The Price of Oil Dependency; Dutch Disease in Russian Regions

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The Price of Oil Dependency: Dutch Disease in Russian Regions

PRELIMINARY DRAFT

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SEO-Discussion paper nr. 83

Abstract

This paper investigates the extent to which the Russian economy suffers from Dutch Disease, and to what extent oil-dependent Russian regions are more prone to the symptoms. We first summarize the main Dutch Disease model and its key predictions. We subsequently test these predictions and find evidence of the key 3 symptoms: real exchange rate appreciation, de-industrialization, and a services sector boom. We find that Russia's oil dependency has carried a price. First, based on cointegration estimates, we find that changes in the oil price have had a strong and robust effect on the Russian real exchange rate, and have thereby reduced the competitiveness of non-oil exports during times of high oil prices. Second, based on cross-section regressions for 77 Russian regions, we find that, the more dependent a Russian region is on oil, the more prone to Dutch Disease it is. We end with some policy recommendations to reduce the impact of Dutch Disease.

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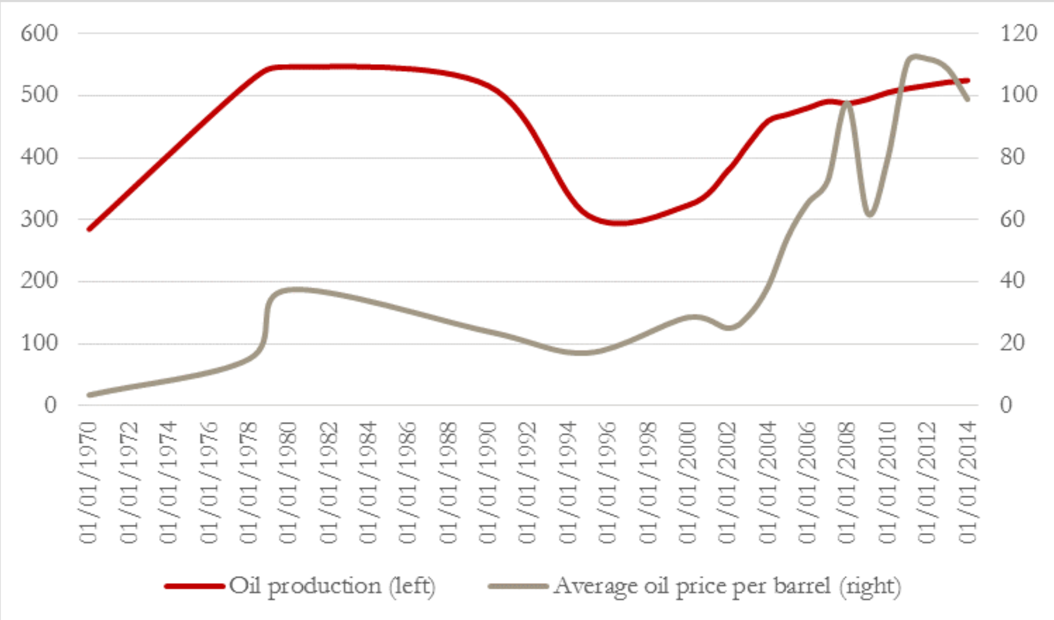
1 Introduction

Russia is one of the world's biggest players in oil and gas. It is the world's largest producer and exporter of natural gas, and the world's second largest producer and exporter of crude oil. It has the world's largest natural gas reserves, the world's second largest coal reserves, and the world's 7th largest oil reserves.

During the past 20 years, Russian oil production nearly doubled while oil prices increased five-fold (Figure 1.1). The increase in oil production in Russia dates back to the 1970s, when production first doubled within a decade. However, the break-up of the Soviet Union and the economic turmoil of the 1990s lowered oil production back to 1970 levels. Following the 1998 crisis, Russian oil production started to increase and is now nearly back at its 1980 production level. This increase in oil production, which mostly occurred during 1998-2008, coincided with the so-called "commodity super-cycle", as a result of which the average oil price increased by more than five times.[1]

Figure 1.1 During the past 20 years, Russia experienced a major oil boom



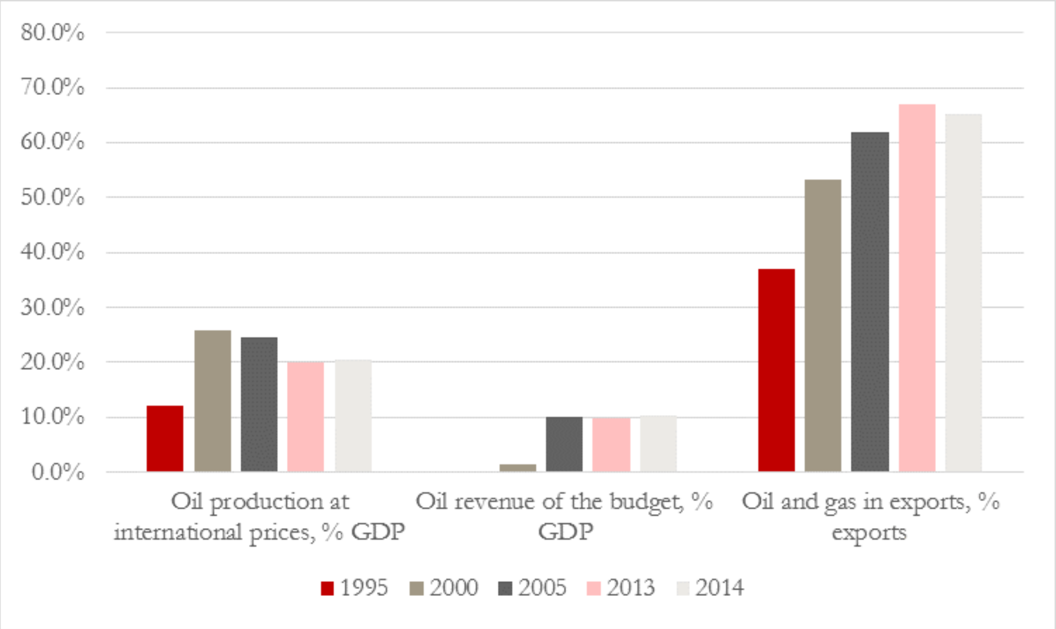
Sources: Rossat, Bloomberg. Oil production in tonnes.

As a result, the Russian economy is now highly dependent on oil and gas (Figure 1.2). Oil production directly accounts for around 20 percent of Russian GDP, while oil and gas account for about two thirds of merchandise exports. Oil and gas revenues account for about 50 percent of

[1] The increase in oil production after the 1998 crisis also coincided with an improvement in Russia's fiscal situation. Following the August 1998 default on rouble-denominated state debt, fiscal responsibility increased markedly. The ensuring government finance stability was coupled with unchanged income taxes and rising social benefits, in line with the increase in oil and gas revenues. This development – no threat of sovereign default and a redistribution of oil proceeds – created another foundation for economic growth and reduction in poverty.

federal budget revenues, or around 10 percent of GDP. While the oil sector is responsible for only 2 percent of total employment, oil companies account for 30 percent of sales, general, and administrative expenses in Russia. Moreover, wholesale and retail trade of fuel make up one third of overall trade sector revenue (including major trade activities such as car sales and grocery sales).

Figure 1.2 Share of oil and gas in selected economic indicators

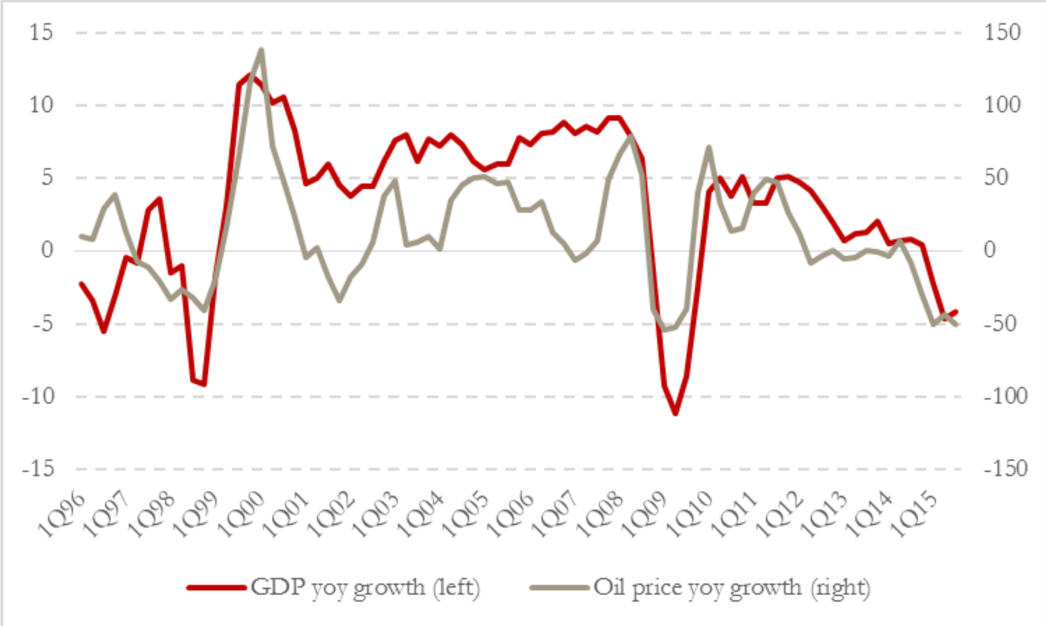


Sources: Rosstat and authors' calculations.

Given this high degree of oil dependence, it is not surprising that Russian GDP growth, the Russian rouble and the Russian stock market index are all highly correlated with the oil price. As Figure 1.3 shows, the period of rapid GDP growth during 1999-2008 coincided with the period of rapid oil price growth. Figure 1.4 shows that the correlation (in log differences) between the Russian rouble and the Brent oil price was 70 percent for quarterly observations during the period 2000-2015. Similarly, the correlation between the MICEX stock market index and the oil price was 80 percent during this period.[2]

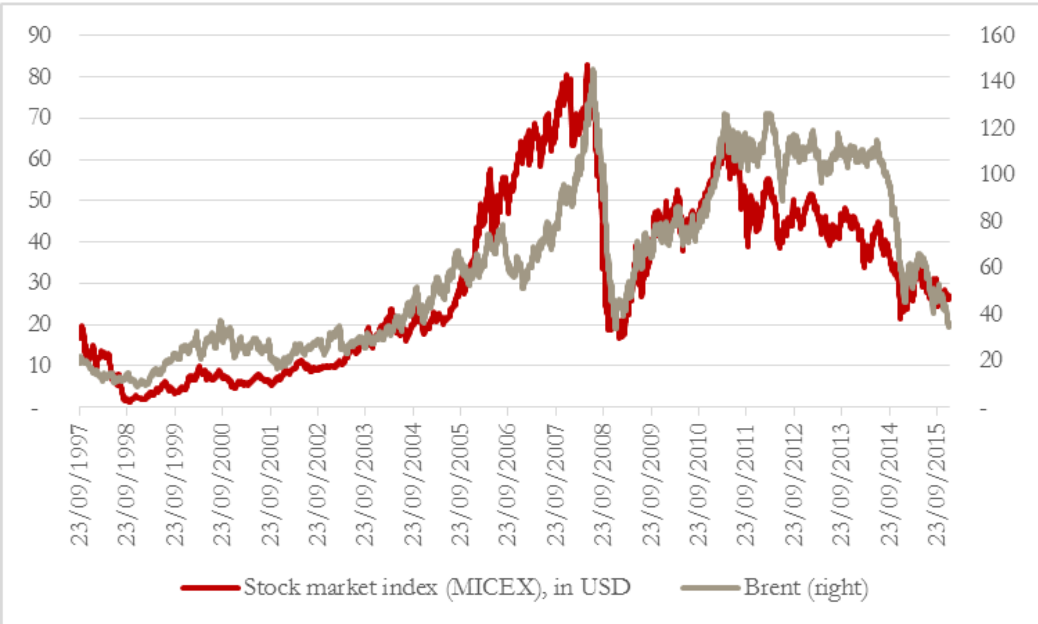
[2] For daily observations, these correlations are 28 and 33 percent respectively.

Figure 1.3 Russian GDP growth is highly correlated with oil price growth



Sources: Rosstat, Bloomberg.

Figure 1.4 The Russian stock market index is also highly correlated with the oil price



Sources: Bloomberg.

This paper tests whether Russia has contracted "Dutch Disease". As we explain in section 2, the symptoms of Dutch Disease include (1) real exchange rate appreciation, (2) a slowdown in manufacturing growth, (3) an acceleration in service sector growth, and (4) an increase in wage growth (particularly in the services sector).

We find that Russia's oil dependency has carried a price. First, based on cointegration estimates, we find evidence of a strong long-run relationship between the real exchange rate and oil price even after controlling for other determinants. This means that changes in the oil price have a strong and robust effect on the Russian real exchange rate. Second, based on cross-section regressions for 77 Russian regions, we find that, the more dependent a Russian region is on oil, the more prone to Dutch Disease it is.

The remainder of this paper is organized as follows. Section 2 describes the main Dutch Disease model and its key predictions. These predictions are subsequently tested in section 3 (real exchange rate appreciation), section 4 (deindustrialization) and section 5 (boom in services). Section 6 ends with conclusions and policy recommendations.

2 The Dutch Disease Model

In this section, we explain why the Dutch Disease model predicts that an exogenous increase in natural resource prices (or in natural resource output) results in real exchange rate appreciation and a decline in the manufacturing sector. The main Dutch Disease model on which subsequent models are based goes back to Corden (1982) and Corden and Neary (1984), and is summarized in an intuitive way by Kalcheva and Oomes (2007).

In this representation, given in Table 2.1, the economy is grouped into three sectors:

1. **"oil"** (which is a shortcut for "natural resources");
2. **"manufacturing"** (a shortcut for "non-resource tradable goods"); and
3. **"services"** (a shortcut for "nontradable goods").

By definition, tradable goods (oil and manufacturing) are subject to international competition; hence, their prices are determined by world demand and supply, and it is assumed that the country is small enough so as not to be able to influence these prices. Services, on the other hand, are not subject to international competition, and therefore their prices depend only on domestic demand and supply.

Table 2.1 Summary of the Corden-Neary model

	Output	Employment	Wage	Price
Resource movement effect				
oil sector	+	+	+	given
manufacturing sector	-	-	+	given
services sector	-	-	+	+
Spending effect				
oil sector	-	-	+	given
manufacturing sector	-	-	+	given
services sector	+	+	+	+
Combined effect				
oil sector	indeterminate	indeterminate	+	given
manufacturing sector	-	-	+	given
services sector	indeterminate	indeterminate	+	+

Source: Kalcheva and Oomes (2007)

Assuming some labour mobility between non-oil and oil sectors, the Dutch Disease model predicts a "resource movement effect" which leads to a decline in manufacturing output and employment and real exchange rate appreciation. Assuming that the supply of oil is not perfectly inelastic, a rise in the oil price increases the demand for labor and capital in the oil sector, which leads to higher wages there and to a higher return on capital. If factors are mobile, this will induce labor and capital to move from the manufacturing and service sectors to the oil sector ("resource movement effect"). Oil sector output and employment will thus increase, while output and employment in manufacturing and services will decline. Corden and Neary (1984) refer to this fall in manufacturing output as "direct de-industrialization." While the price of manufacturing goods does not change, because it is determined abroad, the decline in services output leads to excess demand for services and therefore to an increase in the price of services. The result is an increase in the price of nontradables relative to tradables, inducing an appreciation of the real exchange rate.

Even if there is no labor mobility between non-oil and oil sectors, the model predicts a "spending effect" due to which the real exchange rate appreciates as well. The resource movement effect only occurs if factors are sufficiently mobile between the oil and non-oil sectors, which may not be the case in Russia given that oil sector employment is relatively low. However, the spending effect occurs regardless of the level of employment in the oil sector. It occurs simply because higher oil prices generate higher oil sector wages and profits, thus raising aggregate demand in the economy. This increases the prices of domestically produced services, while the prices of oil and manufacturing goods are not affected, as these are determined abroad. This again induces real exchange rate appreciation.

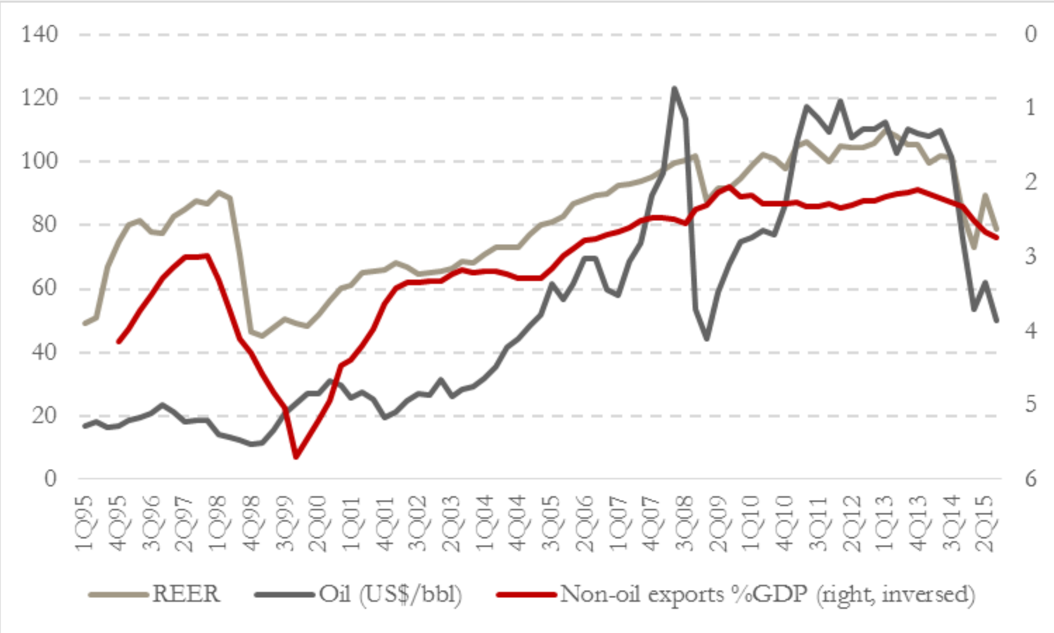
Assuming some labour mobility between manufacturing and services sectors, the spending effect also gives rise to "indirect de-industrialization". If labor is completely immobile, then the supply of services does not change and the only effect of a shift in demand is an increase in the relative price of services. However, if labor is mobile between the manufacturing and service sectors, which is to an extent the case in Russia, then an upward shift in the demand for services will lead to an increase in the supply of services and in the demand for labor in the service sector and thus push up wages in the service sector. This will encourage workers to move from the manufacturing and oil sectors to the service sector, thus forcing manufacturing and oil firms to raise their wages as well. Since they cannot compensate by raising their prices, they will see their profits fall and will need to reduce production and employment. This is referred to by Corden and Neary (1984) as "indirect de-industrialization".

Overall, the Dutch Disease hypothesis generates four predictions. First, the real exchange rate appreciates as the relative price of services increases. Second, there is an unambiguous decline in manufacturing output and employment, reflecting both direct and indirect de-industrialization. Third, the combined effects on output and employment in the oil sector and the service sector are ambiguous, because the spending and resource movement effects pull in opposite directions here. However, if the oil sector employs relatively few workers or if labor mobility is low, as in Russia, the spending effect will dominate the resource movement effect, in which case we would also expect to see an increase in service sector output and employment. Fourth, if labor is mobile, the overall wage level will increase.

3 Real Exchange Rate Analysis

In this section, we test one of the main predictions of the Dutch Disease model, which is that higher oil prices have led to real exchange rate appreciation in Russia. This is not just a prediction of the Dutch Disease model, as any exogenous increase in the terms of trade is expected to bring more foreign currency into the country and therefore is expected to lead to real appreciation, unless it is fully saved or fully sterilized (Chen and Rogoff (2003)). Since Russia is not a member of OPEC we assume that the oil price is essentially exogenous for Russia.

Figure 3.1 Non-oil exports appears to be linked to REER and oil



Sources: IMF, Bloomberg, BIS, CBR

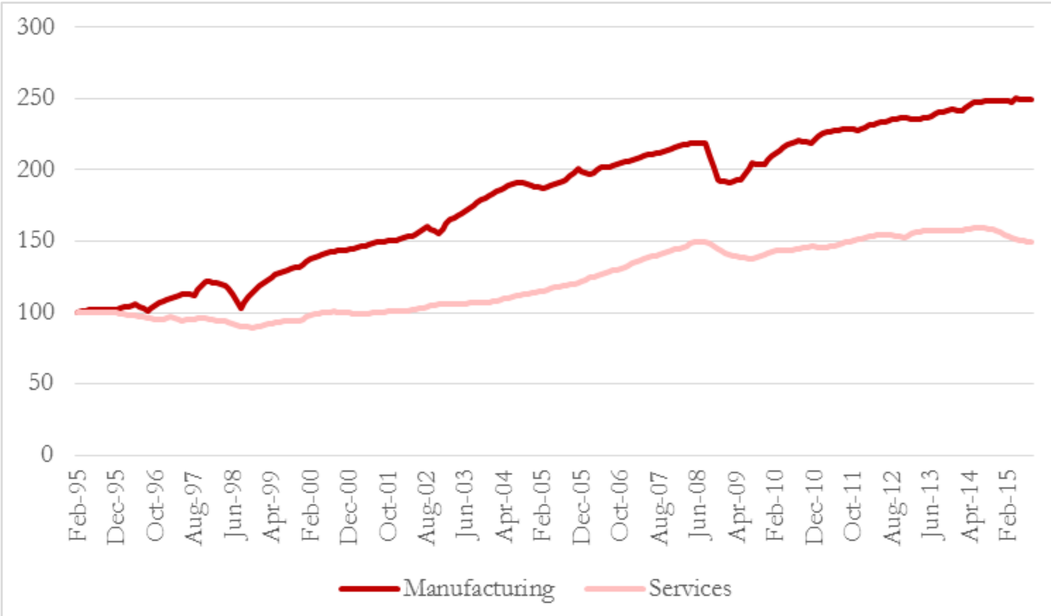
In order to test whether an increase in the oil price leads to real exchange rate appreciation, we use a Behaviour Equilibrium Exchange Rate (BEER) model. This BEER model is commonly used for making equilibrium real exchange rate estimates, and postulates that the real exchange rate should be determined by the changes in the relative prices of traded and not-traded goods which are driven by real variables, like productivity or terms-of-trade shocks (MacDonald 1998).

3.1 Control variables

Following Kalcheva and Oomes (2007), we include primary government spending and the relative productivity differential as our two main control variables in the cointegrating relationship between oil price and real exchange rate. The relative productivity differential is defined as the difference between the relative productivity of tradeables to non-tradeables sectors in Russia and its major trading partner, European Union. Government spending is the ratio of consolidated (central and local government) budget expenditures less debt service, as a share of GDP. All variables are described in Appendix B.

An increase in tradeables (manufacturing) productivity relative to non-tradeables (services) productivity is expected to lead to real exchange rate appreciation, hence we need to control for this factor. This phenomenon is referred to as the Balassa-Samuelson effect and typically occurs as poorer countries catch up with richer countries. Indeed, as Figure 3.1 shows, productivity in Russian manufacturing increased 2.5-fold during the past 20 years, while services sector productivity saw only a 1.5-fold increase. This is likely because Russia was catching up in terms of technological growth and knowledge transfer through FDI, which mostly occurred in manufacturing, while the scope for productivity improvements in the services sector is naturally more limited. This slower productivity growth in the non-tradeables sector then would be expected to lead to an increase in prices for non-tradeables (services) rise relative to prices for tradeables, which leads to real exchange rate appreciation.[3]

Figure 3.2 Russian productivity has grown more rapidly in manufacturing than in services



Sources: Rosstat and authors' calculations.

We also need to control for the rapid increase in government spending over the 2000s, which equally is likely to have contributed to real appreciation. Non-debt-related government spending increased from around 25 percent of GDP in the late 1990s to around 40 percent of GDP by the peak of the recent crisis in 2009. Social spending was a major driver behind this expansion, as pensions and public workers' wages were increased dramatically – in part potentially for election related reasons. Many studies point to a greater consumption-income elasticity for the less well-off people, and this is applicable to Russia. In the mid-1990s, 25 percent of households

[3] Égert (2005) found that productivity growth in industry contributed to real exchange rate appreciation in a panel of transition countries, including Russia. However, he did not calculate tradeables productivity growth relative to nontradeables productivity growth.

were earning less than state-defined minimal subsistence levels, and therefore the increase in pensions and other social benefits is likely to have been mostly spent on consumption. Since there are currently roughly 40 million pensioners out of a total population of 140 million, this is likely to have translated into a significant increase in demand – for both manufacturing goods and services. But since manufacturing prices are to a large extent determined by imports, or limited by import competition, services sector inflation has outpaced manufacturing inflation – which is another important reason for why Russia has witnessed real exchange appreciation.

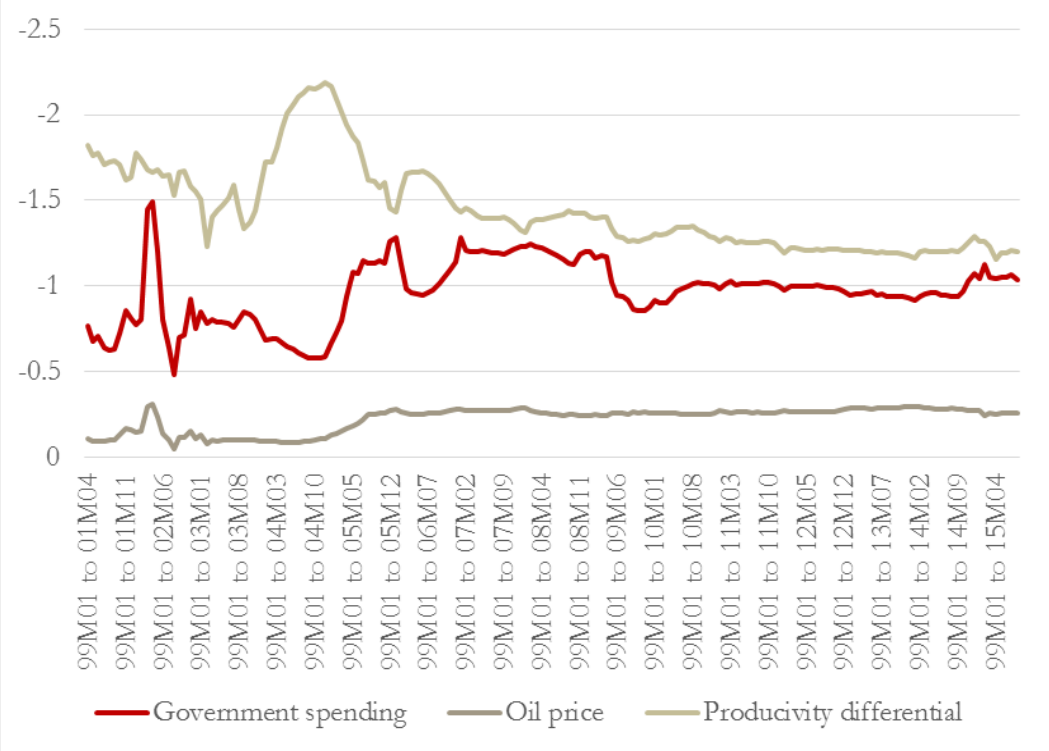
3.2 Cointegration Estimates

Using cointegration techniques, we find evidence of a unique cointegrating relationship between the real effective exchange rate, the oil price, non-debt government spending, and the relative productivity differential. Originally developed by Engle and Granger (1987), the cointegration technique aims at identifying a long-run relationship between a vector of variables, from which short-term deviations are possible but eventually die out. In order for a set of variables to be cointegrated, each variable needs to be nonstationary in levels, or I(1), while a linear combination of these variables (the cointegration relationship) should be stationary or I(0). A typical problem with unit root and cointegration tests is that they both under-reject the null hypothesis, particularly in small samples. Following Richards (1995), we therefore apply small-sample critical values, which are higher than the asymptotic ones (see Appendix B). Even when using these critical values, we find that all variables arecointegrated during the period 1995-2015.[4]

All variables have the expected sign, and are broadly stable for the period after the 1998 crisis. We test for the stability of our coefficients (robustness to changes in sample period) through gradually, month by month, expanding the regression window. This test shows that coefficients estimated using pre-1999 data are not robust, as coefficients can go up or down to unreasonable levels when the window is shifted just by one month. However, when we limit our analysis to the time series starting in January 1999, the stability testing procedure indicates that our coefficient estimates are remarkably robust. In particular, they have not changed significantly since 2009.

4 An exception is the 2004-2006 period when neither of the tests is above its critical value. However, the sample as a whole sample (1999-2015) is cointegrated by any metric.

Figure 3.3 Cointegration vector coefficients (RER coefficient standardised to 1)



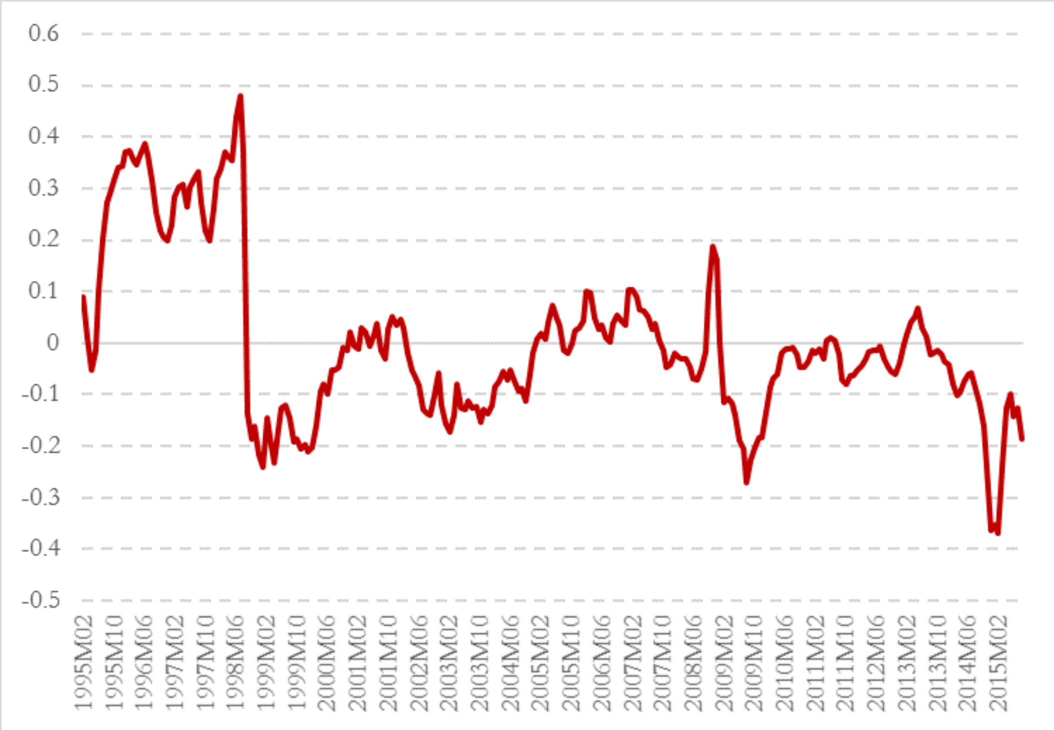
Sources: authors' calculations

The coefficient on the oil price is highly stable at around 0.2, which is somewhat lower than reported previously. A coefficient of 0.2 means that a one percent increase in the oil price leads to a 0.2 percent appreciation of the real exchange rate. Doubling the oil price therefore leads to 20 percent appreciation. This appears more realistic perhaps than the estimate of 0.5 reported by Kalcheva and Oomes (2007). [5]

Our resulting estimates of exchange rate misalignment are intuitive. As Figure 3.3 shows, the estimates suggest that the exchange rate was significantly overvalued prior to the August 1998 currency crisis. The dramatic four-fold rouble depreciation that happened then led to some undershooting, but around 2001 the exchange rate was back into equilibrium. Subsequently, the de facto pegged exchange rate policy led to some renewed overvaluation just before the 2008-9 crisis, and then some undervaluation as a result of overshooting. However, this was quickly corrected for once the regulator introduced more exchange rate flexibility, and the exchange rate was broadly in equilibrium during 2010-2013. Following the rapid drop in oil prices (combined with sanctions and counter-sanctions with the Western countries) in 2014, the rouble became undervalued again [but has more recently returned to equilibrium.]

5 In order to ensure that our lower estimate was not the result of omitted variables or a wrong specification, we tried to replicate the regressions conducted by Kalcheva and Oomes (2007). Firstly, we redefined foreign productivity as an average of US and EU productivity, but this specification produced unstable coefficients when changing the sample period as described above. Secondly, we included reserves as an additional variable, but the coefficient estimate on reserves fluctuated around zero. Finally, we experimented with trend and lag specifications for the cointegrating vector regressions, but they all produced highly unstable coefficients.

Figure 3.4 Estimated real exchange rate misalignment shows intuitive results



Source: Authors' calculations.

Based on out-of-sample projections, we estimate that the rouble will return to equilibrium in 2016 following the recent drop in oil prices to $35 per barrel by end-2015. We project the equilibrium rouble rate at this oil price using the derived coefficients and available data (implicitly assuming that all unavailable data have remained constant). We find that the equilibrium rouble rate at this oil price level is higher than the rouble rate at end-2015 by approximately 10 percent. Given that inflation is expected to stay at or above 10 percent in 2016, the rouble is expected to return to its long-term equilibrium within 2016 provided that there are no further shocks to the oil price or to other variables. (Figure 3.4)

Figure 3.5 The rouble is currently undervalued, but is expected to return to equilibrium in 2016

Sources: Bloomberg and authors' calculations.

3.3 Explaining short-term deviations

Over 2014-2015 Russia was hit by the double effect of precipitously falling oil prices as well as external sanctions. So both capital flight and much lower proceeds from oil exports were the factors behind the sharp depreciation of the rouble. Therefore, **it is interesting to understand whether this recent deviation from the long-term equilibrium level was caused by the sanctions (which are not included into the equation and thus are considered as a temporary phenomenon) or by a larger sensitivity to oil prices**.

While the cointegrating vector indicates the long-run determinants of the real exchange rate, we also want to know what explains short-term movements in the rouble. For this we use a short-term model with three main groups of indicators that can drive the rouble in the short-term:

1. The first group of indicators is related to capital flows of carry traders. Carry traders invest in high-yield currencies while borrowing from low-interest rate countries. Unless a major depreciation is expected, a high-yield country will experience capital inflows.
2. The second group of indicators captures non-carry traders' capital flows, and includes the famous capital flight both by households (e.g. into foreign currency cash) and corporations (e.g. to offshore zones).
3. The third has to do with the rouble supply, which to a large extent is driven by central bank policy.

Within the first group of variables ('carry trade'), we consider interest rate spreads. We focus on spreads, as they better illustrate financial market sentiment, while interest rates per se can reflect many other influences and in fact can be endogenous to the exchange rate. For instance, the central bank can hike interest rates in an event of a devaluation if there are significant financial stability risks. We consider (1) the spread between a 10 year government bond yield and a 1 year government bond yield (maturity premium), and (2) the spread between 1-year interbank market rate and 1-year government bond yield (risk premium charged on non-risk free borrowers).

For the second group of indicators ('capital flight') we consider (1) private sector capital outflows, (2) cash FX withdrawals from FX deposits, and (3) cash FX purchases. In many transition economies dollarisation is a big factor in explaining exchange rate movements. Yet, in the case of Russia cash FX purchase may also capture the overall sentiment towards rouble and therefore serve as a proxy for the variables that would be otherwise hard to find (e.g. the rouble-fear share of private capital outflows).

Finally, in the third group we consider correspondent accounts balances of banks held with the Central Bank of Russia. Unexpectedly high liquidity provision can lead to pressure on the rouble. The list of variables descriptions and sources are given in Appendix B.

Furthermore, we include into the regressions the residual from the cointegration equation. Error correction technique uses short-term deviations from the equilibrium (cointegration) values to predict future movements of the variables. The expected sign by the past deviation from the cointegration relationship is negative, as the gap should be closed to bring the system back to equilibrium.

We find that it takes about 15 months to correct a deviation from the long-term cointegrating vector, suggesting that half of the December 2014 shock was adjusted by August 2015. The coefficient by the error correction term explains how much time it takes on average for the deviation to be corrected. The coefficient is highly significant, and is -0.067, which means it takes 15 months to fully correct a deviation from the long-term average. Using this as a guidance, we estimate that half of the December 2014 depreciation shock was corrected in 7,5 months (i.e. by August 2015 - the "half life"). Interestingly, this is approximately what the residual chart shows.

Table 3.1 Coefficient estimates for the short-term error correction model

Dependent Variable: DLOG(REER)[6]

Method: Least Squares

Sample (adjusted): 2003M01 2015M08

Included observations: 152 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001697	0.004326	-0.392280	0.6954
DLOG(REER(-1))	0.523648	0.073035	7.169817	0.0000
ERROR(-1)	-0.062871	0.022139	-2.839825	0.0052
DLOG(CORRACC/CORRACC(-12))	0.002606	0.009065	0.287413	0.7742
DLOG(CASHOUT/CASHIN)	0.021666	0.007041	3.077280	0.0025
DLOG(DEPOOUT/DEPOIN)	-0.056205	0.017970	-3.127658	0.0021
DLOG(DEPOIN+DE-POOUT+CASHIN+CASHOUT)	-0.021094	0.010289	-2.050190	0.0422
DLOG(BRENT)	0.059533	0.025817	2.305957	0.0226
MIACR_GOV	-0.001330	0.000705	-1.885063	0.0615
10S1S	0.001803	0.001786	1.009773	0.3143
PRIVATECAP-PRIVATECAP(-3)	0.000219	0.000269	0.812467	0.4179

R-squared	0.465669	Mean dependent var	0.000824
Adjusted R-squared	0.427773	S.D. dependent var	0.031574
S.E. of regression	0.023884	Akaike info criterion	-4.561560
Sum squared resid	0.080436	Schwarz criterion	-4.342727
Log likelihood	357.6786	Hannan-Quinn criter.	-4.472663
F-statistic	12.28812	Durbin-Watson stat	1.557360
Prob(F-statistic)	0.000000		

Sources: authors' calculations

We find that for short-term dynamics capital outflow variables are the most significant. The increase in FX cash withdrawal from deposits and in overall turnover of cash foreign currency is associated with depreciation of rouble. Interestingly, higher cash FX turnover caused by all operations including purchases, sales, deposits, and withdrawals, happens at a time of depreciation, which is an indicator of 'flight to safety' using cash dollars. At the same time, cash FX purchases generally coincide with the periods of rouble appreciation, highlighting the speculative nature of such transactions. Distress in financial markets captured by the spread between interbank market rate and a short-term government bond yield leads to rouble depreciation, as expected. Private capital outflow turned out to be insignificant probably due to the fact that the data is available only at a quarterly basis.

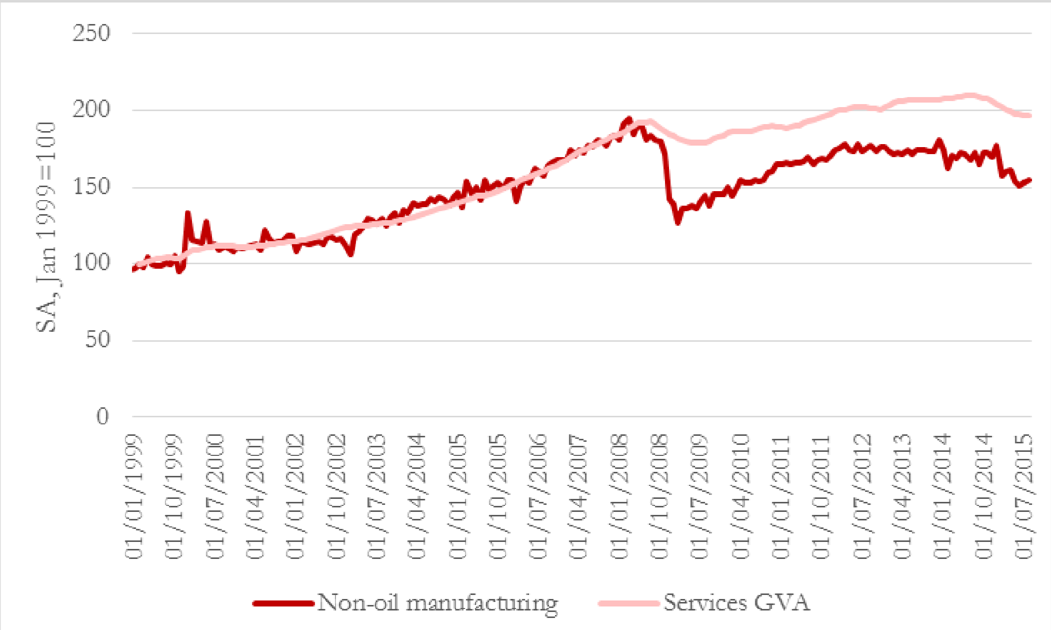
6 *REER* is real effective exchange rate; *ERROR* is the residual from cointegration vector; *CORRACC* is the amount held at correspondent accounts with Bank of Russia; *CASHOUT* is cash FX purchase; CASHIN is cash FX sale; *DEPOOUT* is FX withdrawal from deposits; *DEPOIN* is FX deposited; *BRENT* is Brent oil price; *MIACR_GOV* is spread between interbank market rate and 1-year government bond yield; 10s1s is the spread between 10 and 1 year government bond yields; *PRIVATECAP* is capital flows. A more detailed description of the variables is available in Appendix B.

4 De-industrialisation in Russia

The second Dutch Disease symptom we aim to test for is de-industrialization, i.e., a relative decline of the manufacturing sector. The previous section already established that rising oil prices give rise to real exchange rate appreciation. As domestic currency becomes more expensive, tradable goods become less competitive and therefore are priced out of the market. This is why we expect (both direct and indirect) de-industrialization.

Non-oil manufacturing sector growth has indeed sharply fallen behind services sector growth since 2008. While manufacturing growth remained in line with services sector growth during 1999-2008, it started clearly falling behind services sector growth particularly since the 2008-9 crisis when it experience a major drop. While manufacturing sector output started increasing again from 2009, it remained broadly flat during the past few years and has clearly remained below that of the services sector.

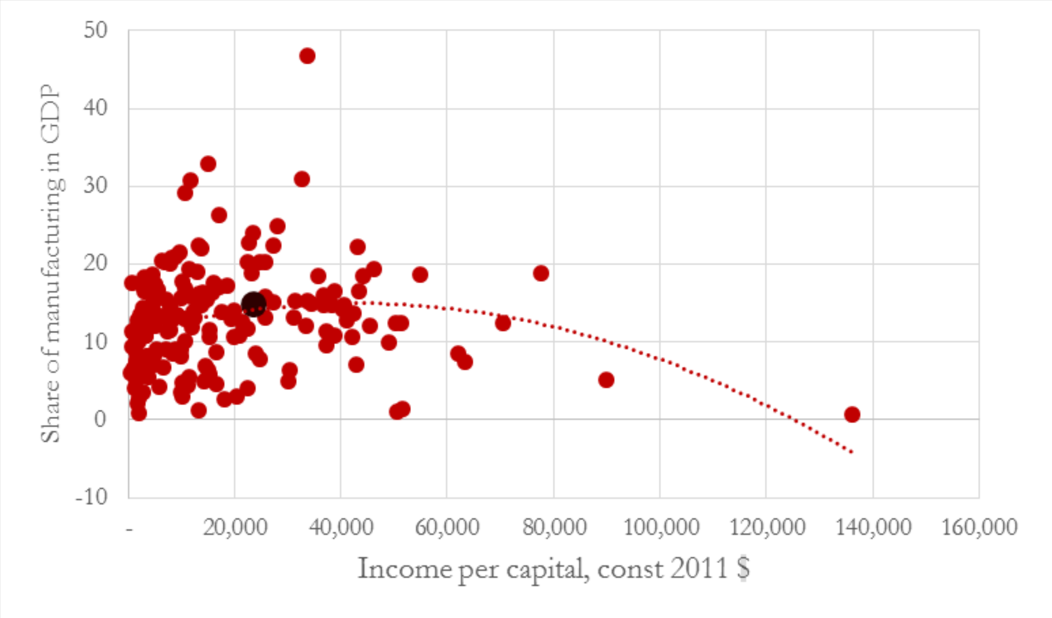
Figure 4.1 Manufacturing sector growth has significantly lagged behind services sector growth



Sources: Rosstat and authors' calculations.

The manufacturing share in Russia has declined as income increased. According to de-industrialization theory, the expected relationship between a country's income per capita and its share of manufacturing has an inverse-U shape (Rodrik 2015). While in 2004 Russia was above the inverse-U line for the cross-country comparison with 17.4 percent of manufacturing in GDP, by 2013 it moved down to settle on the line and 14.8 percent. However, Russia is still located on the increasing segment of the inverse-U. (Figure 4.1)

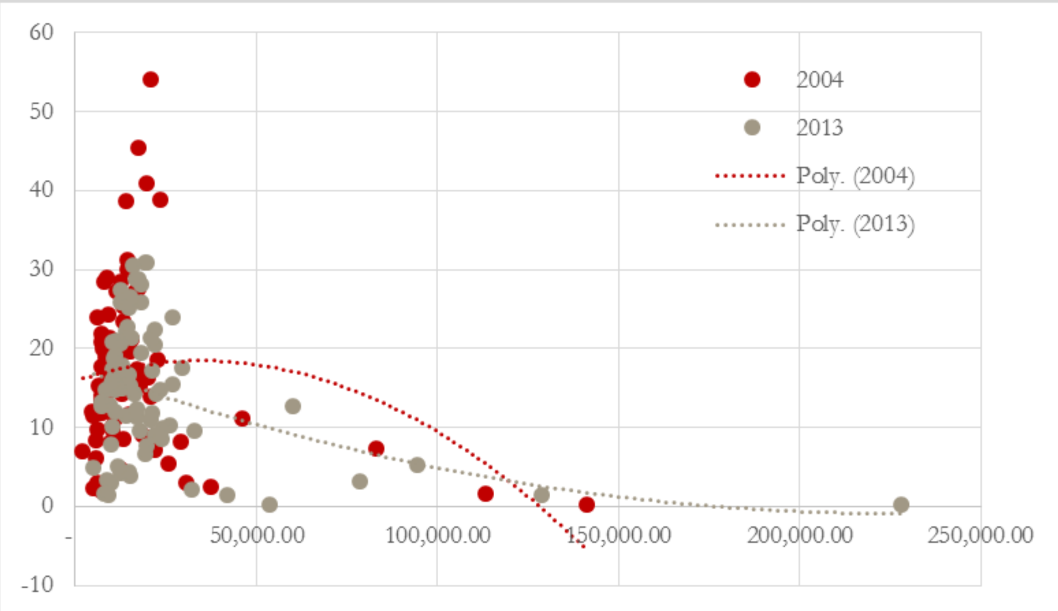
Figure 4.2 Global de-industrialisation (Russia highlighted)



Sources: Rosstat and authors' calculations.

Regional-level data show a different picture (Figure 4.2)**.** Interestingly, most of the 40 percent increase in per capita income was due to the rapid growth in the income of oil-dependent regions. At the same time, most of the manufacturing share decline happened in poorer regions that have not significantly increased their welfare as a group. There also appeared a negative (as opposed to inverse-U-shaped) relationship between income and manufacturing share.

Figure 4.3 Russian regions: from inverse-U to purely negative relationship



Sources: Rosstat and authors' calculations.

The fact that the manufacturing share of GDP has fallen is by itself not yet evidence of a Dutch-disease driven process of de-industrialization. There are many other reasons why de-industrialization may have taken place in a transition economy like Russia. First, it is likely that various types of manufacturing had previously experienced unnaturally high growth rates given the focus on manufacturing during Soviet times, and subsequently had to be downsized once exposed to capitalist pressures. Second, it is natural for a rapidly growing economy to experience rapid services sector growth that take up manufacturing share. Third, as the Russian economy was accelerating during the 2000s, Russia significantly improved its sovereign ratings which supported private foreign borrowing and stimulated manufacturing growth.

In order to control for other factors that may have influenced manufacturing growth, we analyze the relationship between manufacturing growth and the oil price for 77 Russian regions.[7] First, we explicitly allow for the fact that manufacturing growth in Russia has been a function of a number of factors besides the oil price ("oil"), that are hard to observe or quantify:

$$MANU_{RU,t} = a + b_1 * Z_t + b_2 * oil_t + e_t, \tag{1}$$

where $MANU_{RU}$ is manufacturing growth in Russia, and Z is the set of all (unobserved) non-oil factors that affect manufacturing growth. Next, we assume that each individual Russian region i has been exposed in a similar way to these unobserved factors and the oil price. Here we make a simplistic assumption that coefficient c_{1i} is a multiple λ_i of coefficients b_1:

$$MANU_{i,t} = a_i + c_{1i} * Z_t + c_{2i} * oil_t + e_{i,t}, with\ c_{1i} = \lambda_i * b_1. \tag{2}$$

Given these assumptions we then run the following regression:

$$MANU_{i,t} = a_i + c_{1i} * MANU_{RU,t} + d_{2i} * oil_t + e_{i,t}. \tag{3}$$

In this way, the coefficient $c1i$ can be considered as a proxy for all unobserved variables that influenced manufacturing growth in Russia. We also add a trend, a trend squared, and a seasonal dummy for January, since manufacturing appears to be particularly volatile in that month of the year (possibly due to variations in the number of holidays in January).

Based on our regional regressions, we find evidence that manufacturing growth is significantly lower for oil-dependent regions. Figure 4.3 shows the estimated coefficients c_{1i} as a function of the share of fuel production in GDP (where fuel production is defined as the share of mining and quarrying in GDP multiplied by the weight of fuels in mining and quarrying sector of industrial production[8]). This relationship is clearly negative, i.e. Russian regions with a higher dependence on oil experience lower manufacturing growth. This finding holds regardless of whether we exclude oil processing[9] from the definition of manufacturing. However, the coefficient on oil price does not appear to differ significantly across regions and therefore does not appear to be a function of the share of oil in GDP.

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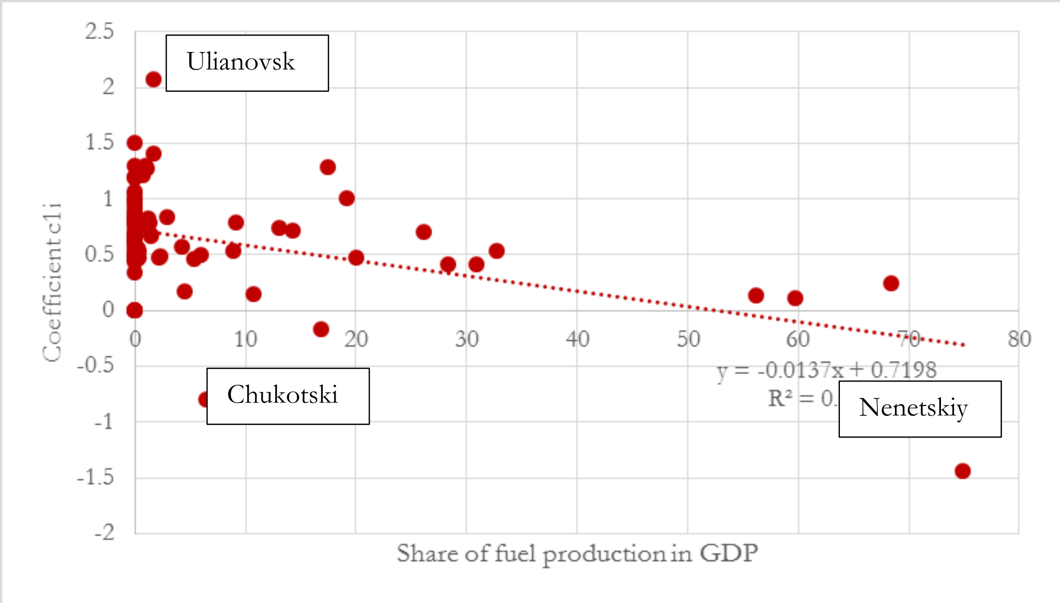
7 The number of regions we analyzed is less than the total 85 due to data availability.
8 In Russian classification, share of sub-sector CA in sector C
9 Su-sector DF 'Oil processing'

Figure 4.4 Sensitivity to Russian manufacturing growth and share of fuel production in GDP



Sources: Rosstat and authors' calculations.

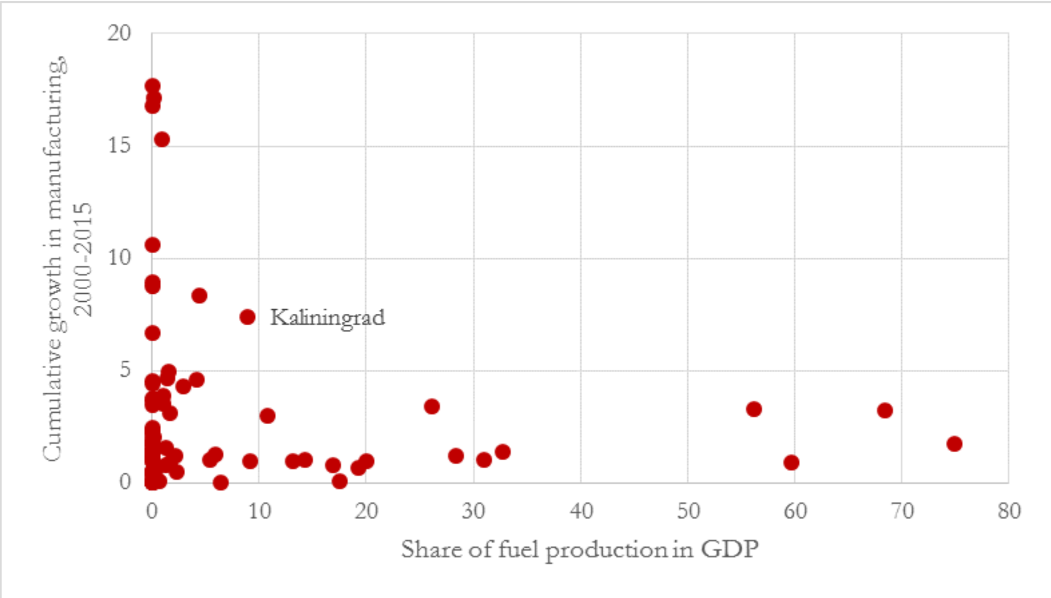
There are several outliers that warrant separate discussion. While some outliers may bias our result in one direction, other outliers may bias our results in another direction. Nevertheless, we find that the negative relationship between oil dependency and manufacturing growth still holds even after excluding these outliers.

- The first is the Chukotski autonomous region, which has a low coefficient c_{1i} (and therefore lower than average manufacturing growth) despite its limited exposure to oil. This can likely be explained by the fact that Chukotski is the leading producer of gold and silver in Russia. Therefore, while we focused our analysis on oil-induced Dutch diseased, there is arguable a negative effect from other minerals.
- The second outlier is the Nenetskiy region, a highly oil-oriented region where manufacturing has declined 100-fold. Nenetskiy region is also the least populated district in Russia, with 45 thousand inhabitants. These two factors explain the extreme sensitivity.
- Finally, Ulianovsk region has a very low dependency on oil but is showing a high rate of manufacturing growth compared to Russia overall. This is likely the case because Ulianovsk experience high growth in machine- and aircraft-building industries, in part because of a favourable business environment, as was documented in EBRD's Business Environment and Enterprise Performance Survey where Uyanovsk was the top performer (EBRD 2012).

We do not find a negative relationship between oil processing and non-oil manufacturing growth. Since oil-processing regions tend to be different than oil-producing regions, there may be some negative effects on these regions as well. However, we find that only oil-producing regions appear to be experiencing significant de-industrialization.

The negative relationship is even clearer when looking at cumulative manufacturing growth. As Figure 4.4 shows, there is a distinctive separation among cumulative manufacturing growth in oil and non-oil regions. Regions with oil dependency (share of oil mining in GDP) of less than 5 percent clearly experience much more significant manfacturing growth than regions with oil dependency of more than 5 percent. Yet, the intra-regional variation is so high that it is barely possible to calculate a reliable t-statistics.

Figure 4.5 Higher manufacturing growth appears to have happened only in non-oil regions



Sources: Rosstat and authors' calculations.

In order to assess the extent to which Dutch Disease has affected overall manufacturing growth in Russia, we aim to answer the counterfactual question of what growth in oil-dependent regions would have been had there been no Dutch Disease. We do this by first running the following simultaneous equation model. For each region we run equation (3) and for oil regions we set the coefficient c_{1i} to 1 and set the seasonal coefficient to 0 because it increases volatility. Simultaneously, however, we run the following equation for Russia overall, using 2004 weights:

$$MANU_{RU} = SUM\ (w_i * MANU_i) + \mathrm{e} \qquad (4)$$

where w_i is the weight of region i as defined by the 2004[10] share of its manufacturing GVA in overall Russian manufacturing GVA.

For the counterfactual scenario, we make the following assumptions:

- We define oil-dependent regions as those regions where oil production exceeds 10 percent.[11]
- For the counterfactual scenario we assume $b4=1$, which is roughly the average rate for regions without oil.
- We assume the weights w_i to be stable over time

Under these assumptions, we find that, in the absence of Dutch Disease effects, manufacturing output in Russia during the period 2000-2015 would have increased 3.4-fold instead

[10] 2004 is the earliest year for which data on the detailed break-down of GDP are available.
[11] 10 percent is where the drop-off in manufacturing is happening (see Figure XX)

of 2.2-fold. The result is significant despite the fact that most oil-dependent regions have low weights in Russian manufacturing.

Table 4.1 De-industrialisation estimates

Growth, base case	2.23
Growth, modified case	3.38
Monthly s.d. of the difference	0.0055
s.d. for the whole period (s.d. * sqrt(num.observations))	0.0779
t-statistic	14.82
p-value	0.000

Sources: authors' calculations

5 Services Sector Boom

In this section, we test the third and fourth symptoms of Dutch Disease, i.e., wage growth and services sector growth. Wage growth and services sector growth are unambigious predictions generated by both the resource movement effect and the spending effect discussed in section [2]. However, there are many reasons apart from high oil prices why wages and the services sector may have grown. We therefore focus on the extent to which differences in oil dependency can explain differences in wage growth and services sector growth between Russian regions. Like in the previous section, the advantage of this methodology is that, in this way, one can correct for other factors that have generated wage growth and services sector growth that are relatively constant between regions – such as those factors related to the general catching-up process of a transition economy.

To the extent that oil revenues accrue and are spent at least in part in the region where they are earned, we expect to see more Dutch Disease symptoms in more oil-dependent regions. While oil is largely taxed by the federal government, rather than at the regional level, oil taxes are essentially proportionate to oil prices. As a result, oil companies still see their revenues, profits and wages rise when oil prices rise. This then creates resource movement and spending effects, causing regional real appreciation, regional wage growth, and labour movements withing regions from manufacturing to services and oil.

Since labour is not fully mobile across Russian regions, we expect to see higher wage growth in more oil-dependent regions. If labour were to be fully mobile between Russian regions, we would not see significant wage differences between regions. However, regional labour mobility in Russia remains relatively low, partly because of housing market and residency restrictions (Kwon and Spilimbergo, 2005). Significant regional wage differences for similar jobs can therefore persist.

For the same reason, we also expect to see higher nontradables prices relative to tradables prices (i.e., a higher "regional real exchange rate") and higher services sector growth in regions with higher oil dependency. Markets for tradable goods tend to be more mobile and more competitive than labour markets, hence price differences for tradables are less likely to persist than wage differences. However, price differences for nontradables (services) are likely to be large and persistent because markets for services (such as construction, home repair, babysitting, cleaning) are very similar to labour markets. And if services prices are higher in more oil-dependent regions, we also expect services sector growth to be higher in such regions.

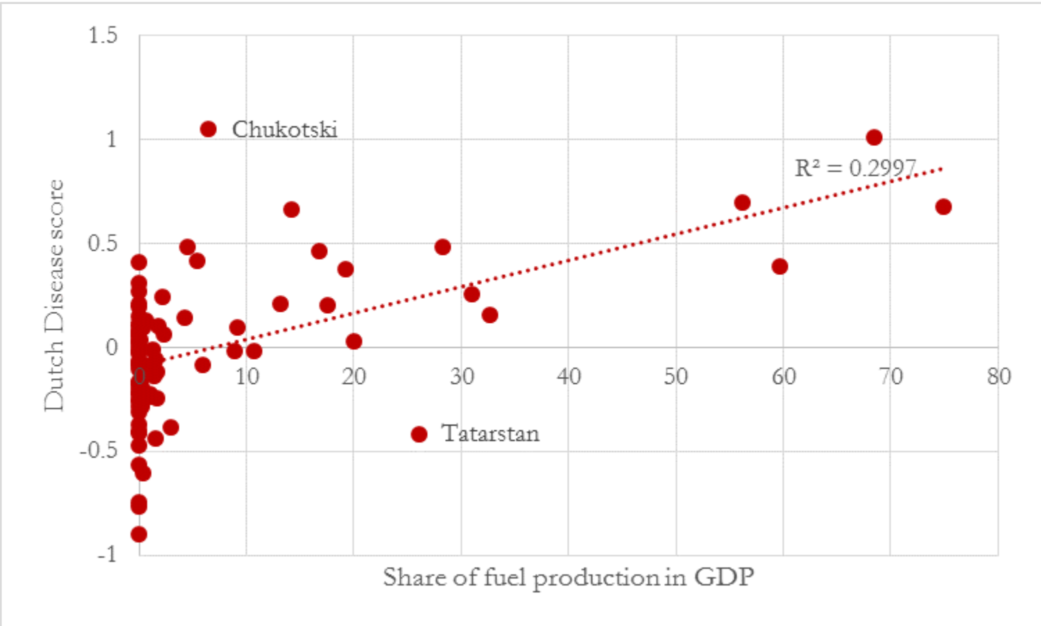
In order to test these hypotheses, we develop a "Dutch disease scorecard" for each region. A region gets a higher Dutch Disease score based on its (1) services sector wage growth, (2) services price growth (both absolute and relative to the overall CPI)[12], (3) services sector employment, and (4) services sector growth (as a share of regional GDP). For each region we calculate deviation of

12 It is important to bear in mind that more than 20 percent of services inflation is accounted for by government-set utilities tariff indexation. This can dampen the regional variation.

the indicator *i* from the non-oil regional average,[13] and divide it by overall cross-section deviation, i.e. standardize the deviation. After that, the average of the standardized deviations is taken.As before, growth rates are taken over 2000-2014 (maximal available time-span for this data). For our definition of services, we exclude transportation and financial services.[14] For other definitions, see Appendix B.

We find, as expected, that regions that are more dependent on oil have a higher Dutch disease score. As in the previous section, we define the level of "oil dependency" by the share of fuel minerals extraction in GDP. The hypothesis is strongly supported by the data. As Figure 4.5 shows, a higher share of oil in GDP is generally associated with a higher Dutch disease score. An important outlier is the republic of Tatarstan, which had lower labour migration to services, and Chukotski region that has higher score possibly due to its specialization in metal production. Component charts and statistics tables are available in [Appendix C], and it may be seen that the primary drivers behind the score are services employment and wages.

Figure 5.1 Estimated Dutch Disease Score by share of fuel in GDP



Sources: Rosstat, authors' calculations

[13] With less than 20 percent of oil in GDP.

[14] The reason for leaving out transportation is that it is a high-capital intensity sector that is oriented towards industry – including to the oil and gas sector - and that is less responsive to higher personal consumer demand. The reason for leaving out financial services is that it is mostly concentrated in Moscow and is influenced by many complex factors; therefore, it is not a representative services sector.

6 Conclusions

This paper finds that Russia exhibits the main Dutch Disease symptoms and that oil-dependent Russian regions are more prone to these Dutch Disease symptoms.

Our equilibrium exchange rate estimates, based on cointegration analysis, suggest that changes in the oil price have a strong and robust effect on the Russian real exchange rate. We find evidence of a strong long-run relationship between the real exchange rate and oil price even after controlling for other determinants (government spending and relative productivity differential). Our estimates suggest that a 10 percent increase in the oil price leads to a 2 percent appreciation of the real exchange rate. This result is robust to various stability tests. We also find that it takes about 15 months to correct a deviation from the long-term cointegrating vector.

Our regional regressions show that more oil-dependent Russian regions are more prone to Dutch Disease. In particular, we find that, the higher the share of oil in regional GDP, the more resources are allocated to the services sector, the higher (services) inflation and wage growth, and the lower manufacturing growth in the region.

Our findings suggest that the recent dramatic drop in the oil price will lead to corresponding ruble depreciation but is unlikely to bring back manufacturing growth and employment. Our error correction model suggests that half of the December 2014 depreciation shock was adjusted by August 2015 and that the full shock will be adjusted for by March 2016. However, de-industrialization (combined with learning-by-doing effects) implies that it will be very difficult to bring back the manufacturing sector now that the oil sector has stopped being the motor of the economy.

We have several policy recommendations to help fight Dutch Disease. First, it will be important to maintain a flexible exchange rate in order to avoid persistent undervaluation or overvaluation. Second, the Russian government should reintroduce its countercyclical fiscal rule for saving and spending out of oil stabilization funds in order to ensure medium-term fiscal sustainability.[15] Third, the government should continue to press ahead with its business environment reforms to support diversification of the economy (particularly: simplifying regulation, improving competition, reducing skills mismatches, and phasing out excessive state intervention in the economy.)

15 While Russia has had oil stabilisation funds in place, apparently taxation has not been high enough. For example, Norway not only taxes oil extraction, but also charges much higher rates on oil companies' earnings. This is likely to have reduced Dutch Disease symptoms in Norway.

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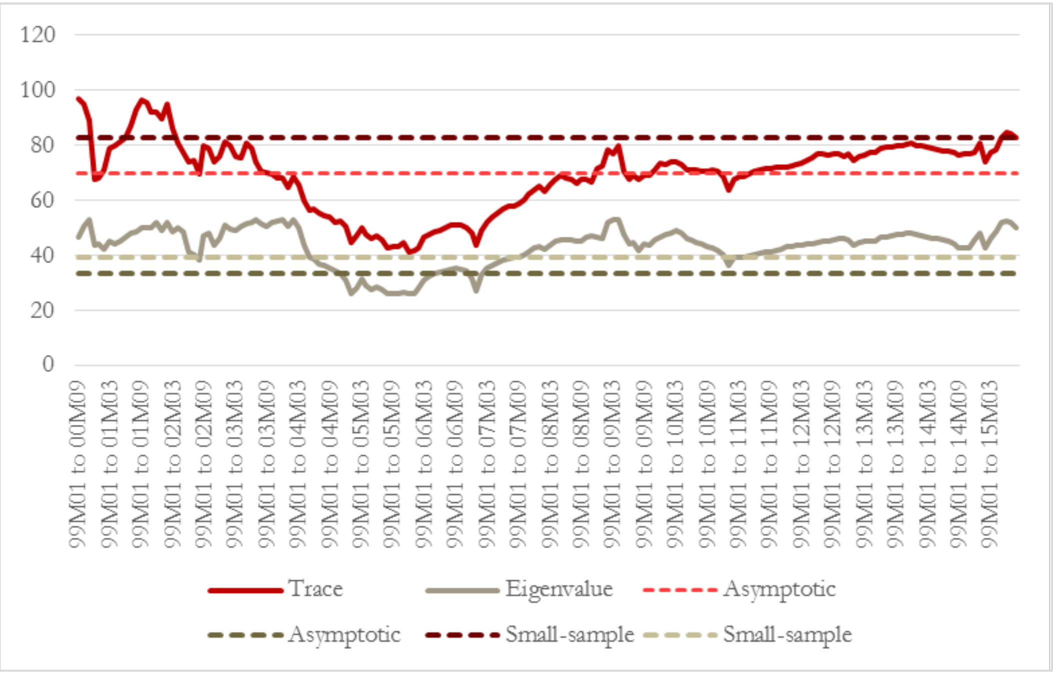
Appendix A Small-sample adjusment

Table A. 1 Five percent critical values for cointegration tests (Richards, 1995)

		Asymptotic		Small-sample	
Number of lags in VAR	Null hypothesis	Trace statistic	Maximal eigenvalue	Trace statistic	Maximal eigenvalue
	r = 0	69.98	33.26	82.70	39.31
j = 2	r ≤ 1	48.42	27.34	57.22	32.31
	r ≤ 2	31.26	21.28	36.94	25.15
	r ≤ 3	17.84	14.60	21.09	17.25
	r ≤ 4	8.08	8.08	9.55	9.55

Sources: Richards (1995)

Figure A. 1 Derived statistics and their critical values



* Critical values are 82.70 for the Trace statistic and 39.31 for Eigenvalue statistic.
Sources: authors' calculations

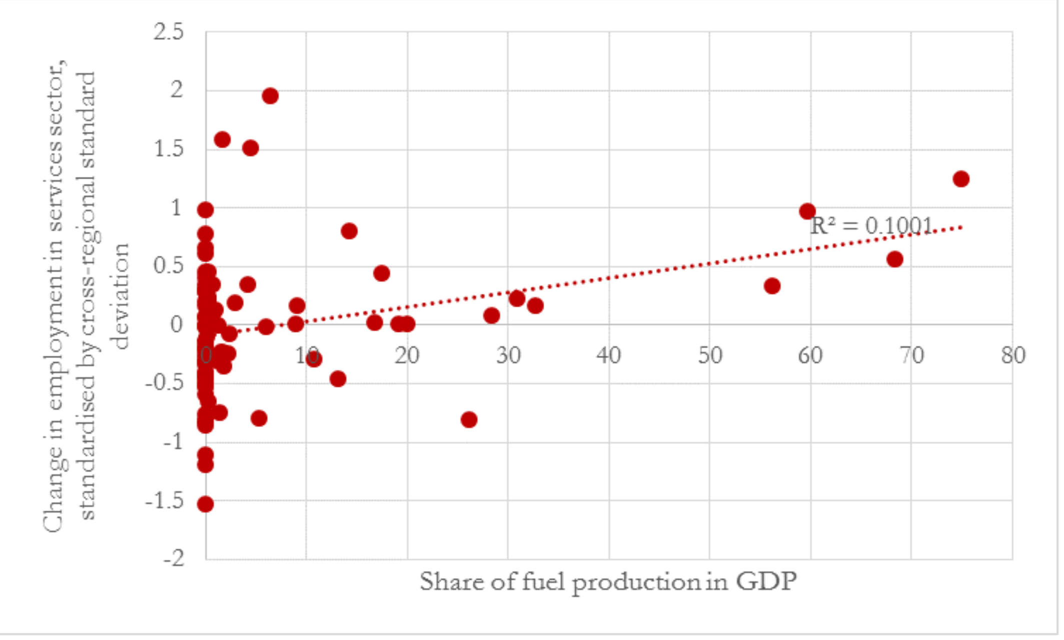
Appendix B Data Sources

Table B. 1 Estimated real exchange rate misalignment shows intuitive results

Series	Source	Notes
REER	BIS	Period used or available: 1995M01 : 2015M09
Oil price (BRENT)	Brent oil price from Bloomberg, average for month derived from daily prices	Period used or available: 1995M01 : 2015M12
Government spending in percent of GDP	MinFin, Roskazna, Rosstat	Spending is smoothed using Hodrick-Prescott filter as variability does not always follow a seasonal pattern to allow applying a seasonal-adjustment procedure. Period used or available: 1995M01 : 2015M08.
Russian productivity differential	Rosstat	Services and manufacturing output is the gross value added, available quarterly, intrapolated and seasonally smoothed. The data on workers in large corporations with the break-down by sectors is available monthly. This is then multiplied by the ratio of all workers in the economy to all workers in large corporations and seasonally adjusted. Period used or available: 1995M01 : 2015M08.
Foreign productivity differential	Eurostat and Bureau of Labor Statistics	Period used or available: 1995M01 : 2015M08.
Correspondent accounts held by banks with Bank of Russia (CORRACC)	Central Bank of Russia	Period used or available: 1998M12 : 2015M08.
Cash FX purchases (CASHOUT)	Central Bank of Russia	Period used or available: 2000M01 : 2015M08.
Cash FX sales (CASHIN)	Central Bank of Russia	Period used or available: 2000M01 : 2015M08.
Cash FX withdrawals from deposits (DEPOOUT)	Central Bank of Russia	Period used or available: 2000M01 : 2015M08.
Cash FX deposited on accounts with banks (DEPOIN)	Central Bank of Russia	Period used or available: 2000M01 : 2015M08.
MIACR	Central Bank of Russia	Period used or available: 2003M01 : 2015M09.
Government bond yield	Central Bank of Russia	Period used or available: 2003M01 : 2015M09.
Private capital flows (PRIVATECAP)	Central Bank of Russia	Period used or available: 2000M01 : 2015M09.

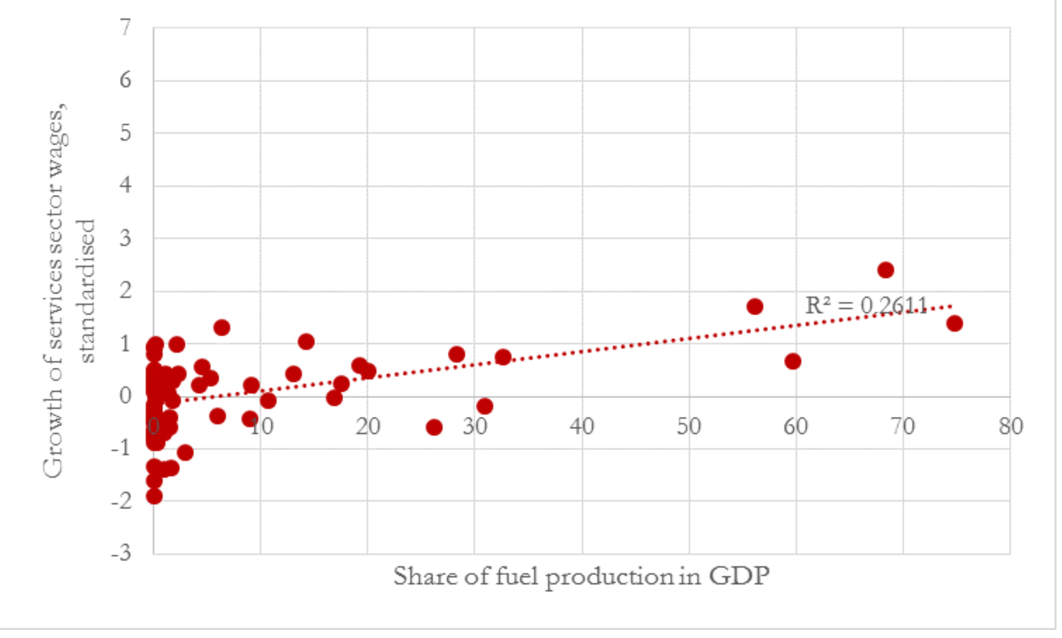
Appendix C Dutch disease scorecard

Figure C. 1 Change in services sector employment to overall employment change and share of fuel production in GDP



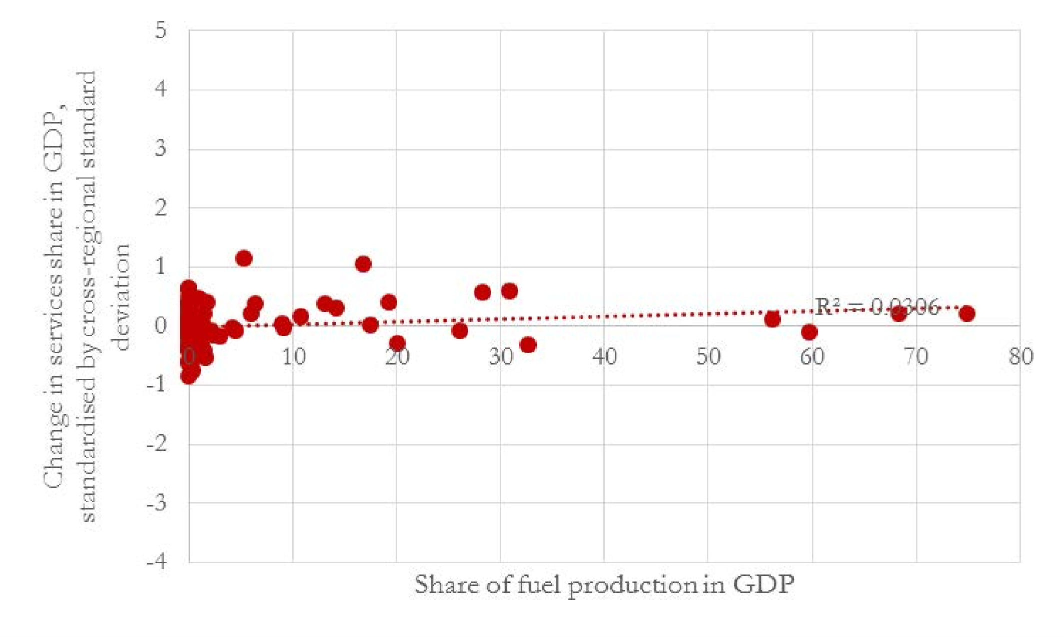
Sources: Rossat, authors' calculations

Figure C. 2 Growth in wages within services' sector and share of fuel production in GDP



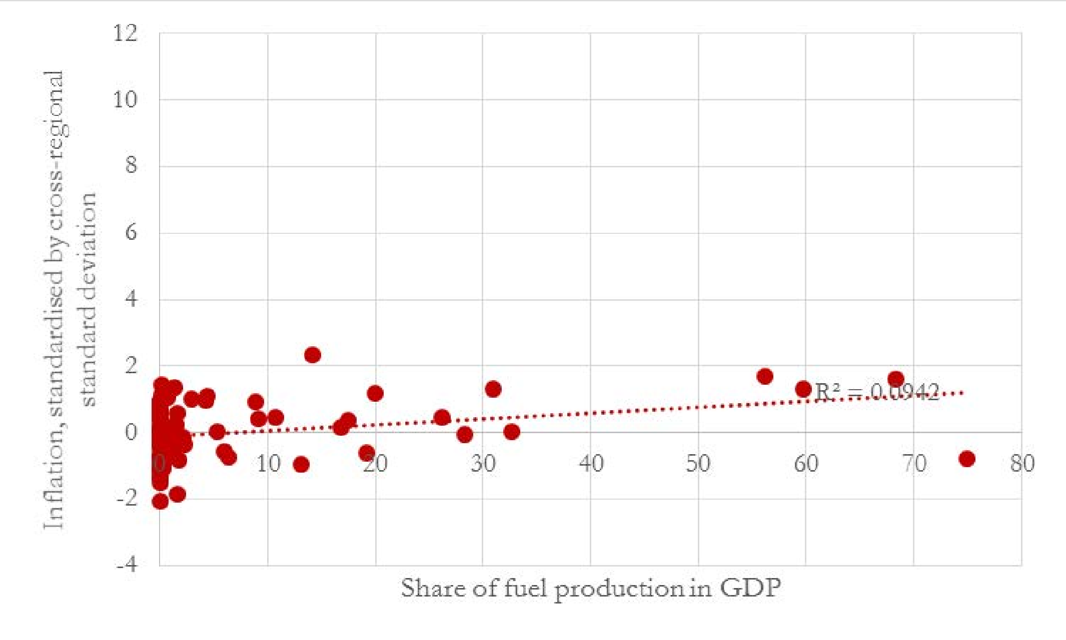
Sources: Rossat, authors' calculations

Figure C. 3 Change in services' share in GDP and fuel share in GDP



Sources: Rossat, authors' calculations

Figure C. 4 Inflation and fuel share in GDP



Sources: Rossat, authors' calculations

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