
The resource curse and human capital

Having confronted the neo-classical growth model with the data on the Russian regions, we now have to focus on the main issue for the Russian economy - the resource curse. The reason why the blessing with the natural resources may turn into a curse is extremely hard to capture with econometric techniques. Thus, we have to analyze the data on industrial structure and examine different causes of the resource curse. We will try to grasp the consequences of the resource curse in Russia with a special focus on the brain-drain problem. The resource curse is often associated with a lower demand for human capital - we will try to check this using the wage distribution. Afterwards we will model the hazardous impact of the resource curse on human capital with the help of game-theoretic approach. Since human capital proxy was relatively robust in some specification in the OLS growth regressions, we consider the human capital to be one of the most crucial, and yet, very vulnerable (e.g. because of the brain-drain), determinants of growth.

2.1 The resource curse: the Dutch disease and institutions

As in De Rosa and Iootty (2012, pp. 2-3) Russia is often considered a country experiencing a resource curse phenomenon (also known as the paradox of plenty). Let us focus more on this aspect and show how the resource abundance may impact on growth, institutions, and human capital. As stated in Leite and Weidmann (1999, p. 21) an abundance of natural resources in frames of the neoclassical growth model can be interpreted as a "positive technology shock", turning natural resources into a long-run positive determinant of economic growth. Leite and Weidmann (1999, p. 21)

note at least two reasons which can turn the blessing into a curse: direct (Dutch disease) and indirect (institutions). Thus we will consider two main approaches to the given problem: the Dutch disease (related to changes in production structure and human capital) and institutions (rent-seeking behaviour). We will finalize the part on the resource curse with a game-theoretic illustration of the brain-drain problem.

Since Sachs and Warner (1995), the problem of economic growth under resource abundance has been widely discussed and researched. The hypothesis that countries experiencing abundance of natural resources would have lower economic growth rates than countries poor in such resources may at first glance appear confusing: in the 1960s after the work of Habakkuk (1962), it was believed that natural resource endowments act as catalyzers for economic growth. In addition, a trivial Ricardian comparative advantage logic, as in Costinot and Donaldson (2012), would lead us to a conclusion that countries specialize their production and trade structure according to their factor productivities and thus resource-abundant countries would tend to specialize in raw materials, whereas countries poor in resources, would specialize in other industries, for example manufacturing. In terms of the well-established Heckscher-Ohlin trade model, the resource curse can be associated with the Dutch disease described as follows: according to Rybczynski (1955, pp. 340-341) an increase in a certain factor endowment would lead to an increase in the output of corresponding goods. For example, an increase in natural resource endowments would cause the production of primary goods to increase, whereas the production of manufactured goods would fall, other things equal.

As it follows from the Table 7, the specialization is far more complicated. Some of the dominant oil producers, like the Netherlands, the US, Norway and Canada, have an extremely large share of high-tech exports in their total manufactured exports. While the US practically refrains from exporting fuels, using it instead for domestic economy, Norway and Canada have substantial exports of carbon fuels. Obviously, the resource abundance does not completely govern the specialization and economic development. Nevertheless, from Table 7 we see that the abundance of natural resources can also be related to lower shares of high-tech exports: obviously Kuwait, Saudi Arabia, Algeria and Nigeria are far better examples of raw material specialization. It may appear striking, but Kazakhstan has a higher share of fuel exports than Russia, and in addition a higher share of high-tech goods in manufactured exports. One should note that the issue of trade and production specialization is more complex than the simple Ricardian thinking. This table helps us to compare the export profile of Russia with the profiles of other oil and gas exporters: clearly, fuels are dominating in the export structure, whereas the high-tech share of the manufactured exports is rela-

tively modest.

Let us focus on the issue of the resource curse and its impact on economic growth. It will be also important to consider the influence of the given phenomenon on institutions and human capital. As in Sachs and Warner (1997), it is empirically shown that countries with high raw resource intensities experience slower growth rates. Moreover, according to Sala-i-Martin (1997, pp. 181-182), proxies for resource abundance such as a high share of primary exports, are highly robust and as a variable in empirical models have a negative impact on growth. A few of the most quoted proxies of the resource curse are the following: indirect proxies, such as the share of raw resources in exports (or in GDP) as in Sachs and Warner (2001) and direct proxies, such as mining and reserve quantities of resources as in Sala-i-Martin and Subramanian (2013) or natural capital, for example land area as in Canuto and Cavallari (2012). In our growth regression we have applied quantities of oil and gas extraction per capita as a proxy for the carbon-based resource abundance. For the Russian regions we did not find a significant impact of this variable on growth rates between 1995 and 2007. Canuto and Cavallari (2012) suggest a methodology of evaluation of the natural capital levels, and also stress the fact that different countries may potentially reach the same income level, albeit by different means: taking advantage of the rich resource endowments or inducing technological progress. A most preferable result would be a mixture of both and minimization of the share of the natural capital in the overall wealth per capita. One should note that the negative correlation between growth rates and resource abundance has an endogenous nature: obviously, oil and gas reserves alone would not be the main reason for economic backwardness and the main question here would be why the blessing turns into a curse for some countries?

Let us examine the conventional Dutch disease explanation of the nature of the resource curse phenomenon and explain how the resource abundance shaped economic developments in Russia after year 2000.

The data prior to 2005 on the industry structure were disaggregated and are incompatible with the data after 2005 due to differences in industry composition in the Goskomstat reports. Nevertheless, even if we consider the data for 2000-2004, we find that the share of extracted resources to the total is relatively stable and the relation is on average 78% for manufactured to 22% for extracted resources. The argument of a price-induced resource curse has very weak empirical evidence for Russia, at least with reference to the time span of 2000-2011. A similar method was applied in Eberhardt and Teal (2013) who traced the structural change and shifts of the economies from an agricultural sector to other sectors in dynamics. In the case of structural change towards the resource sector, as Sachs and Warner (2001) would predict, we should have observed the rising share of the extraction sector

Table 7. Specialization in fuels and high-tech goods

Oil/Gas producers	2005	
	Share of high-tech goods in manufactured exports (%)	Share of fuels in merchandise exports (%)
Algeria	1.484	98.027
Angola*	no data	no data
Azerbaijan	1.0564	76.764
Canada	13.084	21.61
Iran	2.4871	82.611
Iraq	no data	96.445
Kazakhstan	11.291	70.618
Kuwait	0.1167†	94.599
Netherlands	30.89	7.3541
Nigeria	1.7†	97.896
Norway	16.094	67.686
Russian Federation	8.4375	61.774
Saudi Arabia	0.6689	90.936
United Arab Emirates	1.8715	57.791
United States	29.902	3.2743
Venezuela, RB	2.302	87.958

Data: top-15 oil producers according to the CIA Factbook, World Bank.

*Although Angola is one of the major oil producers,
the exact data for recent periods were not available

† value for the last available period

Table 8. Sectoral structural change

Year	Production output	
	Manufactured (%)	Extracted (%)
2005	77.52	22.47
2006	78.2	21.8
2007	78.22	21.77
2008	78.664	21.33
2009	77.35	22.65
2010	78.35	21.6
2011	77.09	22.91

Data: Goskomstat, "Russian Industry", 2012

and shrinkage of manufacturing, which is clearly not the case. Nevertheless, a structural change can be detected in many dimensions. Let us examine the manufacturing sector alone, as in the Table 9.

When considering the structure of the manufacturing sector, we observe a clear positive trend in the share of the carbon derivative production sub-sector: from 2005 to 2011, even despite the global financial crisis and the consequent decrease in oil prices, the carbon derivative sub-sector grew from 16.2% to 19.9%.

Proposition 11. *In Russia the resource abundance is mainly characterized by the sub-sector shifts of manufacturing towards increasing the output of carbon derivatives; whereas the overall proportions of manufacturing to extraction are relatively stable.*

Table 9. Sub-sectoral structural change

Year	Manufacturing output Carbon derivatives (%)
2005	16.208
2006	17.899
2007	16.29
2008	17.694
2009	18.548
2010	18.62
2011	19.924

Data: Goskomstat, "Russian Industry", 2012

The importance of a sub-sector structural change is not often highlighted by authors; however, the sub-sector structural change and growth of the carbon derivative production sub-sector within the manufacturing sector in Russia is obvious. Thus, we state the presence of the sub-sector structural change in manufacturing, driven by the resource abundance, particularly in carbon resources. It is noteworthy that the structural change in economies of countries with resource abundance is rarely studied in the economic literature. Considering the economic nature of the resource curse, let us focus on the labour market.

Bearing in mind the above-mentioned sub-sector structural change, let us consider Sachs and Warner (2001) from a different angle: the Russian labour market and the potential impact of the resource abundance on human capital. The chart above indicates the relation of an industry-specific average wage to an overall average monthly wage of approximately 710 USD¹¹ in

¹¹ With the exchange rate of 31 RUB per 1 USD, as taken from the website of the Central Bank of Russia, www.cbr.ru

2010. An additional piece of information is required: in 2010, around 15.6% of employed population were working in the sphere of education, 12.8% were employed in the sphere of health-care and 3.1% were employed in hospital-ity services¹². That makes 31.5% of the employed population receiving less than 0.75 of the average wage. According to press release N2297 of the WCIOM, approximately 27% of respondents in Russia in 2012 were not satisfied with their present job. In addition, 35% of the respondents in 2012 explicitly mentioned that they receive a low wage and were considering a job change¹³. The social attitudes confirm the presence of wage disparities. In contrast to education (0.67 of the average wage), resource extraction (2.21 of the average wage) and carbon derivative manufacturing (1.98 of the average wage) are sectors with much higher wages. It is interesting to note that only 0.9% of the employed population works in the resource extraction sector and enjoy wages twice higher than the average wage and three times higher than the average wage in education.

Proposition 12. *According to the sector-related wage distribution, in 2010, the highest wage premium over the average wage was observed in financial services, resource extraction and manufacturing of carbon derivatives, whereas the wages in education were only 0.67 of the average.*

We do not fully possess the data for a substantial cross-country comparison; however, in 2006, in Germany the average monthly wage was around 2 544 EUR, whereas the wage of different categories of researchers in education was between 3 233 and 3 699 EUR which is around 1.4 higher than the average¹⁴.

In Russia the wage in education was only 0.67 of the average wage in 2010 and Figure 7 points out to other sharp contrasts. To be more precise, the average wage in education is 3.29 times lower than the average wage in resource extraction, according to the data of 2010. Such a premium over the average wage would not result in an immediate change of qualification. However, production factors would flow to industries with higher returns, and in this case, it is logical to assume that labour would flow to a sector with a higher wage. One should acknowledge that it is quite problematic for professors employed in education or research (both are considered to

¹² Goskomstat, "Russian annual statistics", 2012, section 5.5

¹³ WCIOM press release 2297.

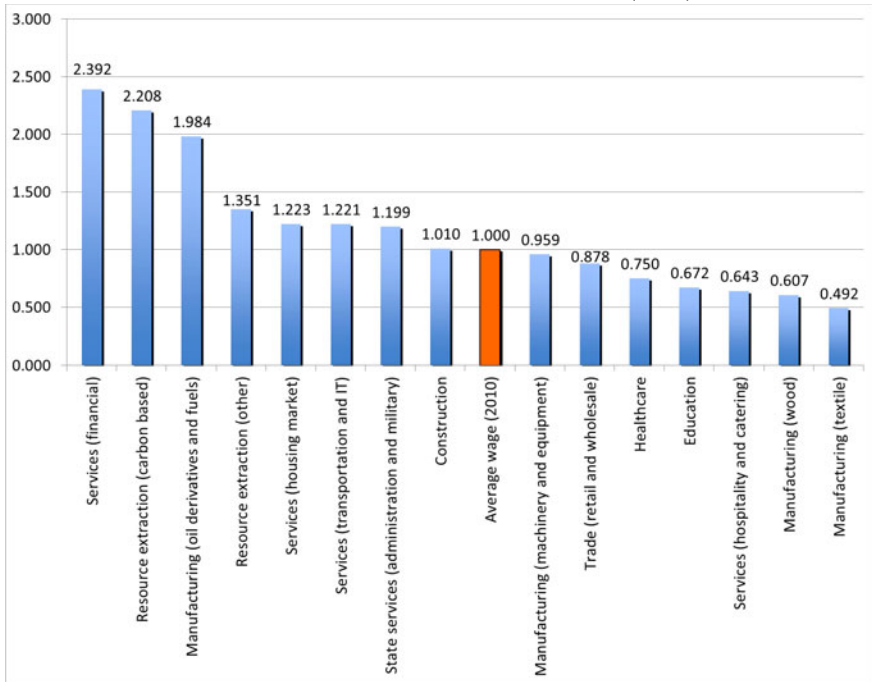
Available at: <http://wciom.ru/index.php?id=459uid=114058>

¹⁴ According to: Verdienststrukturhebung - durchschnittliche Bruttojahres-/Bruttomonatsverdienste der Arbeitnehmer/-innen nach ausgewählten Berufen.

Available at:

<https://www.destatis.de/DE/Publikationen/Thematisch/VerdiensteArbeitskosten/>

Fig. 7. Sector-related wage distribution (2010)



Data: Goskomstat

be identical in the Goskomstat database) to start working on an oil pump. Thus, those employed in education must consider other opportunities and at best, avoid changes in qualification. The labour market wage disparities are one of the reasons for the brain-drain, or the outflow of researchers from Russia to other countries. Let us consider the quantitative dynamics of the number of researchers related to oil price dynamics regarding two countries. For this consideration we have selected Germany since, as in Gathmann and Koch (2013)¹⁵, 896 researchers from Russia were employed in Germany in 2010. Thus, Russians represent the majority of foreign researchers employed in Germany, at least for the year 2010. Keeping this fact in mind, we are able to only partly capture the scale of the brain-drain from Russia.

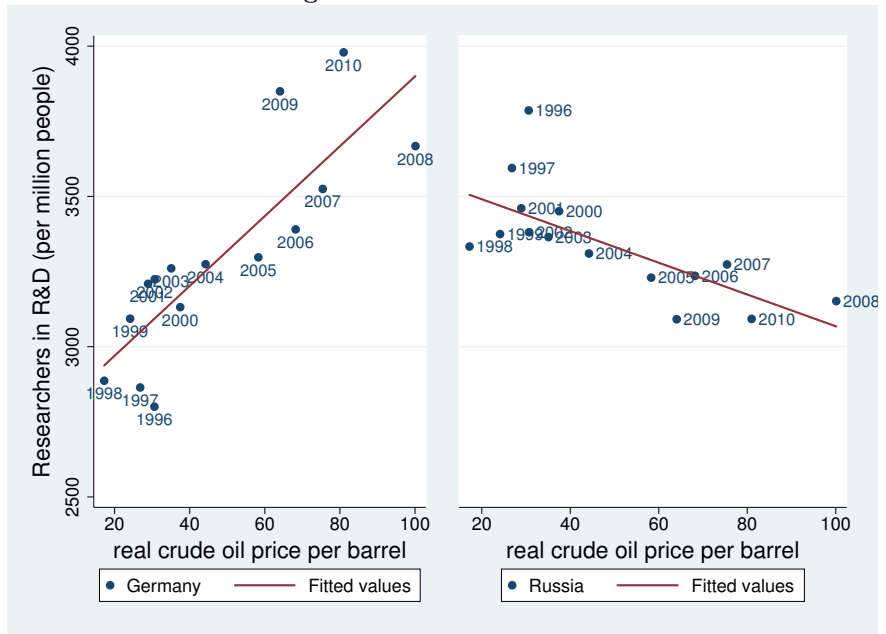
On the scatterplot below we observe an intriguing stylized fact: in Russia the number of researchers decreases; whereas in Germany it is the opposite. This observation is even more intriguing if we consider the dynamics of

¹⁵ We have used the printed version of the article, a shorter version without tables is available online:

<http://www.duz.de/duz-magazin/2013/02/auf-rubel-komm-raus/167>

the oil prices. One could assume that the oil prices would simply represent the time dimension; however, there may be another explanation. One hypothetical reason for such developments is that in Russia, due to resource abundance, technology and energy-saving technology in particular has a lower priority, whereas in Germany, due to an absence of the resource abundance, technology and energy-saving technology in particular would have a higher priority.

Fig. 8. Brain-drain as a trend



Data: World Bank, InflationData.com

Proposition 13. *In Russia the number of researchers has been steadily decreasing.*

This does not imply the reverse, and does not imply that there is a linear causal relation. One should regard this as a stylized fact since the oil prices can simply represent the flow of time. Nevertheless, we will try to expand on the above-mentioned explanation. It is possible that due to cost-saving behaviour, German entities may conduct more research, for example, of energy-saving technologies, whereas in Russia such research may be relevant only in the distant future, when the once abundant natural resources

are exhausted. The movement of human capital would be in accord with the demand for research or the demand for this type of capital. Even though we refer to the cost-driven research explanation of the brain-drain, the resource curse, to our mind, is an integral element of these developments. Thus, for Russia, we establish that the resource abundance is one of the major causes of the labour market disparities and the brain-drain of human capital. The question as to why certain countries experience brain-drain and other countries brain-gain, or accumulate human capital, may be answered in a more detailed way, but this lies beyond the scope of our research.

One can find the link between the resource endowment and human capital in Wood and Berge (1997). The authors present a Heckscher-Ohlin skill-and-land-only model (see Wood and Berge, 1997, pp. 36-38) where land represents the natural resource. The authors empirically show that countries with high skill/resource ratio would tend towards specializing in manufactured goods, whereas countries with a low ratio would tend to export primary goods. In other words, according to the latter authors human capital relation to natural resource endowment governs the export composition and thus the trade specialization. Wood and Berge (1997, p. 35) assume that the manufacturing sector creates additional production and human capital related externalities which, according to the authors, contribute to economic growth. Auty (1998, p. 20) quotes research suggesting that it is not only the supply of human capital which should be analyzed, but rather the demand for human capital, which is determined by the production structure. The production-determined demand for human capital would also dictate a certain price, or return to human capital in a particular economy, which perhaps would be lower in the case of resource curse.

Proposition 14. *The resource curse may be associated with a lower demand for human capital (see Auty, 1998; Wood and Berge, 1997).*

Gylfason (2001, p. 16) discusses whether resource abundance is associated with lower investments, schooling, trade and higher corruption, which represents the mainstream conclusions, repeated by many, while some authors assume the contrary and claim that the resource curse is in fact a blessing: Cavalcanti et al. (2009, p. 20) take advantage of the panel of 53 and 27 years and find that the effect of oil abundance on real income is significantly positive. Cavalcanti et al. (2009, p. 9) explain the negative coefficient received by other researchers by an omitted variable bias and methodological aspects. After accounting for unobserved common shocks and common correlated effects they claim to receive a positive coefficient on oil abundance.

So far we have investigated the economic aspects of the resource curse. But some authors, including De Rosa and Iootty (2012, pp. 3-8), claim

that resource abundance may impact on institutions and governance. The complexity of this interaction is related to the latent nature of institutions and institutional quality, which is difficult to measure accurately. Leite and Weidmann (1999) focus on the emergence of a rent-seeking behaviour in resource abundant countries. The authors refer to Romer (1994a, pp. 23-25) where, using the "Dupuit's equilibrium", a clear-cut comparison of corruption with an informal "bridge-crossing" fee is made. Needless to say, both are considered as trade restrictions, severely damaging the domestic welfare. Romer (1994a) argues that such trade restrictions hinder economic growth. Consequently, Leite and Weidmann (1999, p. 5) suggest a deeper understanding of the institutional aspects of the resource curse: resource abundance stimulates rent-seeking behaviour, which in turn increases corruption. The latter hinders economic growth and investments, and functions as an additional tax levied on firms and their profits. However, corruption is more distortionary and costly than taxation, as presented in Shleifer and Vishny (1993, p. 614). Another logical explanation of the institutional aspect of the resource curse is that rent-seeking behaviour opposes entrepreneurship or productive activities, as can be found in Torvik (2002).

Proposition 15. *Resource abundance may promote rent-seeking behaviour and corruption as well as other inefficient institutions (see De Rosa and Iooty, 2012; Leite and Weidmann, 1999).*

One has to note that the resource abundance may not necessarily promote the rent-seeking behaviour. Each country has an institutional matrix, which has been shaped by a certain historical path. This is also applied to Russia as stated in Hedlund (2005, p. 15), where "kormlenie"¹⁶ is mentioned as a legally defined mean of sustaining civil servants and militia at the cost of local population. In 15th century Russia this method was widespread and regional authorities were entitled to "feed" from the local population without any limits, as in Hedlund (2005, p. 15). Therefore, the rent-seeking behaviour may already be integrated in the institutional matrix and discovery of oil or gas would only stimulate the existing inefficient institution of rent-seeking.

We now have a better understanding that the resource curse may have a negative impact on growth not only due to the structural change, labour market disparities and a lowering human capital demand, but also due to a lowering institutional quality and increasing corruption, driven by the rent-seeking behaviour. Needless to say, as in Mo (2001, p. 76), corruption reduces economic growth. In meta-analysis, as in Ugur and Dasgupta (2011, p. 30), the negative impact of corruption on growth is highlighted consistently.

¹⁶ In Russian: feeding or nourishing.

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