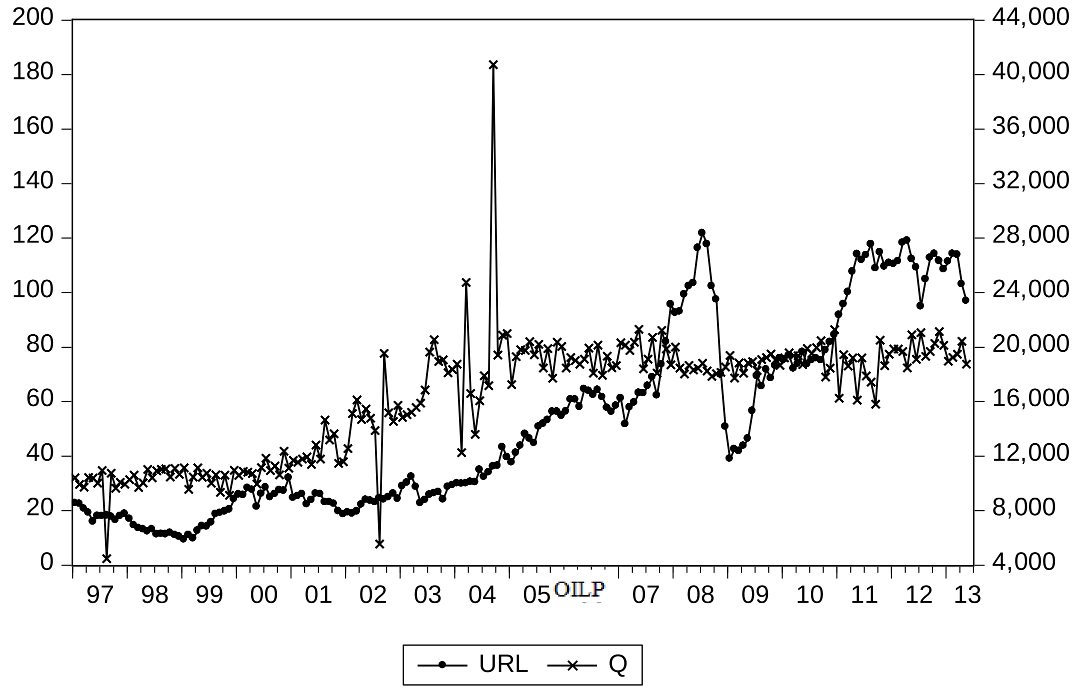
Table 1 Results of the VECM estimation

	Model (1)	Model (2)	Model (3)
First observation	May 1997	May 1997	February 2005
Second observation	April 2013	January 2005	April 2013
Number of observations	192	93	99
Log(OILP)	0.2139		0.2424
t-statistics	2.0806		1.8227
Log(OILP*Q)		0.1724	
t-statistics		3.1947	
Log(EXPG)	1.1254	0.6896	1.4664
t-statistics	20.2964	3.5597	9.4792
Log(RES)	0.0048	–0.0249	–0.2646
t-statistics	0.0996	0.8227	–2.0461
D1(–1)	–0.1720	–0.2358	
t-statistics	2.0656	2.8518	
D2(–1)	–0.2504		–0.1382
t-statistics	4.0228		–2.1104
Loglikelihood	1603.748	414.3264	4313.704

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 magnitude of oil prices in affecting the real currency 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 (June 1997 to April 2013) at February, 2005.

Although the value of crude oil exports increased in both periods, the driving forces of growth varied. From June 1997 until 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 Figure 6).

Figure 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 (1,000 tons) – on the right axis.

The estimates of the cointegrating relation during each of the time periods confirm our assumptions; the values of coefficients are different before and after February 2005. Also, the second interval has a new significant factor – net international reserves. The Zivot-Andrews and Perron tests do not reject the presence of a structural shift in the data; the Chow test agrees that the sample must be divided into two sub-samples. 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 Models (1), (2) and (3), we note the following:

- It is the total amount of oil revenues that affect the REER; not just the price or the volume of oil exported. Indeed, the quantity of exported oil played a large role in the first period, changes in the oil price in the second.

- The influence of the total amount of export revenues on the real effective exchange changed. The growth in exports by 1% resulted in appreciation of the ruble by 0.17% in the first period. At present, the real exchange rate is far more sensitive to oil price, and grows by almost 0.25% when the price of one barrel of oil rises by 1%.
- The elasticity of government expenditures is 4–6 times higher than the elasticity of oil export revenues in both periods, and twice as high in the second period as in the first (1.46 against 0.68).
- 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 0.26%. 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. Its insignificance 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 June 1997 – January 2005, although this conclusion does not coincide with the results of Oomes, Kalcheva (2007) for the same period. 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.

Following the example of 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.

It is notable that the coefficient of the corruption indicator 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 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.

As we have proved that it is through the REER that oil price influences the economy. In the following part of the paper we study the impact of changes in REER, but not the oil price boom itself, which is covered 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 wages, and finally returns to capital.

It is important to comment on the composition of sectors that we adopt for our analysis. We assume mining to constitute the entirety of the 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)[6]. A different approach was used in (Solanko, 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 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 worth a separate study, we take the mining and manufacturing sectors as they are.

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 approximate 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)[7]. The spending effect

[6] Therefore, in our study we considered 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.

[7] 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.

is approximated by the growth rate of disposable income of the population (INCOME_POP), as we assume that the savings rate is constant.

We also control for the share of employees in state-owned companies (SG) in order to account for the transition from planned to state economy, capital accumulation (CAP)[8], and for the financial crisis with the help of dummy D2007, which takes the value 1 after 2006. 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)).

The graphs and descriptive statistics for dependent and explanatory variables are given in Figure B.4, Figure B.5, Table B.6, Table B.7, Table B.8.

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 that we use are very parsimonious due to the limited number of observations. Although all the estimates proved to be quite robust to 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, not to obtain the qualitative estimates.

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

Table 2 OLS regression results: the impact of changes in the real effective exchange rate of ruble on the output, employment, 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	Manufact	Mining	Services	Manufact	Mining	Services
Intercept	14,446*	-1,351	3,104*	-13,664*	-4,457	-0,11
	(-9,828)	(1,445)	(1,048)	(5,046)	(2,796)	(0,718)
REER	-0,289*			0,024		
	(0,093)			(0,054)		
@PC(REER)			0,463*		-0,026	0,161*
			(0,16)		(0,179)	(0,086)
@PC(SG)	-6,519*			-2,702*	-1,033	
	(1,76)			(1,327)	(1,455)	
@PC(CAP)	0,244*		0,194*	0,097		
	(0,096)		(0,069)	(0,69)		
@PC(Q)*D2007		0,63*				
		(0,156)				
@PC(OILP)		0,078*				
		(0,036)				
N obs	14	14	14	14	14	14
R sq	0,87	0,628	0,855	0,627	0,1	0,242

Dependent var	Wages growth rate in:			Returns on capital growth rate in:		
Explanatory var	Manufact	Mining	Services	Manufact	Mining	Services
Intercept	6,476*	3,884	23,413*	0,128	-0,156	14,925*
	(0,542)	(2,116)	(8,073)	(1,933)	(10,47)	(3,31)
REER				0,149*	0,211*	
				(0,022)	(0,12)	
@PC(REER)	0,542*	0,719*	0,908*			0,467*
	(0,216)	(0,253)	(0,384)			(0,381)
@PC(SG)			7,557*			
			(3,914)			
@PC(CAP)						
@PC(Q)*D2007						
@PC(OILP)						
N obs	14	14	14	14	14	14
R sq	0,367	0,424	0,436	0,819	0,236	0,131

Note: @PC stands for percent change. Standard errors are given in brackets. * denotes significance at 10% level, only best-fit specifications are given.

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

Dependent var	Output growth rate in:		
Explanatory var	Manufact	Mining	Services
Intercept	-176,610*	4,16	-67,8*
	(63,347)	(42,860)	(26,155)
L_MAN		0,358	
		(0,289)	
L_MIN			0,603
			(0,345)
L_SERV	-2,804*		
	(1,564)		
INCOME_POP	1,681*	-0,017	0,677*
	(0,594)	(0,399)	(0,069)
N obs	14	14	14
R sq	0,51	0,196	0,476

Note: @PC stands for percent change. Standard errors are given in brackets. * denotes significance at 10% level, only best-fit specifications are given.

Although the regressions are simplistic, the explanatory power of the models is high in several cases, especially for 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) for manufacturing growth rates, corresponding to spending effect, resource movement effect and the overall effect of the rise in real effective exchange rate are significant and have the correct signs.

We discuss model specifications and estimation results below.

5.1 Output growth rates and GDP structure

The data confirm the deindustrializing effect of the real appreciation of the ruble. When controlled for the changes in capital and the share of state employed, 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 again obtain a negative correlation. 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 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 did detect a weak positive link with oil prices (see Table 2).

A somewhat surprising result is a relatively larger impact of changes in REER on the service sector than on mining. Indeed, if we transform the impact of the oil price into the impact of real effective exchange rate though the cointegration model of REER estimated above, we obtain a coefficient of just 0.019 (compared to 0.463 for services). Indeed, the share of service sector grew from 62% to 69% during 2005–2013 (Figure 2), while the service sector far outperformed both mining and manufacturing sectors in terms of production growth rates in fixed prices (Figure 7). At the same time, the cumulative growth rates in manufacturing and mining are strikingly close, which does not correspond to the theoretical results – mining is supposed to grow much faster. We suggest the following reasons for this.

First, 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 an unfavorable investment climate. As pointed out in (Dobryanskaya and Turkish, 2009), in the 2000 decade the Russian Government became an active player on the market of raw materials and imposed limitations on domestic foreign investments, even making a list of so-called strategic enterprises. At the same time, the worsening investment climate in the domestic economy as well as equivocal Russian public opinion on the results of the privatization process in general and mortgage auctions in particular forced the largest Russian mining corporations to be more aggressive in investing overseas (in proportion to GDP compared to other BRIC countries; see Figure A.1). These outward foreign direct investments are naturally not part of the domestic statistics.

Second, 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.

Third, the expansion of the service sector can be related to overcoming the so-called Soviet disease[9]. The transition from planned to 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

[9] For example, see (Oomes, Kalcheva, 2007)

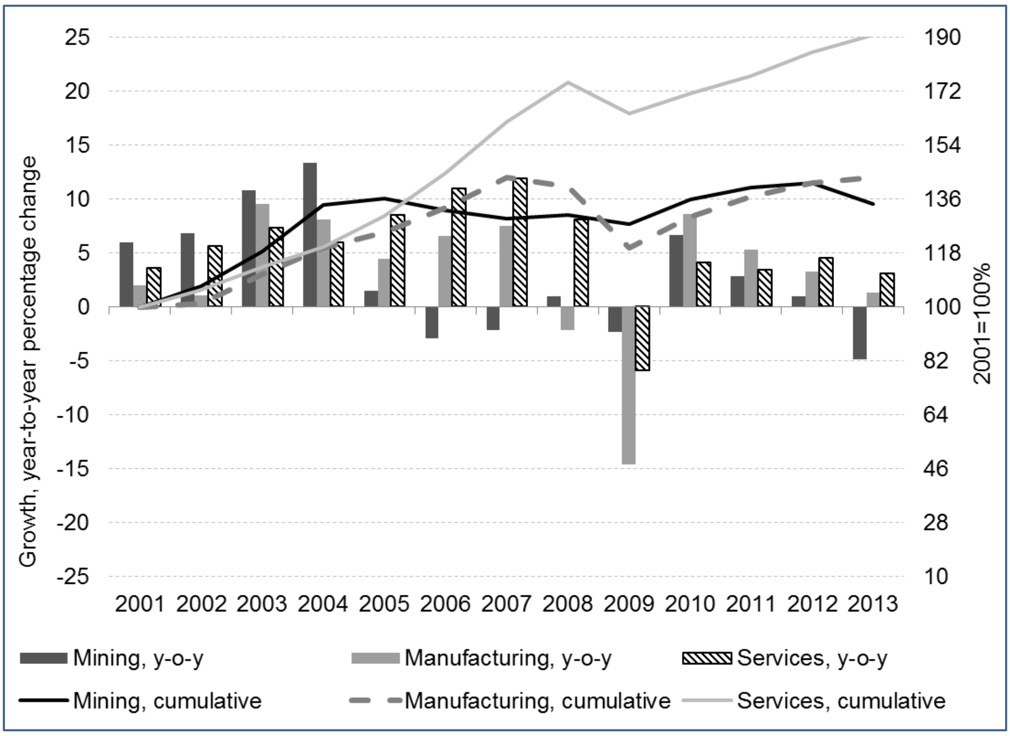
the ownership structure plays a very important role here. During the past years, it has been decreasing gradually from 37.8% in 2000 to 29.4% in 2011, giving more space to private businesses. Apparently, the decrease in the share of inefficient state companies contributed to the growth of manufacturing – the correlation between growth of manufacturing and share of state employed 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 exports of raw materials, with the growing share of pipeline transportation, trade and especially finance, where export revenue is accumulated[10]. In 2003–2013, wholesale and retail trade grew by 112%, transportation and communication – by 54% (see Figure A.1). Thus, some part of this tremendous growth should actually be credited to the mining sector. Undoubtedly, this problem is 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. Assessment of the actual growth in the mining sector was done in (Solanko, Voskoboynikov, 2014), According to the authors' estimates, the extended energy sector (mining and quarrying + fuel + wholesale trade) was growing at 4.6% real growth rate 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 revenues, but are not funded by them directly. 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.

[10] For details, see (World Bank, 2004 (1,2)), (Berezinskaya, Mironov, 2006).

Figure 7 Output in real terms, by sector, 2001–2013, %; cumulative growth is shown on the 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 Russian Classification of Branches of Economy (OKONH).

Sources: *Rosstat*

To sum up, the reorganization of ownership together with the positive capital accumulation effect overcomes the negative impact of ruble appreciation 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 estimation results, 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[11] in manufacturing and mining is negligible: in the regressions for both employment in 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.

Examining the correlation between the employment growth rates in three sectors, one observes the highly negative link between the mining and service sectors (correlation –0.54), and just a weak connection between the manufacturing and mining sectors (insignificant correlation). For the manufacturing and service sectors, the correlation is not negligible and is equal to –0,34. We thus observe some movement of labor from the mining and manufacturing sector, which however was not solely caused 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, employment in manufacturing decreased by more than one third, while the employment in services rose by 9% (see Figure 8, Table A.3). 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. Massive dismissal of employees in mining (–10% in 2002–2003 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 employees 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.

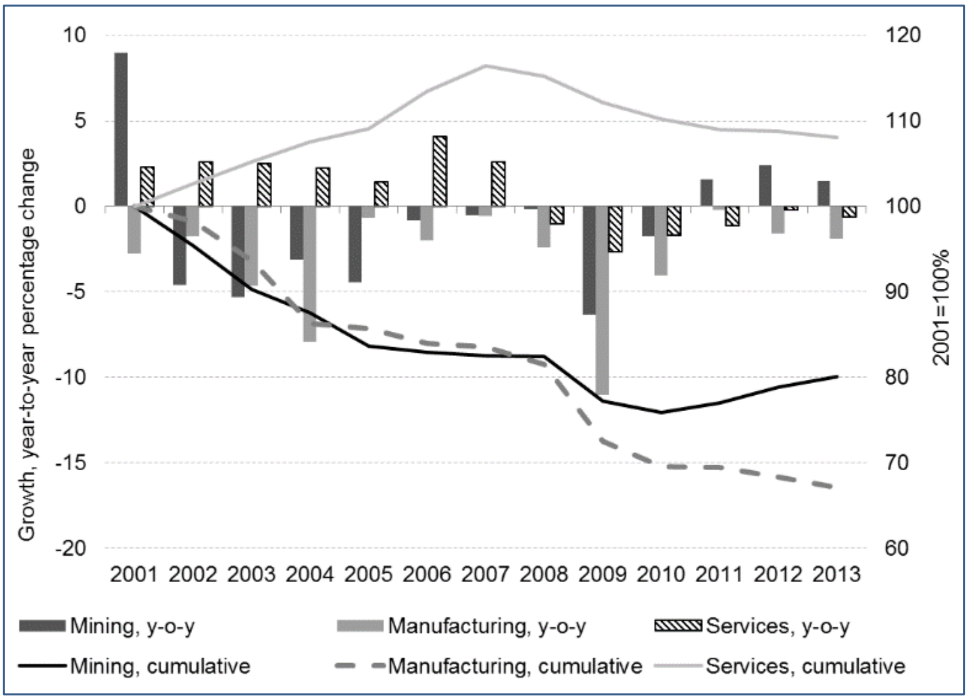
The first reason for this observation may be the emergence of a service sector that was underdeveloped during the late Soviet and early post-Soviet period. At the end of the period under consideration the total share of labor in the service sector was 73% – the level of highly developed economies. On the contrary, the percentage in manufacturing fell to

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

15.6%, which is 8–10 p.p. lower than for developed economies. The second reason may be 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 into services has a strong negative impact (elasticity about –2.8, see Table 3) on manufacturing. On the other hand, the resource movement effect is very likely to be present in the service sector (the estimated relation is negative, see Table 3). This effect is supported by the spending effect in services and manufacturing – the impact of changes in total disposable income of the population on production is positive in both cases, but 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 solely to the inflow of export revenues.

Figure 8 Employment growth rate by sector of the economy in 2001–2013, %; cumulative growth is shown on the right axis



Note: the two points 2012–2013 are the estimates based on statistics of job replacement.
Sources: Rosstat

5.3 Wages

At first glance, the dynamics of real wages do 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 (Figure 9), which led to a sharp rise in unit labor costs. Furthermore, the highest rates of increase of both wage and unit labor costs were observed not in mining (as the model expected), but in the service sector.

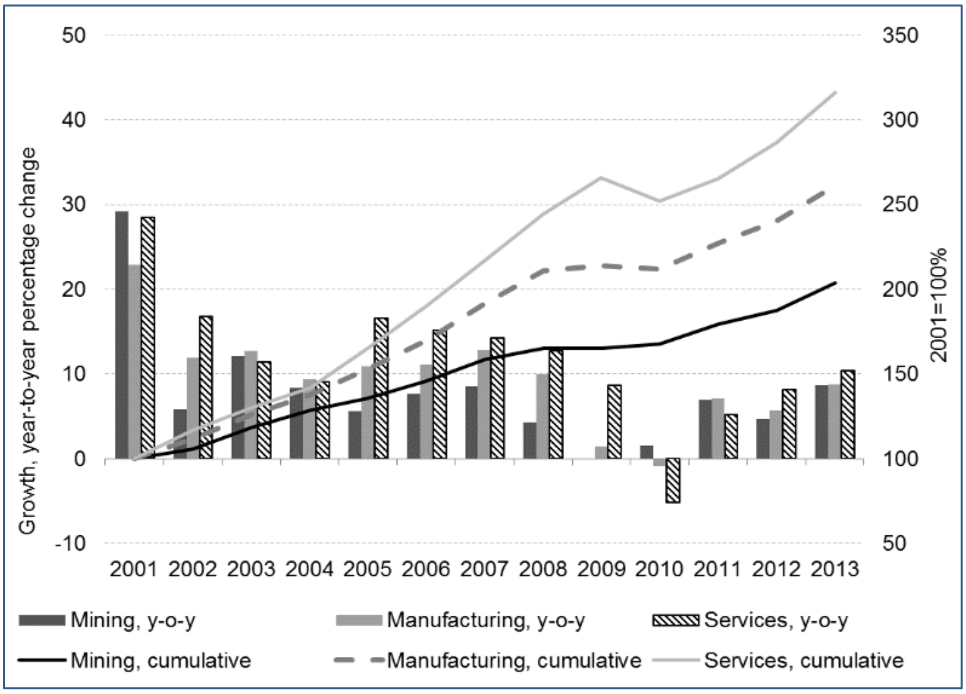
We suggest that the high rate of growth in real wages is related to the factor disregarded in the construction of a standard model of Dutch disease: namely, to a certain “rebound effect” after the crisis of 1998. Yet another version may be traced to the gradual rejection of shadow schemes of remuneration.

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

Although the values of the coefficients are not very reliable in our estimations, we can see that the largest effect is in services, the smallest 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.

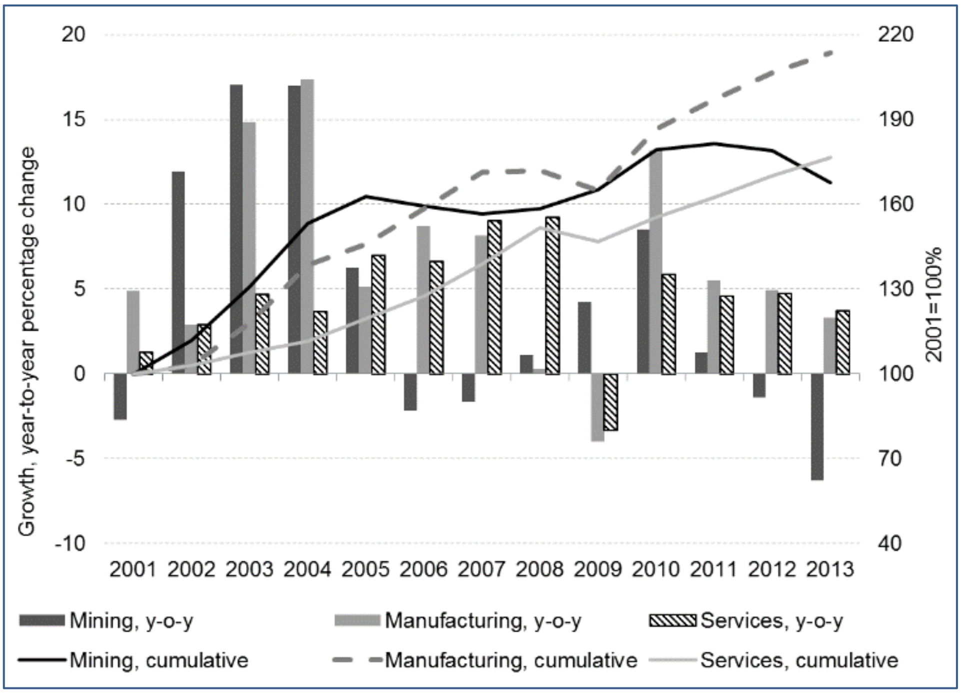
The excess rates of growth in wages over productivity may represent a threat to the manufacturing sector. Growth rates in labor productivity are high but always lower than wage growth rates (see Figure 10 and Table A.6) due to the demographic and structural problems of the Russian economy, which leads to the loss of competitive power. Thus there is a possibility for Dutch disease in Russia to develop into a more pronounced form.

Figure 9 Growth rate of real wages in rubles by sector of the economy, 2001–2013, %; cumulative growth is shown on the right axis



Note: CPI-deflated
Sources: Rosstat

Figure 10 Labor productivity by sector of the economy in 2001–2013, growth rate, %; cumulative growth is shown on the right axis



Note: calculated on the basis of comparison of time series for output and average annual employment
Sources: Rosstat

5.4 Returns on capital

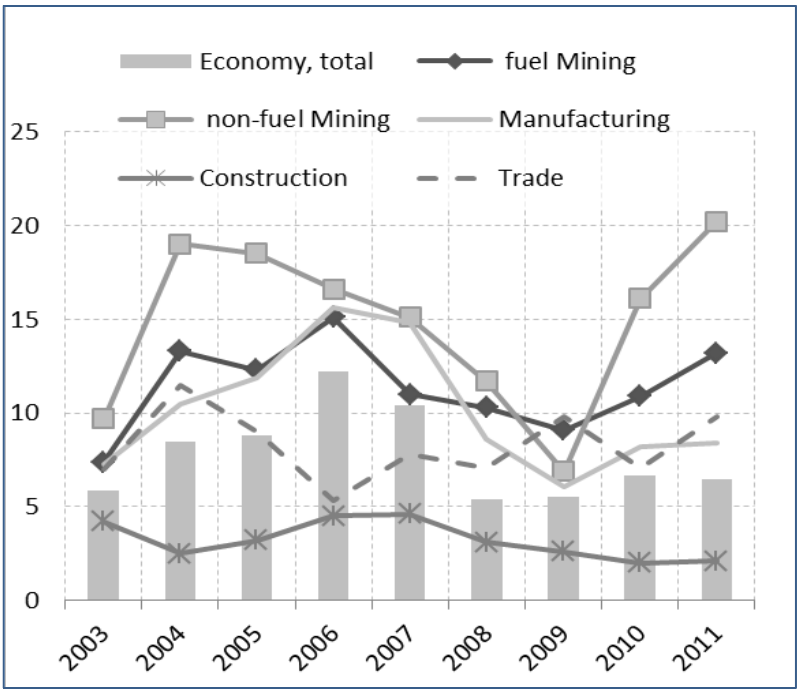
The model assumes that the return on assets should rise in mining due to both the resource movement effect and the spending effect. At the same time, the returns on capital invested in manufacturing and services are indefinite due to the uncertain combination of the negative impact of the resource movement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

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

The dynamics of profitability of assets in the Russian economy over the 2000 decade indicate that mineral mining and drilling, particularly the mining of non-fuel minerals, occupies an advantageous position in the Russian economy from the point of view of returns on capital. This may impede the diversification of the economy, as based on the inter-sectorial redistribution of capital in response to market signals.

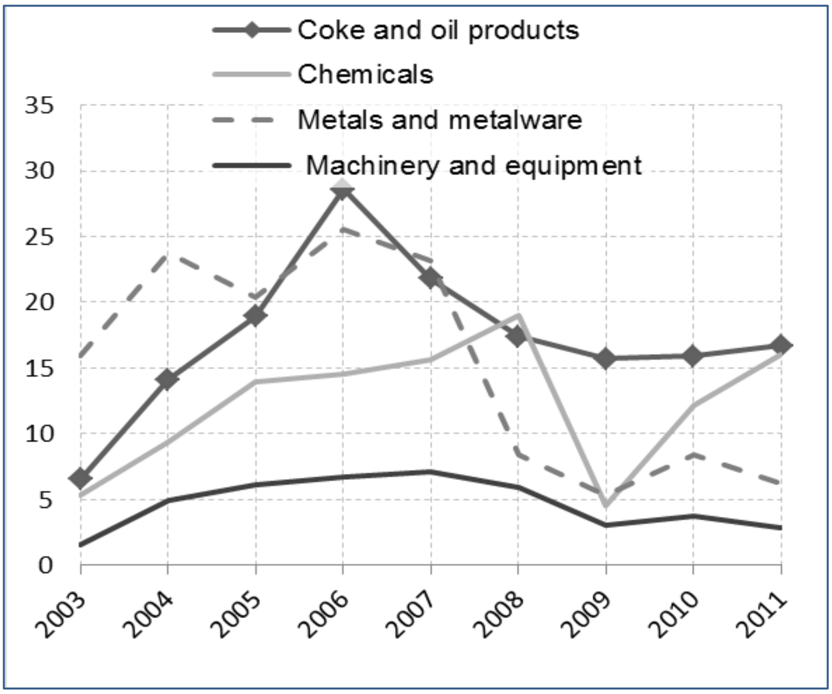
In 2011, the absolute leading sector was not fuel extraction (with its 13% rate of return) but the mining of non-fuel minerals with more than a 20% rate (due to more favorable taxation). Meanwhile, manufacturing, which should in principal be a vanguard of modernization attracting capital with its high profits, returned only 8% on investments (ahead of services with its average rate of about 5% (see Table A.4 and Figure 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. At the same time, return on investments in machinery engineering is less than modest – below 5% (see Figure 12 and Table A.5) 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 5,1% rate after 2001), Humble returns in manufacturing insured only slightly positive average growth.

Figure 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 value of assets belonging to organizations. By the mid–2013, official data are available till 2011.
Source: Rosstat.

Figure 12 Profitability of assets of organizations in some sectors of manufacturing, %



Note: Profitability of assets is correlation between balanced financial result (profits minus losses) and value of assets belonging to organizations. By the mid–2013, official data are available until 2011.
Source: Rosstat.

6 Conclusions

Our findings suggest that the Russian economy in the period under examination reflects a combination of "Soviet" and "Dutch" diseases, after consideration of the economic and political activity, and the effect of the 1998 and 2008 crises on the economy.

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

Eruptive flows of export revenues have resulted in 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-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 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 wages should also decline, though 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 the other sectors, notably services and especially wholesale trade, which finally led to a shrinkage in the share of manufacturing in GDP to 15.6%. As this confirms the results of the theoretical model, we consider this to be a symptom of Dutch disease.

The mining and service sectors have expanded, as predicted by the theoretical model, although 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 foreign direct investment of mining companies, which can be observed in the relatively higher share of foreign direct 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 wages.

The behavior of 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 central bank is key issue. In our opinion, one of the possible directions of future study of the topic could be an analysis of the transition from exchange rate targeting (the focus of the 2000 decade 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.

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Appendix A

Table A.1 Structure of Russian GDP at current prices, % (unless specified otherwise)

	2002	2011	2012	2012 – 2002 (perc. point.)
GDP at market prices	100.0	100.0	100.0	
Agriculture et al	5.3	3.5	3.1	–2.2
Fishing and fish breeding	0.3	0.2	0.2	–0.1
Mining	5.9	9.2	9.3	+3.4
Manufacturing	15.2	13.2	13.0	–2.2
Of which, oil refining and coke production	1.8	3.0	3.0	+1.2
Electric power et al	3.2	3.3	3.0	–0.3
Construction	4.7	5.6	5.5	+0.8
Trade et al	20.2	16.7	16.9	–3.4
Hotels and restaurants	0.8	0.8	0.8	=0.0
Transportation and communications	9.0	7.1	7.0	–2.1
Finance	2.6	3.5	3.7	+1.1
Real estate and lease	9.4	10.1	10.1	+0.7
Public administration and defense	4.5	4.8	5.6	+1.1
Education	2.6	2.5	2.6	+0.0
Public health	3.0	3.1	3.3	+0.4
Other social services	1.7	1.4	1.4	–0.3
Net taxes on products	11.5	14.9	14.5	+3.0

Source: Rosstat

Table A.2 Consequences of Dutch disease from the viewpoint of resource movement effect and spending effect, results of Corden, Neary (1982)

	Model #1					Model #2									
Mobility of labor	in mining, manufacturing and services					in mining, manufacturing and services									
Mobility of capital	Fully sector specific					Specific in mining, mobile between manufacturing and services									
Capital/labor ratio K						$K_{Man} > K_{serv}$					$K_{Man} < K_{serv}$				
Indicators	output	prices	wages	Return to capital assets	employment	output	prices	wages	Return to capital assets	employment	output	prices	wages	Return to capital assets	emplyment
Resourse movement effect															
Mining sector (MIN)	+	exog	+	+	+	+	exog	+	+	+	+	exog	+	+	+
Manufac-turing sector (M)	-	exog	+	-	-	+	exog	+	-	-	-	exog	+	-	-
Services sector(S)	-	+	+	-	-	-	+	+	-	-	+	-	+	-	-
Spending effect															
Mining sector (MIN)	-	exog	+	-	-	+	exog	+	+	none	+	exog	-	+	none
Manufac-turing 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.	+	+
Manufac-turing 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, Neary, 1982)

Table A.3 Average annual employment and structure of employment in the Russian economy by sector

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Average annual employment in economy, total									
Million persons	66.79	67.17	68.02	68.47	67.46	67.58	67.73	67.30	66.59
%	100	100	100	100	100	100	100	100	100
Of which,%									
Mining, total	1.6	1.6	1.5	1.5	1.6	1.6	1.6	1.6	1.7
Manufacturing, total	17.2	16.9	16.7	16.3	15.4	15.2	15.2	15.8	15.6
Services, total	67.0	67.8	68.5	69.4	69.9	70.2	70.4	71.6	72.9
Other sectors (agriculture and fisheries, electricity, gas and water supply)	14.1	13.7	13.2	12.7	13.1	12.9	12.8	12.3	11.7

Table A.4 Return to assets by sector, %

	2003	2004	2005	2006	2007	2008	2009	2010	2011	Difference between the two two-year periods – 2010–2011 and 2003–2004.
Economy, total	5.9	8.5	8.8	12.2	10.4	5.4	5.5	6.7	6.5	–1.2
Mining, total	**7.6**	**13.8**	**12.9**	**15.3**	**11.4**	**10.5**	**8.8**	**11.6**	**14.2**	4.4
Mining, fuels	7.4	13.3	12.3	15.1	11	10.3	9.1	10.9	13.2	3.4
Mining, non-fuels	9.7	19	18.5	16.6	15.1	11.7	6.9	16.1	20.2	7.6
Manufacturing, total	**7.3**	**10.5**	**11.9**	**15.6**	**14.8**	**8.6**	**6.1**	**8.2**	**8.4**	–1.2
Coke and oil products	6.5	14.1	18.9	28.6	21.8	17.4	15.7	15.9	16.7	12.0
Chemicals	5.3	9.4	13.9	14.5	15.6	19	4.5	12.2	16	13.5
Metals and metalware	15.9	23.8	20.4	25.5	23.2	8.4	5.3	8.4	6.2	–25.1
Machinery and equipment	1.5	4.9	6.1	6.7	7.1	5.9	3	3.7	2.8	0.1
Electric equipment	4.3	5.4	6.2	8.3	10.5	5.5	3.2	6.4	6.5	3.2
Transport vehicles and equipment	3.1	2.8	1.6	3.2	4.4	–2	–5.1	–0.3	2.1	–4.1
Services, average	**7.6**	**8.1**	**6.3**	**5.6**	**6.4**	**3.4**	**4.9**	**4.9**	**5.1**	–5.6
excluding education, public health, commercial, social and personal services	7.7	8.1	6.4	5.6	6.5	3.5	5.0	5.0	5.2	–5.7

Note: Note: Return to assets is the ratio between balanced financial result (profits minus losses) and value of assets belonging to organizations. Return to assets in service sector was calculated as a weighted average of the Rosstat annual data by sector against non-current and current assets in 2011. By the mid–2013, official data are available since 2011.Source: Rosstat

Table A.5 Ranking of sectors of the Russian economy by level of returns to shipment (sales), classified by values in 2012, %

	2006	2007	2008	2009	2010	2011	2012
Industry, total	14.8	14.4	11.6	9.9	12.6	12.1	11.3
Mining, fuels	29.9	28.6	26.8	16.3	31.1	38.5	32.9
Mining non-fuels	18.7	19.7	15.8	18.5	21.8	23.8	19.5
Chemicals	11.0	13.7	18.6	6.3	12.2	15.7	15.6
Coke, oil products and nuclear materials	47.1	35.8	27.5	22.4	18.5	17.3	15.6
Metals and fabricated metal ware	22.0	21.7	17.4	9.8	13.7	9.5	9.0
Other non-metal mineral products	14.7	18.5	9.0	2.5	3.3	6.4	8.5
Pulp and paper, publishing and printing	7.7	6.5	3.0	4.0	7.3	5.8	5.8
Foods, beverages and tobacco	5.4	4.9	4.8	5.9	5.7	4.2	5.3
Public utilities	4.9	5.7	3.9	7.6	11.0	3.2	5.1
Rubber and plastic goods	10.6	7.1	1.6	1.7	3.1	3.7	4.9
Electric equipment, electronic and optical instruments	6.5	6.2	5.0	3.1	5.3	5.3	4.9
Machinery and equipment	5.6	5.5	5.1	5.1	4.8	4.4	4.8
Transport vehicles and equipment	3.8	4.6	–1.5	–8.2	0.9	4.0	3.6
Textiles and apparel	1.6	1.4	0.7	0.4	0.5	2.3	3.4
Tanning, leather and footwear	2.7	4.7	3.4	1.2	2.0	2.2	2.6
Woodwork and timber	1.8	4.2	–3.2	–4.8	0.2	–0.4	2.5

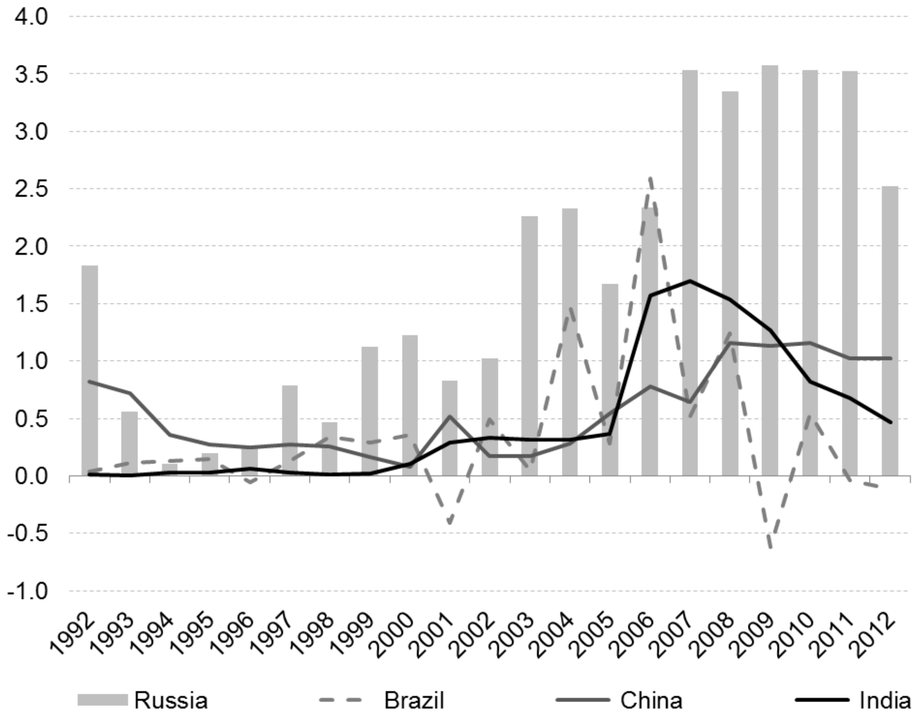
Source: Rosstat

Table A.6 Wages and unit labor costs in the world and in Russia (manufacturing), 2003 =100%

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Earnings per hour									
Developed economies, total	100	102	105	108	112	116	119	120	123
of which:									
USA	100	101	104	106	110	114	119	121	123
Eurozone	100	103	106	109	113	117	121	122	124
Germany	100	101	103	106	108	111	115	114	117
France	100	105	109	112	117	120	122	123	126
Italy	100	104	106	107	111	118	124	123	126
Spain	100	103	108	112	116	122	128	130	131
Japan	100	100	102	102	102	104	102	101	103
Other developed economies (except G–7)	100	106	110	116	122	128	130	132	138
New industrial countries of Asia	100	107	114	120	128	134	135	136	143
Russia (monthly wages in US$)	100	131	163	202	277	325	304	344	400
ULC									
Developed economies, total	100	99	98	98	98	102	109	103	103
of which:									
USA	100	99	97	98	98	102	106	102	101
Euro zone	100	100	99	98	98	104	115	110	109
Germany	100	97	93	88	86	91	111	102	99
France	100	101	99	100	101	105	113	112	113
Italy	100	102	104	104	107	115	124	119	122
Spain	100	102	104	107	111	119	122	117	114
Japan	100	96	95	93	91	96	113	98	101
Other developed economies (except G–7)	100	99	99	98	98	100	101	94	97
New industrial countries of Asia	100	98	98	94	93	94	93	80	83
Russia	100	109	127	142	176	201	197	191	209

Source*:* IMF (World Economic Outlook, April 2012, Online Tables, Table B3, p. 243, authors' calculations; Russia – Rosstat, authors' calculations.

Figure 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”.

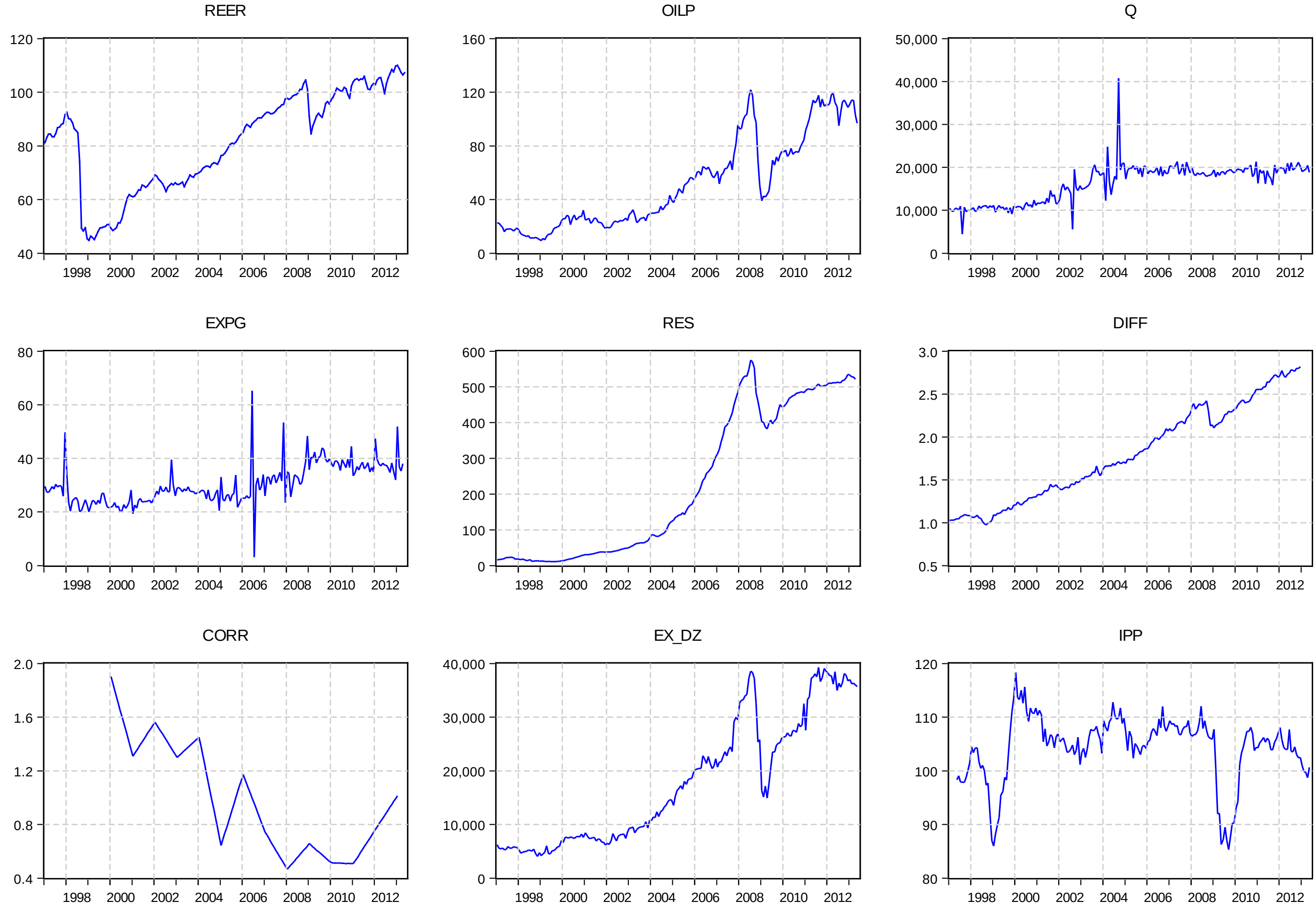
According to our estimates, since the mid–1990s, Russia has moved far ahead of the other BRIC countries in the outflow of direct investment overseas relative to GDP. For example, in 2012 the outflow of direct investments was practically equal to its inflow – 2.5% of GDP, a far higher proportion than in China, which invested abroad only 1% of its GDP (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

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	ГТК	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
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
Index of industrial production	IPP	Rosstat	monthly	Weighted index of industrial production in basic industries, month-to-month change
External demand	EX_DZ	Rosstat	monthly	Russian exports to far-abroad countries, $ million
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

Figure B.1 Dynamics of dependent (REER – real effective exchange rate) and exogenous variables. The variable descriptions can be found in Table B.1



Note: the horizontal axis corresponds to time, the vertical axis corresponds to absolute values of the variables (see Table B.1)

Figure B.2 Dynamics of real exchange rate of the ruble and its factors: oil price (URL), net international reserves (RES), government expenditures (EXPG), January 1997=1

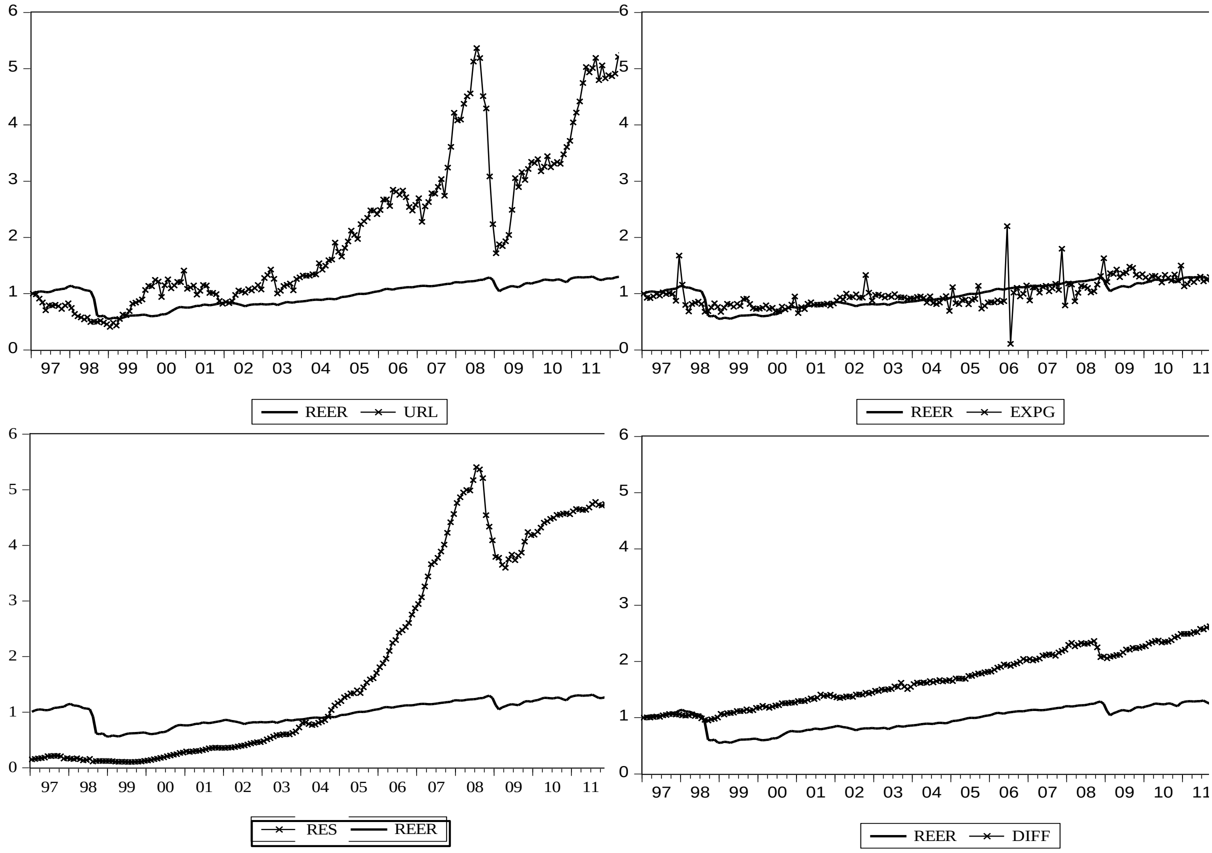


Table B.2 Descriptive statistics of variables

	REER	OILP	Q	EXPG	RES	DIFF	IPP	EX_DZ	CORR
Average	81,61	51,98	103683,30	30,32	225,79	1,80	104,32	17907,32	0,97
Median	85,04	41,87	117319,00	28,36	136,07	1,71	105,66	15092,13	0,89
Maximum	110,04	121,81	132215,70	65,23	574,59	2,82	118,32	39255,33	1,90
Minimum	44,78	9,32	62205,28	3,17	10,86	0,98	85,32	4023,17	0,47
Standard deviation.	18,39	34,13	24649,37	7,53	207,69	0,56	6,14	11653,43	0,39
Skewness	–0,37	0,62	–0,52	0,80	0,36	0,19	–1,20	0,48	0,42
Excess	1,98	2,03	1,54	5,38	1,37	1,75	4,54	1,79	1,85
Jarque-Bera test	12,99	20,36	26,15	67,58	25,84	13,68	65,36	19,66	13,23
p-value	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Observations	197	197	197	196	196	192	193	197	157

Note: REER stands for the real effective exchange rate, OILP – price of URALS oil, Q- Exports of oil from the Russian Federation, EXPG – government expenditures, RES – net international reserves, DIFF – differential of labor productivity, IPP – index of industrial production, EX_DZ – external demand, CORR – corruption

Table B.3 Correlation coefficients

Indicators	Log(REER)	Log(URL)	Log(Q)	Log(EXPG)	Log(RES)	Log(DIFF)	Log(IPP)	Log(EX_DZ)	Log(CORR)
Log(REER)	1,000 -----								
Log(URL)	0,920 (0.000)	1,000 -----							
Log(Q)	0,850 (0.000)	0,739 (0.000)	1,000 -----						
Log(EXPG)	0,548 (0.000)	0,476 (0.000)	0,439 (0.000)	1,000 -----					
Log(RES)	0,982 (0.000)	0,924 (0.000)	0,879 (0.000)	0,557 (0.000)	1,000 -----				
Log(DIFF)	0,974 (0.000)	0,948 (0.000)	0,823 (0.000)	0,577 (0.000)	0,974 (0.000)	1,000 -----			
Log(IPP)	-0,337 (0.000)	-0,201 (0,012)	-0,304 (0.000)	-0,411 (0.000)	-0,358 (0.000)	-0,335 (0.000)	1,000 -----		
Log(EX_DZ)	0,951 (0.000)	0,985 (0.000)	0,813 (0.000)	0,504 (0.000)	0,960 (0.000)	0,969 (0.000)	-0,224 (0,005)	1,000 -----	
Log(CORR)	-0,858 (0.000)	-0,809 (0.000)	-0,751 (0.000)	-0,531 (0.000)	-0,901 (0.000)	-0,838 (0.000)	0,362 (0.000)	-0,843 (0.000)	1,000 -----

Note: for the period 01.1997 – 04.2013. p-values are given in brackets
REER stands for the real effective exchange rate, OILP – price of URALS oil, Q- Exports of oil from the Russian Federation, EXPG – government expenditures, RES – net international reserves, DIFF – differential of labor productivity, IPP – index of industrial production, EX_DZ – external demand, CORR – corruption

Table B.4 Extended Dickey-Fuller Unit Root tests (ADF tests)

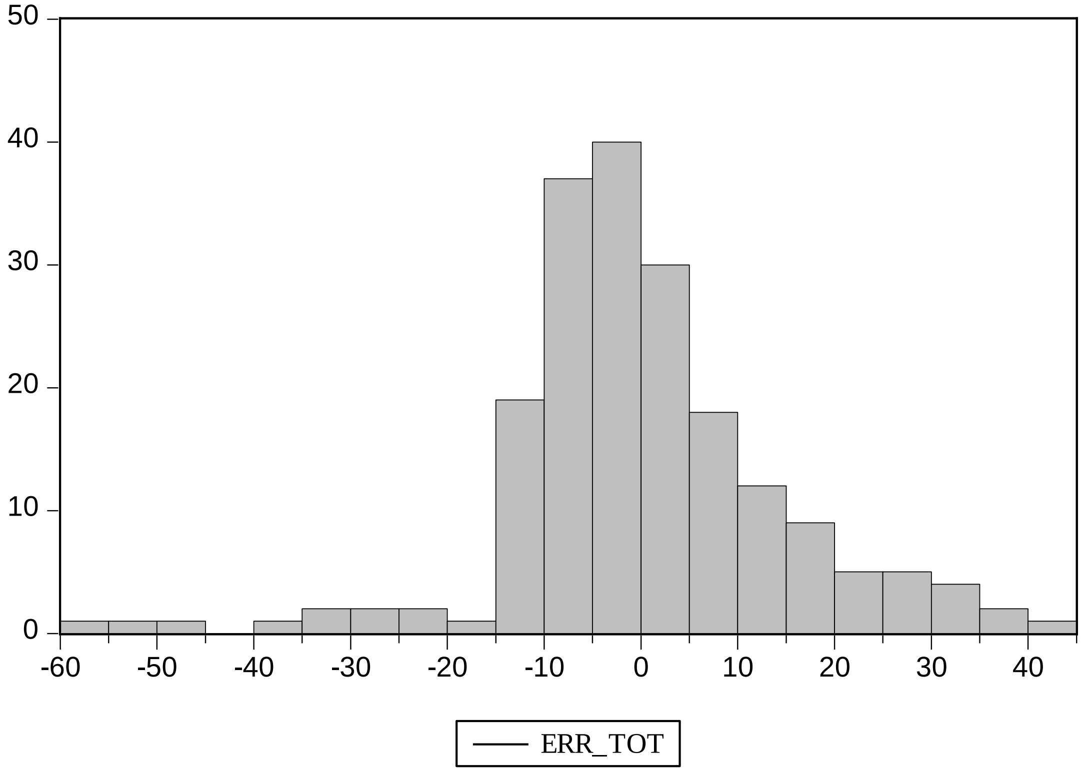
Indicators and specifications of test	Value of ADF-statistics	p-value
log(REER)		
Constant	–1.3526	0.6046
Constant and trend	–3.2153	0.0845
Without constant and trend	0.2510	0.7580
log(OILP)		
Constant	–1.2868	0.6356
Constant and trend	–3.5102	0.0411
Without constant and trend	0.8791	0.8979
log(Q)		
Constant	–1.3778	0.5925
Constant and trend	–0.7562	0.9667
Without constant and trend	2.1020	0.9917
log(EXPG)		
Constant	–1.8420	0.3594
Constant and trend	–3.6216	0.0306
Without constant and trend	0.2450	0.7563
log(RES)		
Constant	–0.7112	0.8402
Constant and trend	–1.7694	0.7159
Without constant and trend	1.3954	0.9592

Note: The table shows values of test-statistics of the Augmented Dickey-Fuller test and its p-values. The null hypothesis states that the series under examination contains a unit root; therefore, if the p-statistics above 0.05, the hypothesis about presence of a unit root cannot be rejected at the 5%-level of significance.

Table B.5 Johansen tests for presence of cointegration

Quantity of cointegrating relations chosen by the Model on the 5%-level of confidence probability)					
Period: 1997M01 2013M06					
Number of observations: 192					
Series : LOG(REER) LOG(OILP) LOG(EXPG) LOG(RES)					
Number of lags: 3					
Trend in the data	none	none	linear	linear	quadratic
Type of test	no constant	constant	constant	constant	constant
	no trend	no trend	no trend	no trend	no trend
Trace	1	2	2	2	3
Max-Eig	1	1	1	0	3
Period: 1997M01 2013M06					
Number of observations: 188					
Series : LOG(REER) LOG(OILP) LOG(EXPG) LOG(RES) LOG(DIFF)					
Number of lags: 3					
Trend in the data	none	none	linear	linear	quadratic
Type of test	no constant	constant	constant	constant	constant
	no trend	no trend	no trend	no trend	no trend
Trace	2	4	1	2	2
Max-Eig	1	0	0	0	0
Period: 1997M01 2013M06					
Number of observations: 152					
Series: LOG(REER) LOG(OILP) LOG(EXPG) LOG(RES) LOG(DIFF) LOG(CORR)					
Number of lags: 3					
Trend in the data	none	none	linear	linear	quadratic
Type of test	no constant	constant	constant	constant	constant
	no trend	no trend	no trend	no trend	no trend
Trace	1	3	2	1	1
Max-Eig	1	2	1	1	1

Figure B.3 Histogram of errors of VECM model (the errors are calculated as deviations of actual REER or ruble from that of Model (2) (Jan 1997–Feb 2005) and Model (3) (Mar 2005–Dec 2013)), January 1997=100

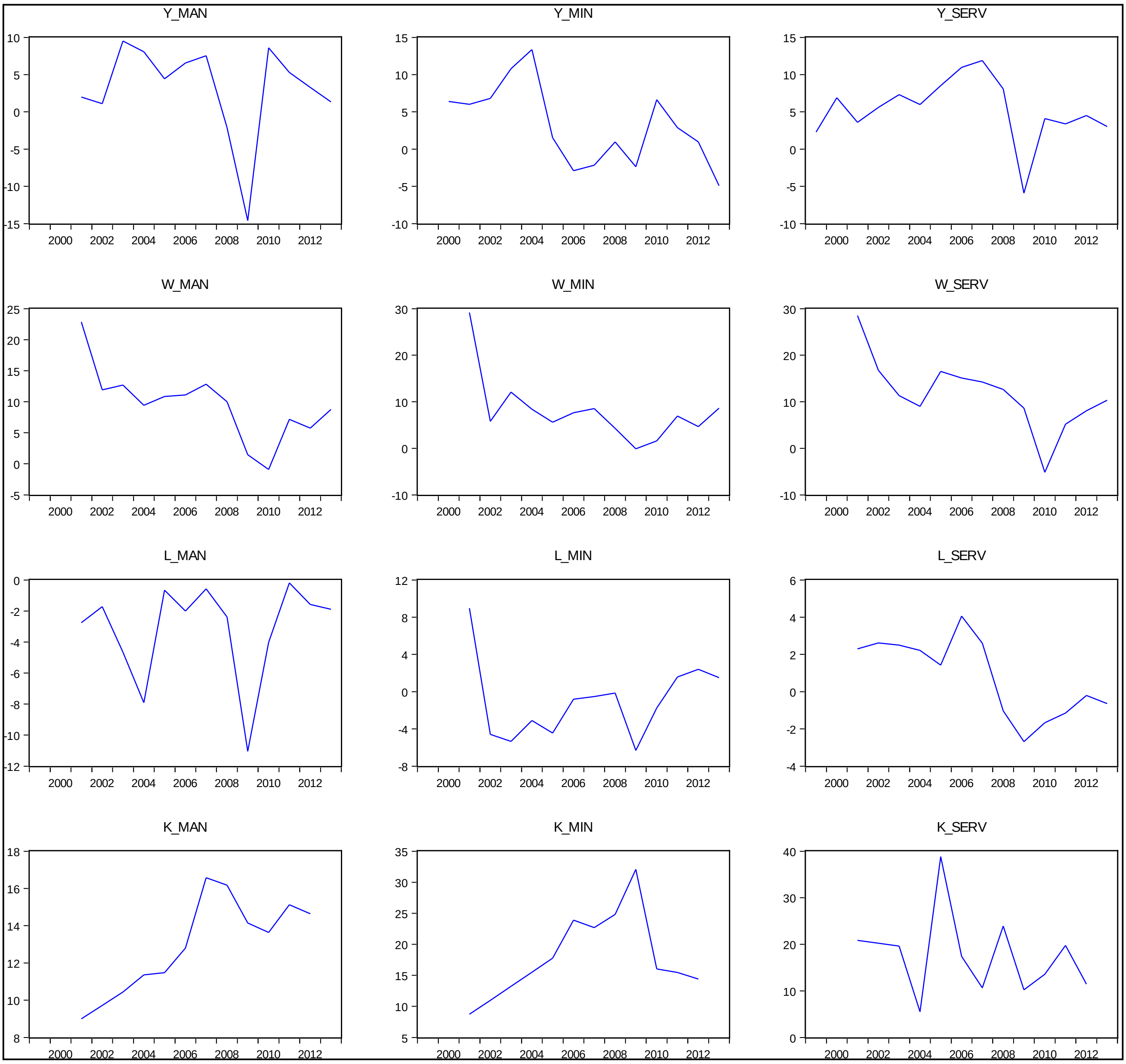


Note: average value – –0.008; median – –2.534; maximum – 41.86; minimum – 59.81; standard deviation – 14.46; skewness– –0.25; coefficient of excess – 5.63. Apparently, in the majority of observations, divergence between the actual and calculated rates is no larger than 15. The majority of the rest of the observations is located in the right tail of distribution, which may be one more evidence in favor of presence of Dutch disease.

Table B.6 Variables and their sources

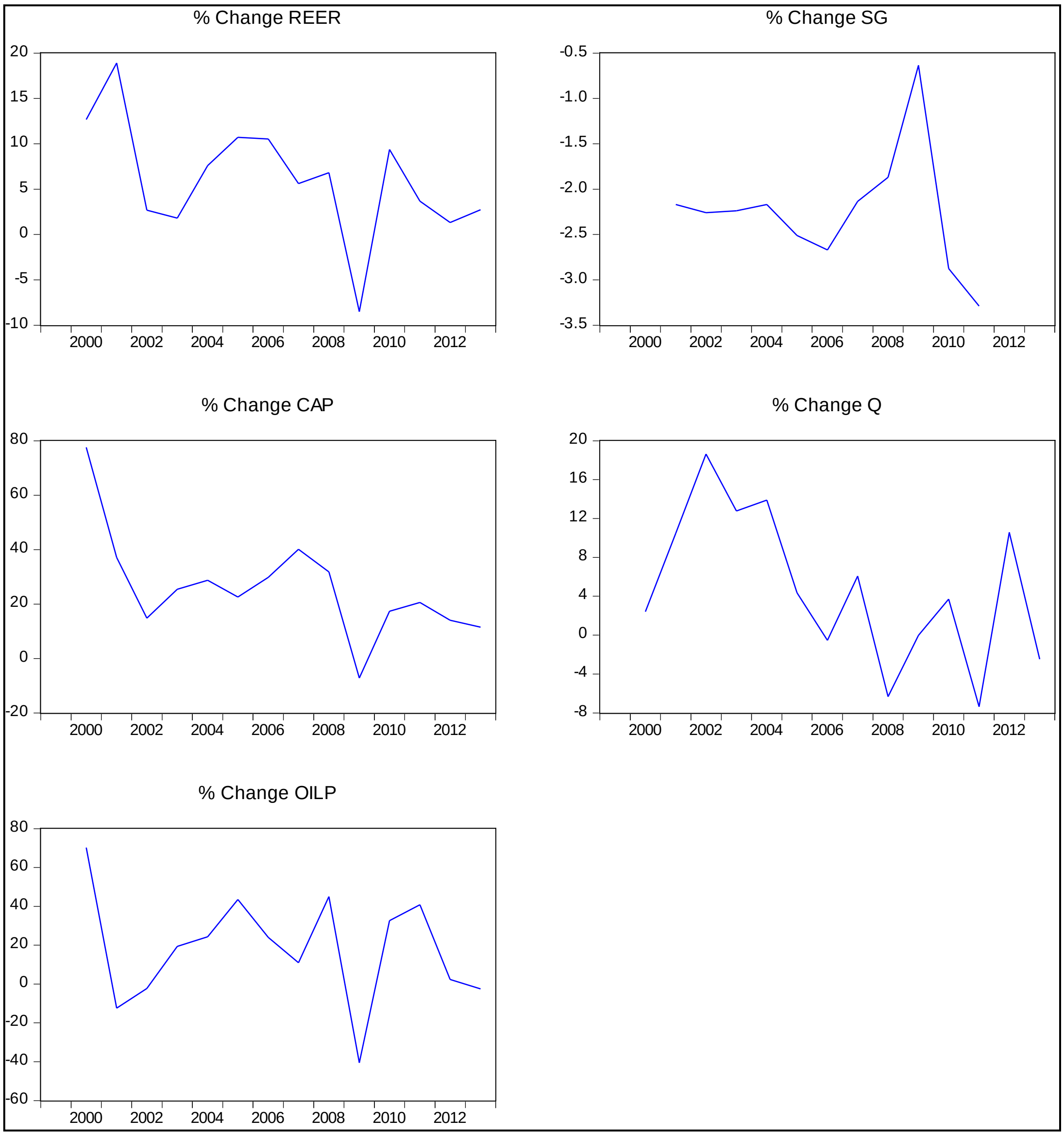
Variable	Name	Source	Frequency	Description
Output in manufacturing	Y_MAN	Rosstat	yearly	growth rate, in value, year-to-year
Output in mining	Y_MIN	Rosstat	yearly	growth rate, in value, year-to-year
Output in services	Y_SERV	Rosstat	yearly	growth rate, in value, year-to-year
Number of employees in manufacturing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

Figure B.4 Dynamics of dependent variables



Note: the growth rate of value of output in manufacturing, mining and service (Y_MAN, Y_MIN, Y_SERV), the growth rate of employment in manufacturing, mining and service (L_MAN, L_MIN, L_SERV), the growth rate of wages in manufacturing, mining and service (W_MAN, W_MIN, W_SERV), the growth rate of returns on capital in manufacturing, mining and service (K_MAN, K_MIN, K_SERV).

Figure B.5 Dynamics of explanatory variables



Note: the real effective exchange rate (REER), share of state-employed labor (SG), capital (CAP), volume of exported oil (Q), price of exported oil (OILP). All the variables are in percent changes to the previous period.

Table B.7 Descriptive statistics of dependent variables

	Y_MAN	Y_MIN	Y_SERV	W_MAN	W_MIN	W_SERV	L_MAN	L_MIN	L_SERV	K_MAN	K_MIN	K_SERV
Mean	3,30	3,54	5,67	9,60	7,88	11,74	-3,29	-1,17	0,91	12,92	17,97	17,67
Median	4,87	2,20	5,79	10,43	6,36	12,00	-2,19	-1,27	1,82	13,22	15,78	18,51
Maximum	9,50	13,35	11,88	22,87	29,16	28,49	-0,19	8,96	4,06	16,58	32,08	38,85
Minimum	-14,62	-2,91	-5,93	-0,91	-0,10	-5,15	-11,04	-6,31	-2,69	8,99	8,72	5,52
Std. Dev.	6,61	5,24	4,58	6,05	7,44	8,01	3,24	4,21	2,15	2,52	6,66	8,63
Skewness	-1,75	0,46	-1,14	0,28	2,04	-0,04	-1,35	1,04	-0,30	-0,09	0,68	1,03
Kurtosis	5,59	2,16	4,60	3,55	6,85	3,94	3,83	3,80	1,73	1,75	2,72	4,14
Jarque-Bera	9,48	0,79	3,86	0,31	15,76	0,44	4,00	2,50	0,99	0,80	0,97	2,76
Probability	0,01	0,67	0,14	0,86	0,00	0,80	0,14	0,29	0,61	0,67	0,62	0,25
Sum	39,65	42,46	67,98	115,19	94,57	140,87	-39,52	-14,06	10,98	155,07	215,66	212,06
Sum Sq. Dev.	479,94	302,10	231,12	402,93	608,22	705,80	115,83	194,90	50,95	70,11	488,55	819,63
Observations	12	12	12	12	12	12	12	12	12	12	12	12

Note: the growth rate of value of output in manufacturing, mining and service (Y_MAN, Y_MIN, Y_SERV), the growth rate of employment in manufacturing, mining and service (L_MAN, L_MIN, L_SERV), the growth rate of wages in manufacturing, mining and service (W_MAN, W_MIN, W_SERV), the growth rate of returns on capital in manufacturing, mining and service (K_MAN, K_MIN, K_SERV).

Table B.8 Descriptive statistics of explanatory variables

	@PC(REER)	@PC(SG)	@PC(CAP)	@PC(Q)	@PC(OILP)
Mean	6,29	-2,26	23,73	5,06	16,85
Median	6,82	-2,24	25,42	4,34	23,97
Maximum	18,91	-0,63	40,15	18,62	45,02
Minimum	-8,51	-3,29	-7,23	-7,37	-40,50
Std. Dev.	6,84	0,67	12,92	8,34	26,44
Skewness	-0,39	1,01	-1,12	0,02	-0,92
Kurtosis	3,76	4,49	4,10	1,97	2,98
Jarque-Bera	0,55	2,89	2,84	0,49	1,54
Probability	0,76	0,24	0,24	0,78	0,46
Sum	69,23	-24,82	261,06	55,67	185,40
Sum Sq. Dev.	467,72	4,50	1669,24	695,92	6990,15
Observations	11	11	11	11	11

Note: the variables are real effective exchange rate (REER), share of state-employed labor (SG), capital (CAP), volume of exported oil (Q), price of exported oil (OILP). @PC stands for percentage change

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