The Effect of Oil on Regional Growth in Russia and the US:

A Comparative Analysis

by

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Abstract

Using comparable 2002-2011 data, we examine the effect of oil on growth of Russia’s regions and American states. Although Russia’s oil regions are richer than other regions, they did not grow faster, while US oil producers grew faster than other states. We attribute these differences to different taxation systems in Russia and the US, with Russian central government taxing away a larger share of incremental oil rents in the 2000s than did its US counterpart. Also, although oil rents attracted labor to oil-producing regions both in Russia and US, only in the US oil rents led to higher investment growth.

Keywords: regional growth, oil rents, taxation of oil
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1. Introduction

The effect of oil abundance on economic growth has received considerable attention in economics and political science literature over the last 20 years.\(^1\) This effect is often referred to as the “oil curse” hypothesis – the claim that oil wealth reduces long-run economic growth, at least in the developing world. Most of the literature examining the effect of oil on growth is based on country-level comparisons, presumably because of better data availability and because some of the transmission mechanisms such as the Dutch Disease or the effect of oil on institutional quality can be most readily analyzed at the country level.

Country-level analysis might be problematic, however, because of significant differences across countries differ along many dimensions such as history, culture, geography, institutional quality and macroeconomic policies, and some of those dimensions are likely to be endogenous with growth rates. This is a particularly serious problem in cross-sectional analysis. Panel data analysis can take account of the time-invariant differences among countries, but time-varying hard-to-measure or endogenous factors such as macroeconomic policies may still render country-level analysis problematic.

In order to alleviate the problems, a few recent papers have tested the oil curse hypothesis using regional-level data.\(^2\) Regional level analysis offers some advantages, because even in large
countries differences among regions in history, culture, and institutions, not to mention the 
effects of macroeconomic policies, are usually not nearly as great as differences among 
countries. However, regional analysis of the oil curse hypothesis also presents significant 
pitfalls. Because factors are typically much more mobile across regions than across country 
borders, regions are likely to experience economic and institutional convergence, putting 
downward pressure on both positive and negative effects of oil abundance. Moreover, we will 
argue that at least in some countries another potentially important source of downward bias of 
the estimates of these effects based on regional data is the extraction of regional resource 
rents by the national government and mining companies. The main goal of this paper is to 
illustrate the latter argument using comparative regional-level analysis of the effects of oil 
wealth in Russia and in the US.

More specifically, we use comparable measures for 2002-2011 to examine the effect of oil 
abundance on the economic growth of Russia’s regions and American states. We demonstrate 
that despite the apparently large positive impact of oil wealth on Russia’s growth during the 
2000s, its oil-rich regions did not grow faster than other regions. In fact, there is some 
evidence that Russia’s oil-producing regions grew slightly slower than the rest of the country. 
By contrast, the US oil producers grew slightly faster than the other states. We argue that one 
plausible source of these differences is very different systems of taxation of oil extraction in 
Russia and in the US. We also find that unlike in the US, Russia’s oil-rich regions have 
significantly higher per capita gross regional products (GRP) and higher wages. This evidence is 
consistent with lower factor mobility in Russia as well as with the view that although the federal 
center taxed away (or oil/gas firms channeled away) the incremental rents in 2000s, the pre-
2000 rents have so far remained in the regions. Finally, we show that although oil rents play a role in attracting labor to oil-producing regions both in Russia and in the US, only in the US oil rents growth is associated with higher investment growth than in non-oil-producing regions. This is again consistent with the thesis that during 2000s the overwhelming share of Russia’s oil rents went to the federal government. Moreover, this evidence argues against the possibility that oil rents were shifted away from the regions by the oil companies, because if oil corporations were getting a large share of the oil rents in 2000s, they would have had strong incentives to invest more as oil prices increased.

To the best of our knowledge, this paper represents the first attempt in the literature to conduct a comparative study of the effects of natural resource wealth on economic growth at the regional level. Our other contributions include the use of more recent data than all but one other regionally-focused papers for either Russia or the US, and the use of panel-data analysis that was absent in the US-oriented papers and was rarely used in the studies of the resource curse for Russia. In addition, we present a discussion of some important measurement and specification issues that we hope will be helpful to other researchers working in this field.

Most of the work on the natural resource impact on Russia’s regions uses the data for 1990s or the early 2000s. The only exception is Alexeev and Chernyavskiy (2014) who use the data for the same period of time as the present study. However, Alexeev and Chernyavskiy focus exclusively on Russia and rely on resource wealth measures (mineral tax collections in regions) that cannot be used for comparative purposes. Libman (2013) uses the 2000-2006 data, but he also studies only Russia’s regions. Moreover, the use of 2000-2006 period is problematic, because of a substantial change in Russia’s system of oil taxation effective in 2002. In fact, our
choice of the time period is motivated mainly by the relatively stable institutional environment, particularly the tax system, in Russia.  

Most of regionally-focused papers use cross-sectional estimation approach, either exclusively or predominantly, instead of panel regression analysis.  Although cross-sectional analysis has its place, the ability of panel regressions to account for time-invariant effects and, in the case of system-GMM, incorporate dynamic effects and alleviate potential endogeneity problems make them an important tool in the analysis of economic growth.

In the next section, we briefly review the royalty and taxation systems for oil producers in Russia and in the US. Section 3 discusses some important specification and data issues. Estimation results are presented and interpreted in Section 4. Brief concluding remarks are made in Section 5.

2. Royalty and Taxation of Oil in Russia and in the US

Because we argue that at least in part the differential impact of oil abundance on regional growth in Russia and the US is due to the different taxation and royalty systems, it is important to describe the main elements of these systems in the respective countries.

2.1 Taxation of oil in Russia

Revenues derived from oil represent a large share of Russia’s federal budget. These revenues derive mostly from three sources: the tax on the extraction of natural resources or mineral tax (NDPI in Russian abbreviation), the export fee, and the regular profits tax. Mineral tax on oil was collected at the rate of 16.5 % during 2002-2005, but during 2006-2008 it was assessed
according to the following formula (tax base: quantity in the pipeline): \( RUB 419 \times K \) per ton, where 
\[
K = (USD \text{ Price of Urals/barrel} - 9) \times E / 261 \quad \text{and} \quad E = USD/RUB \text{ exchange rate}.
\]

In 2009, “9” in parentheses was replaced with “15”. Tax holidays and depletion factor were added for some oil fields in 2007.

The upper limit on the export fee was set according to the following rule:

\[
\begin{array}{|c|c|}
\hline
\text{Urals Price in USD/barrel (P)} & \text{Tax in USD/ton} \\
\hline
\text{Less than 15} & 0 \\
\text{15 – 20} & 0.35 \times (P - 15) \times 7.3 \\
\text{20 – 25} & 12.78 + 0.45 \times (P - 20) \times 7.3 \\
\text{Greater than 25} & 29.2 + 0.65 \times (P - 25) \times 7.3 \\
\hline
\end{array}
\]

The combined marginal rate of the mineral tax and the export fee at $100/bl price is about 80%. If we include the profits tax, the average government share of net present value (NPV) of oil extraction projects according to Alexeev and Conrad’s (2009) simulations is close to 85%, which is the highest in the world outside of the countries with direct government ownership of the entire oil extraction industry. The overwhelming majority of this revenue accrues to the federal budget. In 2002-2003 the revenue from the mineral tax was split 80/20 between, respectively, the federal and regional governments (when the region contained no okrugs) but since then the federal
share has been increasing and by 2010 the federal government was receiving 100% of all mineral tax revenue (see Table 1). And, of course, the export fee has always gone entirely to the federal government. Although the regions receive most of the profits tax, the oil companies appear to be able to shift at least some of the profits tax to their headquarters mostly located in Moscow, which is one of the reasons why we exclude Moscow region from our data.

<< Table 1 here >>

2.2. US oil taxation

In the US, the royalty belongs to the land owner, whether it is the government or a private entity. The federal royalty for offshore oil (all of which is the property of the federal government) is 18.75% of gross wellhead value. For onshore oil the royalty is negotiated with the owners and is typically in the range of 12.5%-30%. In addition, some states impose severance taxes, which are usually less than 5%. And, of course, the oil companies pay corporate income tax. According to Alexeev and Conrad (2009), the US government share of NPV for federally-owned oil deposits is generally between 60% and 70%. Royalties from oil located on state-owned land accrue to the states in their entirety. Private owner of oil deposits pay only severance taxes to their states. Income taxes from oil extraction accrue to federal and state governments at their usual rates.

The discussion in this section demonstrates clearly that the share of federal government in oil rents is substantially smaller in the US than in Russia.
3. Data and Specifications Issues

The typical cross-sectional and panel specifications in the regional studies of the effect of natural resources on economic growth are, respectively, as follows:

\[ GRP_i = \alpha \times Resource_i + \beta X_i + \epsilon_i \]  
\[ GRP_{it} = \alpha \times Resource_{it} + \beta X_{it} + r_t + \gamma t + \epsilon_{it} \]  

where the dependent variable is either GRP growth rate or GRP itself (or per capita GRP), \( Resource \) is a measure of natural resource abundance, \( X \) is a vector of controls, \( r \) and \( \gamma \) are, respectively, regional and time fixed effects, \( i \) indexes regions, \( t \) is a year index, and \( \epsilon \) is the error term. Sometimes interaction terms between the resource measure and one of the “controls” are added in order to test for the transmission mechanism.6

There are several important issues that warrant discussion with respect to both the data and the specifications. We begin with the dependent variable based on GRP. Some authors use growth rate of GRP while others use (per capita) GRP itself.7 Alexeev and Conrad (2009) argued that per capita output (GDP in their case) would be an appropriate dependent variable in a cross-sectional regression aimed at estimating the effect of natural resources on long-term growth. In general coefficient \( \alpha \) in equation (1) reflects the change in GRP when we compare regions with different resource endowments, i.e., the comparison is across space. The only way to estimate the impact of resources on medium-term growth of a given region in a cross-sectional regression is to use GRP growth rate as a dependent variable. In contrast, a fixed-effects panel regression (2) with logarithm of GRP as a dependent variable estimates the effect
of changing resource abundance (also in logarithms) on GRP of a given region over time (or more precisely, it estimates the average such effect for all regions in the panel). In other words, when we use logarithm of GRP as a dependent variable in (2), we actually estimate

\[ \frac{\partial \text{GRP}}{\partial \text{Resource}} \] or elasticity of GRP with respect to Resources over time. When we use GRP growth rate in (2), we estimate the impact of Resources on growth rate over time. This measure is more difficult to interpret. Because of this, we prefer using GRP itself as a dependent variable, but in the end the appropriate choice of the dependent variable depends on the purpose of the study.

Another issue with the dependent variable in (1) and (2) is whether to use “physical volume” GRP or GRP deflated by the countrywide price index. The former uses base year prices of every component of GRP in any given year. The latter takes nominal GRP in year \( t \) and divides it by the price index. These two indices could produce very different results for oil-rich regions if the price of oil changes much more than the overall price index. Depending on the researcher’s purpose one or the other index may be appropriate, but when oil prices increase faster than the other prices, deflated GRP would put oil producing regions in a more favorable light.

With respect to measures of oil abundance, either shares in GRP or per capita measures can be used. The former reflects the importance of oil to the economy, but it can produce misleading results, because the share of the oil sector in GRP might be large simply because GRP is small for reasons unrelated to oil. Also, in time series or panel regressions, GRP growth coincident with unchanged oil sector output would increase the dependent variable while reducing the resource measure producing a negative \( \alpha \), which would be a misleading outcome. On the other
hand, the shortcoming of the per capita oil measure is that the same amount of oil obviously might reflect very different importance of oil to the regional economy, depending on how large the non-oil GRP is. In addition, having per capita oil output on the right hand side of the regression results in regressing GRP on its part. Our preference is to use both measures while keeping in mind their respective drawbacks.

Some researchers use oil abundance measures expressed in physical output terms that are unrelated to oil prices (e.g., Zuo and Schieffer, 2014). This approach may be acceptable in cross-sectional analysis, because all countries or regions face the same world prices. However, it is not appropriate in panel regressions, because most of the transmission mechanisms for the oil curse hypothesis rely on the effect of oil rents, and these rents obviously change with oil price changes.

Oil abundance is usually measured via some indicator based on oil output. There is a possibility that oil output in a given year would be endogenous with GRP. For this reason, researchers sometimes use oil output in the first year of the period under study or the average oil output over the period. This approach addresses the endogeneity problem and as we will see later the problem of missing data, but it exacerbates the measurement error problem.

Typical growth regressions include factors of production (capital and labor), “initial period” or lagged output, and perhaps other variables such as institutional quality. The inclusion of such controls or conditioning variables in regressions (1) and (2) is problematic, because these conditioning variables are often themselves affected by oil abundance. For example, Alexeev and Conrad (2009) showed that “initial” GDP is significantly higher in oil producers than in
otherwise comparable countries with no oil. Therefore, the inclusion of initial GDP on the right hand side incorporates some of the impact of oil on the dependent variable and may radically alter the coefficient of the oil abundance measure in the regression. Similar effects can take place when other conditioning variables are included. If investment is influenced by oil, the inclusion of investment in regressions (1) and (2) would attribute some of the effect of oil of GRP to the effect of investment on GRP, and so on. For this reason, we favor regressions containing only purely exogenous controls such as time fixed effects in addition to the resource abundance measures. Of course, if we want to test for the presence of convergence effect, we need to use lagged GRP, but we need to keep in mind the possibility that its coefficient would incorporate some of the effect of oil.

As the preceding discussion illustrates, using different specifications and measures implies significant tradeoffs. Due to limited space, we cannot present the results based on all alternative approaches described above. Instead we report the results of what are in our view the most appropriate approaches and simply mention whether the results of other approaches are significantly different from those we present. Specifically, we report the results of both cross-sectional and panel regressions. In the latter, we use GRP (both “physical volume” and deflated values)\(^9\) rather than its growth rate as the dependent variable. We present the estimates based on both per capita oil output and its GRP share measures, and we use both “initial” oil abundance measures and current ones, although in the latter case we use system-GMM specifications in order to address potential endogeneity problems.
We do not include any conditioning variables, but we do examine the effect of oil on investments and labor flows. In the case of Russia we also exclude Moscow and Chechnya and include okrugs into the larger regions to which these okrugs belong administratively. Moscow is excluded, because it is the main beneficiary of oil rents while producing no oil itself whatsoever and Chechnya is excluded for the reasons of poor data availability and because it is the region seemingly least controlled by the central government.

Finally, we also run between-effects regressions in order to demonstrate that Russia’s oil producing regions remain considerably richer than the rest of the country despite the same or even slower growth during 2002-2011.

The definitions of all our variables, sources for them, and their descriptive statistics are presented in Tables 2 and 3.

<< Table 2 here >>

<< Table 3 here >>

4. Estimation Results

We begin with cross-sectional regressions based on specification (1). The results in Table 4 show that Russia’s oil-producing regions did not exhibit faster growth rates during 2002-2011, i.e., during the period that saw a very significant and sustained (with the exception of one year) rise in oil prices. The US states, however, displayed a small (elasticities in the range of 0.002-
but statistically significant positive influence of oil abundance on average GRP growth rates. The results remain qualitatively the same if we do not control for the log of 2001 GRP.

The fixed effects regression results are somewhat different (see Table 5). The US growth elasticities in regressions using state-specific prices are much larger (0.06-.19) although in one of the US regressions using countrywide deflator, the coefficient of per capita oil is not statistically significant. For Russia, coefficients for the deflated GRP regression are become almost statistically significant (they are significant at 15% level). One could argue that using 2001 oil abundance measures multiplied by oil price introduces a significant measurement error and induces the attenuation effect. To address this potential issue we use current year oil output values. The drawback of these measures is that they might be endogenous with GRP, although this is unlikely, because oil is traded in world markets and regional GRP would typically have no influence on its output or price. The results for the US (see Table 6) are similar to those in Table 5 while the estimates for Russia are lower and are even less significant than for the measures based on 2001 oil output. These estimates for Russia may be affected by the fact that post-2007 oil output data by region are not publicly available. Therefore, Russia’s regressions cover only 2002-2007 period. Note, however, that the estimates based on concurrent oil output measures are not qualitatively different from those based on 2001 measures for either Russia or the US.
The above results do not control for lagged GRP, because this would bias fixed effects estimates. Controlling for lagged GRP is common in growth regressions although as we noted earlier, it might be problematic because oil output influences GRP and thus some of the effect of oil on growth may work though lagged GRP. Keeping in mind this issue, we use system-GMM approach to produce dynamic panel estimates. Note that system-GMM also alleviates the endogeneity problem. The estimates presented in Table 7 are qualitatively similar to the fixed effects results in Tables 5 A,B and 6 A,B. One possible exception is the negative coefficient of the share of oil in GRP for the US in Table 7 B that is borderline significant (at 15% level) but this is presumably not sufficient evidence to undermine the rest of the results, particularly given that system-GMM does not produce reliable estimates for only 50 groups.10

<< Table 7 here >>

The above results suggest that oil-producing regions in Russia did not grow statistically significantly faster during 2002-2011 than the other regions despite considerable increase in the price of oil over the same period of time. This is particularly noteworthy, given the apparent growth benefit from rising oil prices that Russia experienced as a country. The US oil-producing states on the other hand do show slightly higher growth that the other states. These results are consistent with the view that Russia’s federal government taxed away most of the rents generated by regional oil extraction.

One may speculate that instead of being taxed away, these rents were channeled away to their headquarters by the oil companies. This argument can be indirectly tested by looking at the effect of oil abundance measures on investment in the regions, because if oil companies were
receiving outsized rents from oil production, they would have strong incentives to invest more in these regions. The regional data on investments in extraction industries are available for Russia starting in 2005 and are not available for the US states at all. Of course, extraction industries is a broader category that the oil industry, but this is the best proxy we have. Fixed effects estimates of the effect of oil on investment in the extraction industries are negative and statistically significant at 1% level. These results hold whether or not we control for per capital stock in the region (see Table 8). The negative relationship between oil wealth measures and growth of investments in extraction industries undermines the hypothesis that oil companies obtained significant rents from oil extraction in the 2000s.

Although we do not have state-level extraction industries investment data for the US, we do have some data (through 2007) for overall investment by state. Table 9 presents the results of the overall investment regressions. The dependent variable is the ratio of investments to capital stock, but very similar results obtain when the dependent variable is logarithm of overall gross investments. Also, the estimates are not significantly affected by the presence or absence of lagged capital stock. In Russia, oil wealth does not appear to influence overall investment growth but the US investment growth is positively and statistically significantly affected by the presence of oil. We note, however, that the regressions reflect the effect of oil abundance of investment growth rather than the level of investment. Both in Russia and in the US, the average ratio of investment to capital stock in the oil-producing regions has been higher in 2002-2011 than in other regions.
The incremental oil rents of the 2000s did not accrue to the workers in Russia’s oil-producing
either. The point estimates of the oil abundance measures in the wage regressions for Russia
are negative although not statistically significant (Table 10). In the US, however, oil producing
states did see a positive relationship between oil measures and wages in the 2000s. However,
there is some weak evidence that labor flows in both countries were positively related to oil
rents (see Table 11).

It is important to emphasize two points. First, our argument that oil rents in Russia were taxed
away from the oil-producing regions by the federal government does not prevent these regions
to be better off in terms of per capita GRP than other regions. As between-effects regressions
in Table 12 demonstrate, the oil producers in Russia (but not in the US) had considerably higher
GRP per capita than other regions. The elasticities of per capita GRP with respect to oil wealth
measures ranged from approximately 0.05 to 0.07. Our interpretation of these results is that
Russia’s oil-producing regions did keep pre-2002 rents, but did not receive extra growth
benefits from oil price increases in the 2000s.

The second important point is that taxing away incremental oil rents starting in 2002 is not
necessarily a bad idea for Russia. After all, according to the Russian law, subsoil resources
belong to the entire country and, therefore, there is little reason for oil-producing regions to benefit much from increasing rents. Moreover, regional income inequality in Russia is large and significantly higher than in the US (see Table 13). It makes sense, therefore, to redistribute incremental rents to poorer non-oil producing regions. But it is also necessary to understand that the tradeoff may involve weaker incentives for the oil companies to invest in exploration and development of new fields and in increasing the extraction from the older fields.

<< Table 13 here >>

5. Conclusions

Using the data for 2002-2011 we compared the effect of oil abundance on the regional economic growth in Russia and the US. For Russia’s regions we found that oil had an insignificant impact on regional growth, negative effect on investment growth, and small positive influence on labor flows. However, natural resource rich regions do have higher per capita GRP and higher wages. We conclude that the Russian central government taxed away the incremental post-2002 rents, but not the pre-2000s rents thus preventing the oil-rich regions from benefitting from the surge of oil prices in the 2000s.

In the US, there was a small but statistically significant positive effect of oil on state economic growth, investment growth, wage growth, and labor flows. We attribute the difference in the results for the US and Russia to relatively heavier federal taxation of oil extraction in Russia.12

The present study focused on regional economic growth and its conventional factors. This research can be extended in several directions. Particularly fruitful might be the examination of
the relationship between natural resources and regional institutions, the effect of natural resources on the structure of regional budgets; and comparisons with Canada and China. We leave these extensions for future studies.
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1 The early examples of this mostly empirical literature include Auty (1993) and Sachs & Warner (1995). Recent surveys of this literature include Frankel (2010) and van der Ploeg (2011).


3 See, for example, Kuboniwa (2012).

4 Russia’s tax system was radically changed with the introduction of the Tax Code in 2001, see Alexeev and Conrad (2013) and references therein.

5 In particular, both Papyrakis and Gerlagh (2007) and James and Aadland (2011) rely exclusively on cross-sectional regressions, which is particularly problematic in the former paper’s case because it severely limits the number of observations. Libman (2013) runs some panel regressions as a robustness check, but emphasizes on cross-sectional analysis, presumably because his focus is on the interaction between oil wealth and institutional quality, including the quality of the bureaucracy, and the data on the latter are available only for one year.

6 Interaction terms in this context were used for example by Mehlum et al. (2006). The “controls” are put in quotes, because these are sometimes variables that are endogenous with GRP or its growth rate, e.g., institutional quality or investments.

7 Bruckner et al. (2012) use logarithm of GDP as the dependent variable. Strictly speaking, they regress the change in the logarithm of GDP on the change in the logarithm of the resource measure, which is in effect the first differenced regression of logarithm of GDP on logarithm of
the resource measure. Brunnschweiler (2009) uses logarithm of growth rate as a dependent variable while her resource measure is not in growth terms.

8 For example, let region A produce 100 barrels of oil and region B produce 100 widgets. Year 1 price of a barrel of oil is 1 and the price of a widget is 1. In year 2, the price of oil rises to 3 and the price of a widget remains at 1, but “physical output” stays constant implying that “physical volume” index is 1. Then the deflator is \( \frac{3 \times 100 + 1 \times 100}{1 \times 100 + 1 \times 100} = 2 \), and deflated output of region A is \( 3 \times \frac{100}{2} = 150 \) while the deflated output of region B is \( 1 \times \frac{100}{2} = 50 \).

9 No data on “physical volume” GRP are available for the US. Instead, we use GRP deflated by state-specific price indices.

10 Bruno (2005) proposed the bias-corrected Least Square Dummy Variable Estimator (LSDV) that appears to work better than system-GMM for relatively narrow samples as long as the right hand side variables are exogenous. This procedure yields positive point estimates of the concurrent oil abundance coefficients for the US with per capita output significant at 1% level. Otherwise, the LSDV estimates are similar to the fixed effects and system-GMM estimates for both the US and Russia using either 2001-based measures or concurrent measures of oil output. These results are available upon request.

11 It is possible that Russia’s oil companies do not increase investments in response to oil price increases because of their short-term orientation. This reasoning is not mutually exclusive with our main argument. Also, short-term thinking might be to a large extent caused by the predatory policies of the central government, including high rate appropriation of oil rents.
It is important to note that the Russian central government is probably aware of the negative effects of excessive extraction of regional rents and a particularly pernicious impact of export fee. According to the recently adopted legislation, the marginal rate of the export fee is supposed to decline from 0.6 in 2014 to 0.55 in 2016 while the base rate of the mineral tax on oil is scheduled to increase from 493 rubles/ton in 2014 to 559 rubles/ton in 2016. Moreover, the central government is considering an even faster reductions of the export fee and an increase in the mineral tax in the near future motivated by the problems export fee causes in the presence of the customs union with Belarus' and Kazakhstan (see http://www.minfin.ru/ru/press/speech/printable.php?id_4=21243)