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CHANGING TAX EFFORT IN RUSSIA'S REGIONS; THE IMPACT OF RE-CENTRALIZATION

Judith Thornton
University of Washington, USA
Email: thornj@uw.edu

Krisztina Nagy
Corresponding author: Pacific Lutheran University, USA
Email: nagyka@plu.edu

Pasita Chaijaroen
College of William & Mary, USA & Vidyasirimedhi Institute of Science and Technology, Thailand
Email: pasita.c@vistec.ac.th

Abstract

We use panel data for 1998 – 2012 and system General Methods of Moments (GMM) specification to test for differences in behavior of resource-rich regions and other Russian provinces due to re-centralization of resource royalties from the region to the center. We ask whether joint taxation of the same tax base by both federal and provincial governments led to vertical externalities and possible over-taxation between federal and regional authorities. We explore whether a shift in the collection of resource taxes from the provinces to the center impacted the size and share of regional tax collection. We find that own tax collections of resource-rich regions declined after re-centralization, while strong vertical externalities persisted between federal and provincial taxes due to joint collection of profit taxes and the overlap between regional income taxes and federal value added taxes.

Keywords: Fiscal Federalism, Fiscal Policy, Russia, Dynamic Panel Data

JEL Classifications: H33, H77, O11, O5, P3

1. Introduction

Despite Russia's formal federal structure, the degree of independence of Russia's regions has changed over time. The early transition era was characterized by considerable formal centralization combined with de facto decentralization. However, the post-Putin era saw a significant re-centralization of tax collection. Beginning in 2000, the rights to resource royalties were transferred gradually from regional budgets to the federal budget, and the federal government levied substantial export taxes on the sale of oil and gas on international markets.

In this paper, we explore the response of Russian regional governments to a shift from a tax-sharing regime to a formal centralization of economic and political decision-making in Moscow. How did changes in the tax base and the structure of tax rights influence the tax

collection of regional administrations? Are there differences in the behavior of resource-rich regions and other provinces of Russia? Are there vertical externalities between federal and regional taxes due to overlapping tax rights over value added tax, income tax and profit tax?

To analyze the impacts of the changes in the tax system, we collect panel data for 1998 – 2012 on regional tax collections, federal tax collections, federal transfers, and other regional characteristics from the official sources, such as the Russian Ministry of Finance, the Russian Federation Treasury, the Russian Federation Statistical Office, and other sources. We believe that our dataset is one of the most comprehensive on the extent of regional diversity. This detail allows us to explore how varying provincial characteristics impact regional tax capacity reported to the center and the resulting regional tax collection. We focus on the effects of changes in tax sharing legislation and federal transfers on regional own tax collections, asking whether these effects are different between resource-rich regions and others. Since regional tax collections could, in turn, affect federal tax collection, the empirical issues require addressing endogeneity of two-way relationships. We apply the Blundell and Bond (2000) framework and use lagged variables and lagged differences as instruments to address potential endogeneity.

Our estimation results indicate that there are significant differences in tax collection efforts between resource-rich and other Russian regions due to re-centralization of the rights to resource royalties. We find that own tax collections of resource rich regions declined over the periods of during 2005-2009 and 2010-2012, as evidenced by the statistically significant negative coefficients of fuel share interacted with period dummy variables. Positive, statistically significant coefficients on the impact of federal taxes on regional tax efforts provide evidence for possible over-taxation.

Our findings contribute to the literature on fiscal federalism in transition economies by providing some surprising results. First, they demonstrate strong vertical externalities within Russian federalism. These vertical externalities persist even though tax reforms after 2004 were intended to reduce overlapping tax rights. Vertical externalities persisted in the joint profit taxes and in the overlap between regional income taxes and federal value added taxes.

The remainder of the paper is organized as follows. Section 2 describes the changing structure of Russian taxes. Section 3 provides literature review and a theoretical framework that motivates our analysis. Section 4 describes the data used in our analysis, Section 5 discusses the empirical methodology and presents the empirical results. Section 6 concludes.

2. The Changing Structure of Russian Taxes

The fiscal and administrative divide is substantial between the first decade of Russia's transition in 1992 until 2002 and the second decade after Putin's subsequent re-centralization since 2002. The macroeconomics of the first decade reflected an era of hyperinflation and capital flight followed by a deflationary era in which enterprises and regional governments turned to barter, non-cash offsets, and the informal economy as survival strategies when payment systems collapsed (Ericson and Ickes, 2001; Gaddy and Ickes, 2002).

In October 2004, President Putin announced that, after 2005, direct election of governors would be replaced by Presidential appointment. The Putin era saw the re-emergence of market forces following a significant revision of the ruble-dollar exchange rate in late 1998 from 6 rubles per dollar to almost 30 rubles per dollar. There was a major revision in government fiscal and monetary discipline together with a fundamental change in the structure of tax collection.

Prior to 2000, the federal government and regions shared the same tax base which led to tax competition and welfare loss due to vertical tax externalities. Table 1 exhibits the changes in the distribution of tax revenues before and after 2000. Before 2000, sub-national regions received one-quarter of value added taxes (VAT), 60 percent of energy royalties from their oil and gas resources, and more than 60 percent of enterprise profits taxes. However, by 2004, 95 percent of royalties for oil and gas extraction were transferred to the federal level, while export taxes on international sales of hydrocarbons accounted for the dominant share of federal tax revenues. Similarly, after 2000, the federal government captured all of the VAT on production. In exchange, regions were allowed to keep two-thirds of enterprise profit taxes, could levy personal

income taxes, and could keep 100% of personal income tax in the region. The transition to the new budgetary principles was gradual and most of the transition was not complete until 2004.

Table 1. Changes in the distribution of tax revenues, % for selected categories

	1994-1999		2004	
	Federal	Regional	Federal	Regional
Income tax on individuals		100		100
Value added tax	75	25	100	
Alcohol excise tax	50	50	100	
Excises on alcohol products and beer		100		100
Excises on tobacco, cars and motorcycles		100	100	
Excises on gasoline, diesel fuel		100	40	60
Oil extraction		Varied by region	95	5
Property tax	80	20		100

Source: Gaidar Institute (2004) and Lavrov and Makushkin (2001)

This vast reallocation of tax rights significantly improved the sub-national tax structure. As central and sub-national tax authorities had rights to separate sources of tax revenue after 2000, the strong vertical externalities caused by duplicate taxation of the same tax base by two or more levels of government in early years lessened. In sum, in 1999, the share of Russia's subnational budget was 49 percent of the total—only slightly smaller than the budget shares in the US and Canada; yet, in 2003, the subnational share of revenue had fallen to 40 percent of total revenue. The decline in the share of sub-national taxes is shown in Figure 1, where sub-national budget revenues fell from 16.6% of GDP in 1998 to 13.9% in 2005, even including transfers from the federal level as a source of revenues.

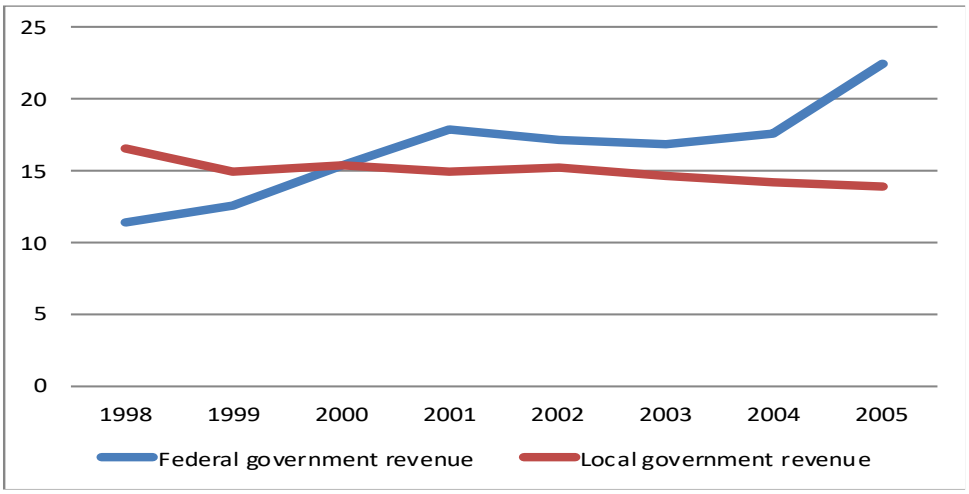

Figure 1. Revenues Received by Federal and Sub-National Levels of Government, % of GDP

Source: IMF (1998-2012, 2006)

3. Literature Review

Existing economic literature on changing tax efforts in Russia's regions uses the general literature of fiscal federalism, with the underlying theory exploring aspects of federalism relevant to Russian policy-makers in the early transition era and in the post-Putin era of re-centralization. A common concern in both periods asks how the division of central and regional rights to taxes and the

resulting supply of public goods impacted growth and productivity in Russia and in its individual regions.

A main concern before 2002 was the possible negative effects of vertical and horizontal tax externalities on the size of the total tax base in individual regions shared by central and regional tax administrations and the incentives of regional authorities to collude with local producers to evade federal taxes by concealing their true tax capacity. Treisman (2007) provides an excellent survey.

The main question after 2000 when regional public expenditures became increasingly dependent on transfers from the center was the effect of strong versus weak fiscal incentives on the incentives facing regional authorities to raise own taxes (Zhuravskaya, 2000). Does the region expect that the center will offset lower own tax collection with a larger transfer from the center? In this case, the region has weak incentives to tax its own producers. Alternatively, if the center does not offset lower local tax collection, then the region must increase own tax collection to increase local public expenditure. In fact, our initial empirical estimates of the interaction between a region's own tax collections and transfers is positive, indicating a "fly-paper effect." Thus, the center provides extra rewards to regions that increase efforts to tax local producers.

Alexeev and Weber (2013) observed that the assignment of federal and provincial rights to tax separate tax bases in Russia reduced some of the perverse effects of vertical externalities. A gradual shift to a formula-based framework for federal equalization transfers to provinces removed some of the strongest effects of lobbying for influence on the part of sub-national decision-makers.

Do subnational units enjoy any fiscal autonomy and, if so, how do they exercise their autonomy? If subnational governments view federal transfers as a common pool, then what strategies do they adopt to increase the in-flow of central transfers or to increase the share of "own taxes" remaining in the region? There is a vast theoretical literature on the consequences of decentralization in a federation that addresses vertical and horizontal externalities. A few benchmark models deserve particular note. Keen (1998), Boadway *et al.* (1998), and Keen and Kotsogiannis (2002) look at vertical tax externalities. Boadway and Tremblay (2006), Treisman (2006), Treisman and Cai (2004) look at the consequences of decentralization and vertical fiscal imbalance.

The literature on vertical and horizontal externalities focuses on the impact of concurrent taxation between individual regions and the central government. For example, Berkowitz and Li (1999) and Keen and Kotsogiannis (2002) focus on the vertical externality that arises when two competing tax authorities co-occupy the same tax base. Berkowitz and Li (1999) model the effect of co-occupancy of the same tax base by numerous competing government agencies. Like a model of over-fishing of a common pool, increased rent-collection by one tax authority reduces the size of the pool of producers available for taxation by a second authority. Berkowitz and Li (1999) posit that an important difference between high Chinese growth and poor Russian economic performance can be attributed to the early ability of Chinese local government authorities in the 1980s to shelter local producers from taxation by the center.

Keen and Kotsogiannis (2002) investigate conditions under which co-occupation of the same tax base by federal and local government levels results in over-taxation. Vertical co-occupancy of the same tax base means that the potential tax base of each level of government is influenced by the tax policies pursued by the other. The traditional role of the federal government lies in redistribution of income across regions, motivated by risk-sharing and internalizing fiscal externalities that result from horizontal tax competition between lower levels of government. In Russia, the geographical separation of provinces and the weakness of inter-regional labor, housing, and capital markets made vertical tax competition a more important issue than horizontal competition.

Freinkman and Plekhanov (2009) explore the effect of resource dependence on degree of decentralization. They find that both rent-dependence and transfer-dependence in Russian regions are associated with greater centralization of tax structure. Freinkman *et al.* (2011) look at the determinants of provincial growth. They find that higher own taxes had a negative effect on regional growth, particularly in the early period, while higher federal transfers to a province were associated with higher regional growth.

Alexeev and Chernavskiy (2014) show that resource-rich regions of Russia did not grow faster than other regions in spite of their resource wealth. The absence of growth benefits is explained by the fact that the Russian central government succeeded in taxing away resource rents from resource-rich regions and transferring the rents to other federal programs during 2002-2011.

Alexeev and Weber (2013) observe an increase in effective centralization of budget revenues after 2000. While the share of regional taxes and transfers rises from 43 to 47% of total taxes between 2001 and 2011, the share of regional government expenditure in total government expenditure falls from 49 to 41% in the same period. They investigate the elasticity of regional government expenditures on determinants - the sum of own taxes and transfers and on change in gross regional product. They observe that additional regional tax revenue increases regional expenditures. Thus, for each 100 rubles of additional regional tax revenues, regional expenditures rises by 23 rubles.

Other policy observers, notably at the World Bank, conclude that the post-2004 structure of taxes that gives central and regional government administrations tax rights to separate sources of tax revenue leads to a considerable reduction in apparent vertical tax externalities. Our estimates confirm this effect. However, vertical externalities remain, largely because of the vertical sharing of profit taxes between the center and the regions.

More importantly, policy observers note that, in the post-Putin era, the amounts of regional per capita transfers were determined on a uniform, formula-based system, with federal transfers set to reduce the disparities between regional tax capacities and the per capita consumption levels of public services delivered to the regional population. They show that in the absence of federal transfers, substantial differences would persist in the tax collections of resource-rich and other regions. However, after central transfers these regional differences disappear.

Alexeev *et al.* (2018) provide policy input to the federal treasury. They review the size and structure of regional tax collections and recommend setting *ad hoc* limits on the amount of regional tax collection attributed to various expense categories claimed by the provinces. Thus, Alexeev *et al.* (2018) advise the federal Treasury to impose specific regulatory constraints setting limits on the amounts and shares of taxes that may be provided to regions for various regional expenditure categories. It appears that the Alexeev team at the Laboratory of Investigation of Budgetary Policy, Russian Academy of National Economy and Government Service monitors the federal and provincial shares of taxes to prevent excessive out-flow of tax revenues to the provincial level.

In sum, the literature on Russian fiscal federalism engages both academic and econometric research by outsiders, such as Treisman (2006) exploring the interaction of federal tax authorities with Russia's regional administrations and, separately, research, such as the Alexeev *et al.* (2018) providing direct advice to the central tax authorities on how to limit the amount of tax revenue remaining under the control of regional decision-makers. This body of literature focused mainly on how a changing structure of tax revenues and expenditures allowed Russia's federal government and its 85 sub-national units to support public infrastructure and provide public services in a period of rapid economic change during transition. There was little evidence that tax revenues collected in a region supported higher public expenditures or economic growth in that region because of the high share of regional taxes collected at the center and spent elsewhere.

4. Data and Methodology

We use data on 79 sub-national administrative units of the Russian Federation for 1998 – 2012 out of a reported 85 regions and sub-units. This period reflects Russian policy decisions before the period when Western policies began to impact central government priorities. This sample eliminates double-counting of sub-units that are already included in larger administrative units, for example, Nenets, Khanty-Maniisk and Yamalo-Nenets when sub-units are already included in the larger provinces. We also exclude Chechnya due to incomplete and inconsistent data for a region that experienced political turmoil. We estimate two sets of results one including Moscow and one

without Moscow. Some authors argue for excluding Moscow because many of the large natural resource companies are based in Moscow and report revenues there. However, our results are robust regardless of Moscow's presence. For completeness of our analysis, our final results allow for the inclusion of Moscow.

Table 2. Variables and sources

Variable	Description
Own tax	Logarithm of consolidated budget revenue less transfers, deflated using constant year 1998 prices. Source: Ministry of Finance (1998-2012) and Regiony Rossii (1998-2012).
Federal tax	Logarithm of federal consolidated budget revenue, deflated using constant year 1998 prices. Source: Ministry of Finance (1998-2012) and Regiony Rossii (1998-2012).
Transfer from federal	Logarithm of regional transfers, deflated using constant year 1998 regional prices. Source: Ministry of Finance (1998-2012) and Regiony Rossii (1998-2012).
Tax arrears	Logarithm of regional arrears, deflated using constant year 1998 prices. Source: Ministry of Finance (1998-2012) and Russian Federation Treasury (1998 – 2012).
Fuel share	Value added of fuel industries as a share in industrial value added. Source: Ministry of Finance (1998-2012) and Regiony Rossii (1998-2012).
GRP	Logarithms of regional Gross Regional Product (GRP), deflated using constant year 1998 regional prices. Source: Regiony Rossii (1998-2012).
Oil price	Logarithm of price of oil in constant 2016 dollars. Source: British Petroleum (1998-2012).
Unemployment	Regional unemployment rate in percent. Source: IMF (1998-2012, 2006).
Crime rate	Number of murders per capita. Source: Regiony Rossii (1998-2012).
Federal administrative officers	Number of federal administrators per capita. Proxy of federal infrastructure allocated to a region, measuring the importance of the region to the center. Reflects federal administration costs assigned to the regional budget. Source: Regiony Rossii (1998-2012).
Deflator	1998 rubles, national and regional levels. Source: Regiony Rossii (1998-2012).

Note: Since we are using logs, negative and zero observations are dropped from our analysis. That means we exclude Moscow in all models with transfers since it is recorded with negative transfers.

Our data comes from official Russian data sources: tax variables from the Ministry of Finance and publications; tax arrears from Ministry of Finance and Russian Federation Treasury; Gross Regional Products, crime rate, number of federal administrative officials from Regiony Rossii publications; unemployment rates from International Monetary Fund (IMF) – Russian Federation Statistical Appendix; oil price data from British Petroleum. Exact data sources are indicated in Table 2 and cited in the Bibliography.

All nominal variables, except for world oil price, are deflated per capita values in rubles. The deflator is derived from regional costs of a fixed basket of goods from *Regiony Rossii.* We use regional indices because levels and rates of inflation of revenues, costs, and per capita

incomes differ markedly across regions of Russia. The estimation uses the log transformation of the tax variables. The number of observations in estimations changes, for example, when zero or negative values drop out of estimates using logs. The number of observations across various models is also impacted by the specifics of the lag structure of estimation. Blundell and Bond (2000) methodology requires the use of one to three lags.

Table 3 provides the overall descriptive statistics of the main variables in our model. The descriptive statistics illustrate disparities between regions in terms of income, taxes, and other economic indicators, and motivate the use of a model that controls for this heterogeneity.

Table 3. Descriptive Statistics – all data (1998-2012)

	Mean	SD	Min	Max	N
Own tax	3,912	2,973	0	44,009	1,185
Federal tax	2,195	5,888	0	82,346	1,185
Transfer from federal	1,732	2,000	-4,413	24,598	1,185
Tax arrears	716	1,421	17	21,352	1,185
GRP	21,062	14,616	3,227	111,587	1,185
Oil price	55.28	32.54	12.72	111.67	1,185
Unemployment	9.83	6.33	0.80	63.10	1,185
Crime rate	0.00019	0.00011	0.00004	0.00092	1,185
Federal administrative officers	0.00442	0.00238	0.00134	0.02108	1,185

Note: All nominal variables, except for oil price, are deflated over time and measured per capita and in rubles.

Given the goal of examining the relationship between regional own taxes and federal taxes, the main empirical challenge follows from the endogeneity of the main variables of interests. In particular, federal tax remittances and transfers might affect the region's own tax collection while the own tax collection could also impact transfers and federal taxes, especially when taxes were shared prior to the tax reform in 2000. After 2004, only profit tax was shared between the federal and regional governments, so there should be less cause for simultaneity. However, the federal value added tax may show simultaneity with regional personal income and profits taxes. Blundell and Bond's (2000) dynamic panel model utilizes lagged endogenous variables and lagged differences of the endogenous variables as instruments to address this simultaneity issue. As we focus our analysis on regional behaviors, our dependent variable of interest is regions' own tax collection.

Our treatment of regional tax collection as a dependent variable diverges from the approach in the literature cited, above. These papers generally treat regional expenditures as a dependent variable, viewing own taxes collected and transfers received in a region as the independent determinants of expenditures. However, Alexeev and Chernavskiy (2014) show that resource-rich regions of Russia did not enjoy growth benefits. The absence of growth benefits is explained by the fact that the Russian central government succeeded in taxing away resource rents from resource-rich regions and transferring the rents to other federal programs during 2002-2011. Treisman and Cai (2004) show that regional governments have incentives to shelter local capital from federal taxes. Since federal and regional taxes are shared, the amount of own tax depends directly on federal taxes in the equation, below.

$$own\ tax_{it} = \alpha_1 own\ tax_{it-1} + \alpha_2 federal\ tax_{it} + \alpha_3 fuel\ share_{it} + \Sigma_\tau \delta_\tau I(period_t = \tau) + \Sigma_\tau \beta_\tau fuel\ share_{it} I(period_t = \tau) + x'_{it}\gamma + u_{it},$$
$$u_{it} = \mu_i + v_{it}, \quad (1)$$

where i is a subscript for region, and t is a subscript for time period. γ_t is year fixed effects, μ_i is regional fixed effects, and v_{it} is the i.i.d. error term. x'_{it} is a vector of exogenous independent variables, which include price of oil, tax arrears, unemployment rate, crime rate, and number of federal administrators.

To capture the changes in resource royalty sharing schemes overtime, we include three time period dummy variables: period 1 from 2000-2004, period 2 from 2005-2009, and period 3 from 2010-2012. The base time period is before the tax reform, 1998-1999. The first period reflects the transitioning period where some of the royalties were still shared with the regions. During the second period, 80-90% of the royalties went to the federal government. By the third period, the federal government received all of the resource royalties. Since one of our main focuses is on the difference between resource-rich and other regions, we also interact these time period dummies with percentage of income from fuel in total GRP. These interaction terms allow us to investigate time-varying effects of the change in the sharing scheme on region's own taxes.

We also include year fixed effects to flexibly account for general time trend in own taxes as well as to ensure that our standard errors are correct (Roodman, 2009). In addition, we perform a Hansen test for overidentification as well an AR(2) test for serial correlation to ensure proper specification. All values are listed in the results tables.

In addition to the simultaneity bias, Blundell and Bond's (2000) dynamic panel estimation technique also addresses issues of unobserved heterogeneity and serial correlation (Roodman, 2009; Bond *et al.* 2001). Given that macroeconomic data tend to be persistent over time, we tested for serials correlation using a Lagrange multiplier test and found evidence for serial correlation. The data reflect the high degree of heterogeneity of characteristics between regions.

We use a number of control variables to account for various regional differences. *Crime per capita* is used as a proxy for the informal economy[1]; *Federal Administrative Officials* is a proxy for central monitoring of tax evasion. In order to identify resource-rich regions, we use *fuel share* of industrial output as a proxy.

An issue arises whether or not to control for GRP. On the one hand, omitting GRP might cause an omitted variable bias because it is correlated to both own taxes, the dependent variable, and many of the independent variables, especially federal taxes. On the other hand, controlling for GRP will not allow us to fully capture the relationship between own taxes and federal taxes because both taxes are percentages of GRP. If we were to control for GRP, then the coefficient on GRP would just be an effective tax rate and would not have a meaningful interpretation for our research questions. For these reasons, we do not control for GRP in our main specifications.

We use fixed effects estimation method as our benchmark model but focus on the system General Methods of Moments (GMM) specification to draw our main conclusions. The system GMM model accounts for the potential simultaneity bias between own tax collections and federal tax collections. The GMM specification also includes lagged dependent variables (1 through 3 lags) in order to address the issue of autocorrelation in the model. Table 4 presents results for model specifications with year fixed effect and without year fixed effect for robustness check.

5. Results

Our empirical results highlight two key findings. First, the shift in resource tax collection from regional to federal government resulted in a decrease in regional own tax collection. Second, when we account for endogeneity, an increase in federal tax is associated with an increase in own tax collection. This is evidence for vertical externalities. Strong centralization still persists and regions are strongly influenced by incentives from the center. Alexeev *et al.* (2018) indicate that they provide policy advice to central tax authorities recommending *ad hoc* constraints on allocation of regional tax revenues. Central tax authorities appear to have strong incentives to monitor and intervene to restrict the ability of provinces to transfer fiscal resources from central to regional priorities.

There are two main sets of variables of interest; fuel share and its interaction with period dummies and federal tax. The lack of statistical significance on fuel share indicates that there was no significant difference in tax collection efforts between resource-rich and other regions prior to the change in the tax sharing legislation. The consistent and highly significant coefficients on fuel share interacted with period dummies across all models indicate a decrease in own tax collection by fuel rich regions that are no longer collecting tax on oil extraction. During 2005-2009 the federal

[1] Higher crime rate is associated with higher illegal activities and possible to lower tax payments.

government collected 95% of the tax on fuel, and after 2010 tax collection on fuel by the federal government increased to 100%. Looking at the size of the coefficients over the various time period, we notice that the magnitude of the decrease in tax collection increased over time from 0.4% to 1% for each percentage point increase in fuel share.

In order to account for simultaneity bias, we estimate our main model presented in the methodology section using system GMM and include the lagged dependent variable to account for possible dynamic structure and autocorrelation in the model. Results are presented in models (3) and (4) in Table 4. This specification allows us to examine how regional own tax collection responds to changes in federal tax. Note that when we control for federal tax in models (2) and (4) of Table 4, the coefficients on interactions between time period dummy variables and fuel share are very similar to those in models (1) and (4). Note, however, that model (3) may suffer from simultaneity bias as own tax may also affect federal tax. As a result, the coefficients on federal tax and other related regressors in this model should be interpreted with caution. Results for the control variables can be seen in Table 5. Our results are robust regardless of Moscow's presence. Results from Table 4 and 5 and comparable with the estimates when we exclude Moscow (Tables A5 and A6 in Appendix). Some authors argue for excluding Moscow because many of the large natural resource companies are based in Moscow and report revenues there. However, for completeness of our analysis, our final results allow for the inclusion of Moscow.

The results based on system GMM also affirm the decline in own tax collection among fuel rich regions. The implication of this is that own tax collections respond to federal tax collections, not the reverse. In addition, the positive and statistically significant coefficients across the models on federal tax indicate that regions increase their own tax collection in response to an increase in federal tax collection. This result is consistent with over-taxation.

We test our main model against alternative specifications and find that our results are robust to eliminating year fixed effects, adding federal transfer as an additional regressor, and excluding Moscow from our analysis. We find that excluding year fixed effects does not change the general nature of the results. We exclude year fixed effects to avoid collinearity between the year fixed effects and period dummies. Similarly, Alexeev and Mamedov (2017) find that inclusion versus exclusion of regional fixed effects does not alter results in their study of the degree of decentralization of Russian and US regions. Tables A3 and A4 in Appendix confirm that excluding Moscow does not alter our main conclusions of decline in regional own tax collections in resource-rich regions and it supports our conclusion of over-taxation.

We also estimate our main model by including federal transfers as another regressor in order to completely control for all tax variables. Results in Table A1 and A2 of Appendix suggest that our two main findings are robust to this addition. The coefficient on transfers is positive and statistically significant under simple fixed effects specifications but not statistically significant under system GMM. This indicates that when accounting for simultaneity, we cannot statistically detect any responses in regional own tax collection to levels or changes in federal transfers. This implies that transfers did not appear to impact own tax collection in a consistent manner during this period. We also found no consistent effects in separate regressions exploring the possible reverse impacts of regional tax variables on level of federal taxes.

Table 4. The effect of fuel share and federal taxes on own regional taxes (1998-2012)

Dependent variable: Log of deflated own tax per capita

Without year fixed effects	(1) Fixed effects	(2) Fixed effects	(3) System GMM	(4) System GMM
Period1*Fush	-0.440	-0.446*	-0.579*	-0.481
	(0.273)	(0.261)	(0.340)	(0.309)
Period2*Fush	-1.138**	-1.199**	-0.867**	-0.902**
	(0.521)	(0.492)	(0.338)	(0.356)
Period3*Fush	-1.313**	-1.365**	-1.125**	-1.058**
	(0.657)	(0.625)	(0.431)	(0.472)
Period1	1.095***	1.013***	-0.237***	-0.138
	(0.0426)	(0.0444)	(0.0466)	(0.0877)
Period2	0.984***	0.879***	-0.286***	-0.257**
	(0.0819)	(0.0825)	(0.0564)	(0.0973)
Period3	1.397***	1.250***	-0.0183	-0.0614
	(0.104)	(0.104)	(0.0693)	(0.124)
Fuel share	-0.730	-0.603	-1.671*	-0.909
	(1.224)	(1.202)	(0.994)	(1.606)
Federal tax		0.0972***		0.313***
		(0.0167)		(0.0492)
Own tax_{t-1}			0.878***	0.679***
			(0.0230)	(0.0552)
Own tax_{t-2}				
Own tax_{t-3}				
N	1103	1103	1102	1102
Adj. R-sq.	0.944	0.948		
Hansen p-value			0.957	0.230
AR2 p-value			0.485	0.749
With year fixed effects	(5) Fixed effects	(6) Fixed effects	(7) System GMM	(8) System GMM
Period1*Fush	-0.405*	-0.410*	-1.180*	-0.604**
	(0.228)	(0.225)	(0.595)	(0.275)
Period2*Fush	-1.013**	-1.034**	-1.405*	-1.027***
	(0.443)	(0.438)	(0.727)	(0.272)
Period3*Fush	-1.121**	-1.139**	-1.428*	-1.088**
	(0.554)	(0.549)	(0.804)	(0.327)
Period1	2.336	2.331	0.622***	0.494***
	(2.215)	(2.217)	(0.178)	(0.0672)
Period2	4.667	4.663	0.396***	0.456***
	(5.798)	(5.805)	(0.0584)	(0.0568)
Period3	6.903	6.922		
	(10.24)	(10.25)		
Fuel share	-0.563	-0.524		-0.737
	(0.998)	(0.998)		(0.732)
Federal tax		0.0269**		0.0551*
		(0.0128)		(0.0320)
Own taxt-1			0.842***	0.814***
			(0.141)	(0.136)
Own taxt-2			0.0161	-0.0489
			(0.152)	(0.132)
Own taxt-3			0.0407	
			(0.110)	
N	1103	1103	942	1022
Adj. R-sq.	0.979	0.979		
Hansen p-value			0.363	0.610
AR2 p-value			0.302	0.159

Note: Time period dummy variables include *Period1* for 2000-2004, *Period2* for 2005-2009, and *Period3* for 2010-2012. The base time period is 1998-1999. Heteroskedasticity robust standard errors are in parentheses. All models control for fuel share, price of oil, price of oil*fuel share, unemployment, crime per capita, number of federal employees per capita, lagged tax arrears, and region fixed effects. Results for the control variables are located in the appendix.

Table 5. The effect of fuel share and federal taxes on own regional taxes (1998-2012) – without year fixed effects

Dependent variable: Log of deflated own tax per capita				
	Without year fixed effects			
	(1) Fixed effects	(2) Fixed effects	(3) System GMM	(4) System GMM
Price of oil	1.228***	1.176***	-0.0413	0.172
	(0.0708)	(0.0670)	(0.0436)	(0.114)
Price of oil * Fuel Share	0.308	0.246	0.701**	0.321
	(0.398)	(0.386)	(0.303)	(0.436)
Arrears - Lagged	0.0467*	0.0317	-0.216***	-0.314***
	(0.0243)	(0.0227)	(0.0243)	(0.0422)
Unemployment rate	-0.0146**	-0.00899	-0.0171***	-0.0105
	(0.00676)	(0.00615)	(0.00458)	(0.00670)
Crime rate	-776.0**	-748.5**	320.0	496.7
	(322.2)	(299.5)	(256.7)	(452.4)
Federal administrators	86.13***	99.58***	38.95***	52.45***
	(20.20)	(19.68)	(6.041)	(12.06)
	With year fixed effects			
	(5) Fixed effects	(6) Fixed effects	(7) System GMM	(8) System GMM
Price of oil	-2.734	-2.792	0.368**	0.578***
	(7.513)	(7.527)	(0.127)	(0.121)
Price of oil * Fuel Share	0.228	0.211	0.355**	0.428*
	(0.323)	(0.321)	(0.177)	(0.221)
Arrears - Lagged	0.0439**	0.0425**	-0.0700	-0.0804**
	(0.0196)	(0.0194)	(0.0472)	(0.0263)
Unemployment rate	-0.0192***	-0.0178***	-0.0101**	-0.0152**
	(0.00530)	(0.00504)	(0.00432)	(0.00505)
Crime rate	-59.64	-61.31	278.4**	269.5
	(244.2)	(239.0)	(120.6)	(198.2)
Federal administrators	8.435	13.63	17.19**	28.58***
	(17.13)	(17.43)	(5.792)	(8.103)

6. Conclusion

We explore the response of Russian regional government decision-makers to a gradual centralization of control over tax revenues from the regions to the central government after Russia's currency devaluation in 1998. The rights to tax resource royalties shifted gradually from regions to the center, depriving resource-rich regions of revenues from resource royalties and creating an imbalance between the share of tax revenues collected at the center and the unfunded expenditure responsibilities assigned to the regions. For this reason, the division of taxes between the center and the regions might have affected resource-rich regions differently from other regions.

We complied a large dataset that includes regional tax collections, federal tax collections, federal transfers and a significant number of control variables from 1998 – 2012. This dataset is one of the most comprehensive on the extent of regional diversity. It covers an important period for Russian policy decisions before Western policies began to impact central government policies. The size of the dataset lends itself to the use of advanced panel data methods in order to address the issue of possible endogeneity between regional tax collections and federal tax collections. We

implement the Blundell-Bond (2000) dynamic panel model ensuring that our standard errors are correct (Roodman, 2009) and we also correct for unobserved heterogeneity and serial correlation (Roodman, 2009; Bond *et al.* 2001).

We find that there are significant differences in tax collection efforts between resource-rich and other Russian regions due to the re-centralization of resource royalties. Specifically, we find a decline in regions' ability to collect own taxes after the re-centralization (2005 – 2009 and 2010 – 2012). This decline is consistent with the tax sharing legislation implemented after 2004 that gradually reduced regions' rights to resource royalties. This result is very robust across alternative specifications.

In addition, we find statistically significant evidence for possible over-taxation. The positive, statistically significant coefficient on the impact of federal taxes on regional tax efforts implies that the increase in federal taxes is associated with increase in regional tax efforts. This result suggests that centralization introduced in the post-Putin period did not fully eliminate vertical over-taxation in Russian federalism.

Previous studies that focus simply on the relationship between taxes and GDP fail to take account of the diversity of Russia's regional economies and fail to identify the crucial role of provincial diversity in the management of Russian tax policy toward its provinces. Central tax authorities appear to have strong motivation to restrict the share of total tax revenues available for regional expenditure. When the central tax code assigns above-average taxes to a region, the center appears to intervene in an *ad hoc* manner to limit the amount of taxes remaining in a region.

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Appendix

Table A1. The effect of fuel share, transfers and federal taxes on own regional taxes (1998-2012) – main independent variables

	Dependent variable: Log of deflated own tax per capita			
	Without year fixed effects		With year fixed effects	
	(2)	(5)	(2)	(5)
Main Variables	Fixed effects	System GMM	Fixed effects	System GMM
*Period1*Fush*	-0.431	-0.441*	-0.408*	-0.363
	(0.264)	(0.232)	(0.225)	(0.245)
*Period2*Fush*	-1.146**	-1.005***	-1.015**	-0.979**
	(0.483)	(0.289)	(0.426)	(0.358)
*Period3*Fush*	-1.300**	-1.169**	-1.115**	-1.150**
	(0.615)	(0.418)	(0.533)	(0.378)
Period1	0.939***	-0.278***	2.069	0.527**
	(0.0490)	(0.0615)	(2.239)	(0.202)
Period2	0.788***	-0.333***	3.992	-0.674***
	(0.0865)	(0.0762)	(5.864)	(0.0747)
Period3	1.162***	-0.134	5.792	
	(0.108)	(0.0929)	(10.35)	
Fuel share	-0.507	-1.599	-0.491	0.597
	(1.169)	(1.345)	(0.953)	(0.909)
Transfers	0.0817**	0.00304	0.0359*	-0.0224
	(0.0259)	(0.0293)	(0.0207)	(0.0630)
Federal tax	0.0969***	0.207***	0.0271**	0.153**
	(0.0166)	(0.0341)	(0.0128)	(0.0583)
Own tax$_{t-1}$		0.800***		
		(0.0318)		
N	1103	1102	1103	1103
Adj. R-sq.	0.948		0.979	
Hansen p-value		0.998		0.968
AR2 p-value		0.401		0.541

Note: Time period dummy variables include *Period1* for 2000-2004, *Period2* for 2005-2009, and *Period3* for 2010-2012. The base time period is 1998-1999. Heteroskedasticity robust standard errors are in parentheses. All tax variables are log of deflated per capita tax. All models control for fuel share, price of oil, price of oil*fuel share, unemployment, crime per capita, number of federal employees per capita, lagged tax arrears, and region fixed effects. Moscow has negative federal transfers and hence is excluded from these specifications as we use the log form of the transfers.

Table A2. The effect of fuel share, transfers and federal taxes on own regional taxes (1998-2012) – control variables

	Dependent variable: Log of deflated own tax per capita			
	Without year fixed effects		With year fixed effects	
	(2)	(5)	(2)	(5)
Control Variables	Fixed effects	System GMM	Fixed effects	System GMM
Price of oil	1.153***	-0.0000587	-2.007	1.869***
	(0.0675)	(0.0687)	(7.598)	(0.229)
*Price of oil * Fuel Share*	0.233	0.547	0.206	0.0851
	(0.377)	(0.377)	(0.308)	(0.212)
Arrears - Lagged	0.0350	-0.264***	0.0441**	0.163
	(0.0227)	(0.0433)	(0.0195)	(0.119)
Unemployment rate	-0.00991	-0.00791*	-0.0181***	-0.0439**
	(0.00608)	(0.00444)	(0.00504)	(0.0136)
Crime rate	-555.6*	412.5	-42.35	555.1
	(296.6)	(346.9)	(238.5)	(511.1)
Federal administrators	100.5***	41.89***	15.57	85.72**
	(19.32)	(9.562)	(17.59)	(27.65)

Table A3. The effect of fuel share and federal taxes on own regional taxes (1998-2012) – without year fixed effects and excluding Moscow

	Dependent variable: Log of deflated own tax per capita			
	(1)	(3)	(6)	(7)
Main variables	Fixed effects	Fixed effects	System GMM	System GMM
Period1*Fush	-0.448	-0.451*	-0.595*	-0.486
	(0.273)	(0.261)	(0.342)	(0.308)
Period2*Fush	-1.164**	-1.221**	-0.896**	-0.923**
	(0.523)	(0.495)	(0.338)	(0.354)
Period3*Fush	-1.341**	-1.390**	-1.157**	-1.082**
	(0.659)	(0.628)	(0.431)	(0.473)
Period1	1.098***	1.016***	-0.222***	-0.128
	(0.0434)	(0.0453)	(0.0458)	(0.0858)
Period2	0.989***	0.885***	-0.275***	-0.244**
	(0.0835)	(0.0840)	(0.0563)	(0.0968)
Period3	1.409***	1.263***	-0.00380	-0.0462
	(0.106)	(0.106)	(0.0693)	(0.124)
Fuel share	-0.811	-0.687	-1.662	-0.926
	(1.228)	(1.206)	(1.002)	(1.605)
Federal tax		0.0955***		0.307***
		(0.0168)		(0.0485)
Own tax_{t-1}			0.875***	0.678***
			(0.0231)	(0.0543)
N	1075	1075	1074	1074
Adj. R-sq.	0.943	0.946		
Hansen p-value			0.971	0.275
AR2 p-value			0.543	0.825

Note: Time period dummy variables include *Period1* for 2000-2004, *Period2* for 2005-2009, and *Period3* for 2010-2012. The base time period is 1998-1999. Heteroskedasticity robust standard errors are in parentheses. All tax variables are log of deflated per capita tax. All models control for fuel share, price of oil, price of oil*fuel share, unemployment, crime per capita, number of federal employees per capita, lagged tax arrears, and region fixed effects.

Table A4. The effect of fuel share and federal taxes on own regional taxes (1998-2012) – with year fixed effects excluding Moscow

	Dependent variable: Log of deflated own tax per capita			
	(1)	(3)	(6)	(7)
Main Variables	Fixed effects	Fixed effects	System GMM	System GMM
Period1*Fush	-0.413*	-0.417*	0.247	-0.612**
	(0.229)	(0.226)	(0.292)	(0.278)
Period2*Fush	-1.022**	-1.042**	0.0200	-1.029***
	(0.445)	(0.440)	(0.129)	(0.274)
Period3*Fush	-1.124**	-1.143**		-1.094**
	(0.557)	(0.552)		(0.327)
Period1	2.343	2.345	0.674***	0.496***
	(2.253)	(2.258)	(0.0798)	(0.0686)
Period2	4.673	4.688	0.371***	0.467***
	(5.899)	(5.912)	(0.0368)	(0.0566)
Period3	6.915	6.965		
	(10.42)	(10.44)		
Fuel share	-0.576	-0.538	-1.376*	-0.664
	(1.003)	(1.003)	(0.791)	(0.739)
Federal tax		0.0266**		0.0534*
		(0.0128)		(0.0316)
Own tax_{t-1}			0.809***	0.823***
			(0.142)	(0.135)
Own tax_{t-2}			0.0334	-0.0745
			(0.150)	(0.129)
Own tax_{t-3}			0.0441	
			(0.111)	
N	1075	1075	918	996
Adj. R-sq.	0.978	0.979		
Hansen p-value			0.458	0.808
AR2 p-value			0.288	0.182

Note: Time period dummy variables include *Period1* for 2000-2004, *Period2* for 2005-2009, and *Period3* for 2010-2012. The base time period is 1998-1999. Heteroskedasticity robust standard errors are in parentheses. All tax variables are log of deflated per capita tax. All models control for fuel share, price of oil, price of oil*fuel share, unemployment, crime per capita, number of federal employees per capita, lagged tax arrears, and region fixed effects.

Table A5. The effect of fuel share and federal taxes on own regional taxes (1998-2012) – without year fixed effects excluding Moscow

	Dependent variable: Log of deflated own tax per capita			
	(1)	(3)	(6)	(7)
Control variables	Fixed effects	Fixed effects	System GMM	System GMM
Price of oil	1.224***	1.173***	-0.0393	0.168
	(0.0717)	(0.0678)	(0.0450)	(0.114)
Price of oil * Fuel Share	0.334	0.272	0.705**	0.333
	(0.399)	(0.388)	(0.305)	(0.437)
Arrears - Lagged	0.0457*	0.0311	-0.215***	-0.307***
	(0.0246)	(0.0230)	(0.0244)	(0.0419)
Unemployment rate	-0.0147**	-0.00911	-0.0157***	-0.00962
	(0.00678)	(0.00618)	(0.00397)	(0.00610)
Crime rate	-733.0**	-710.0**	345.6	499.1
	(324.4)	(301.7)	(276.6)	(464.6)
Federal administrators	86.19***	99.22***	42.12***	54.35***
	(20.27)	(19.73)	(5.601)	(12.24)

Table A6. The effect of fuel share and federal taxes on own regional taxes (1998-2012) – with year fixed effects excluding Moscow

	Dependent variable: Log of deflated own tax per capita			
	(1)	(3)	(6)	(7)
Control variables	Fixed effects	Fixed effects	System GMM	System GMM
Price of oil	-2.742	-2.822	0.396**	0.605***
	(7.644)	(7.665)	(0.137)	(0.124)
Price of oil * Fuel Share	0.232	0.215	0.344*	0.416*
	(0.324)	(0.323)	(0.175)	(0.222)
Arrears - Lagged	0.0454**	0.0440**	-0.0693	-0.0750**
	(0.0198)	(0.0197)	(0.0479)	(0.0255)
Unemployment rate	-0.0192***	-0.0178***	-0.0102**	-0.0150**
	(0.00534)	(0.00507)	(0.00434)	(0.00492)
Crime rate	-54.82	-56.17	295.2**	287.9
	(246.4)	(241.4)	(133.4)	(220.2)
Federal administrators	9.265	14.36	19.71**	31.66***
	(17.22)	(17.47)	(6.331)	(8.412)