Resource Rents and the Russian Economy

Clifford G. Gaddy and Barry W. Ickes[1]

Abstract: The paper, by two prominent American specialists on the Soviet and post-Soviet economies, explores the role of Russia's energy resources. The authors offer a more inclusive definition of oil and gas rents than is traditionally given and analyze how the mechanisms for distributing those rents have changed over time. They show how fluctuations in the level of rents have played a key role in Russian economic performance. Oil rents, in particular, are shown to have varied widely over the past 35 years. The paper also examines how the distribution of rents affects the sustainability of production. It concludes with some reflections on the proper organization of the energy sector. *Journal of Economic Literature*, Classification Numbers: E60, O13, O17, Q43. 6 figures, 23 references, 2 appendices. Key words: resource rent, resource economy, transparency, Russian oil and gas, transition, Dutch disease, property rights.

INTRODUCTION

Russia is the second-largest producer of oil and the largest producer of natural gas in the world. The abundance of these and other resources has been a key determinant of Russia's economic evolution for decades. Throughout its modern history, the country's political economy has centered on the transfer of value created in the resource sector to other parts of the economy. During the Soviet era, resource abundance made it possible to impose a costly economic structure on society. Today, the bounty from Russia's resources continues to fuel its economy and its polity.

One of the main characteristics of value distribution has been nontransparency. Under the Soviet regime, the command-administrative system was able both to effect the value transfer and to conceal it by its formal pricing mechanism. In the post-Soviet era, new institutional structures evolved to perpetuate and hide the value transfers. In the past five years, progress in taxation and accounting practices has brought a significant proportion of the value transfer into the open. At the same time, the increase in the sheer volume of value produced in the resource sector has meant that large amounts of value continue to be distributed by nontransparent means. Unraveling how the wealth from Russia's energy production is redistributed remains key to understanding the country's political economy. The purpose of this paper is to estimate the total amount of value produced in Russia's oil and gas sector, to

[1]Respectively, Senior Fellow, The Brookings Institution, 1775 Massachusetts Avenue, NW , Washington, DC 20036-2188 [cgaddy@brookings.edu] and Professor, Department of Economics, The Pennsylvania State University, University Park, PA 16802 [bwickes@psu.edu]. We thank Anders Åslund, Julian Cooper, Richard Ericson, Silvana Malle, and seminar participants at Oberlin College and the VII World Congress of the International Council for Central and East European Studies for their comments on earlier drafts of this paper. We are responsible for any remaining errors.

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outline the manner in which that value is distributed, and to discuss the implications of the value-distribution mechanisms for the continued production of this wealth.

DEFINING RENTS

Traditionally, discussion of the value produced from the resource sector is couched in terms of rents. This terminology is a bit misleading. What we are really interested in is the surplus that is obtained from the production of gas and oil. To conform to the broader discussion, we too will employ the term "rent." We will, however, make the meaning precise.

We define rent as the revenue received from sale of the resource minus the cost of producing it. By this definition, rent is equal to economic profit, that is, revenues minus economic, or opportunity, costs (including depreciation of fixed assets and a "normal" return on capital).[2] To calculate rents we need estimates of market prices for oil and gas, the quantities of these commodities produced in Russia, and the cost of extraction and distribution for each. Production data for both oil and gas are readily available, as are world market prices for Russian oil. Because there is no single international market for natural gas, determining the true market price of gas presents special problems.

Obtaining good estimates for costs of extraction is even more difficult. There are both practical and conceptual problems. The practical difficulty stems partly from the fact that oil and gas are produced in Russia over a vast geographic area with widely differing cost conditions. The conceptual problem, however, is more fundamental. What we ideally want to estimate is the "natural" cost of production, as opposed to the reported cost at any point in time. By "natural" we mean the cost that would be incurred if the industry were organized efficiently—that is, the cost of production that would be incurred in a competitive market with free entry. The reported cost of production may include waste and inefficiencies. This was especially true during the Soviet period.

This distinction between natural and reported cost of production is important. Suppose, for example, that oil production is organized inefficiently. In particular, suppose that the wage bill is inflated by half, raising the reported cost of production. This reduces the profits of the oil sector. These extra wages, however, are distributed within the economy, so they still represent a share of the value from oil production. Hence, a proper measure of rents would not exclude this amount. Indeed, it is useful to think about the decomposition of total rent a bit further.

Let R_t denote the true total rent produced in period t, which is defined as:

$$R_t \equiv P_t Q_t - C_t, \tag{1}$$

where P and Q are the current spot price and the actual quantity produced, respectively, and C is the natural cost of production. If, however, one measures the production cost using data on the reported cost, the measure of rent that is obtained will be different. Let the reported

[2]This is to be distinguished from the notion of Hotelling (or scarcity) rent, which is defined as the unit price of a resource minus the marginal cost of extracting it (Hotelling, 1931). Hotelling rent is the theoretically correct measure of the value of resource depletion. It is often used in environmental economics (so-called "green accounting"). In practice, even these studies are forced to make the simplification of using average cost rather than marginal cost (thereby implicitly assuming a constant marginal cost). If marginal costs are rising, however, using average costs as a proxy will yield an overestimate of the Hotelling rent. This issue is not relevant for us, inasmuch as it is the total cost of extraction of annual output that we seek.

cost be $\hat{C}_t = C_t + \varepsilon_t$, where ε is the excess cost of production. Then the corresponding measure of rent, $\hat{R}$ will be

$$\begin{aligned} \hat{R} &= P_t Q_t - \hat{C}_t \\ &= P_t Q_t - C_t - \varepsilon_t . \end{aligned} \tag{2}$$

Further, note that while P is the market price, producers may receive less than this if there is a price subsidy. For instance, in the specific case of Russian oil and gas, the domestic price is below the world price, and exports to CIS countries are made at below market prices. Let price subsidies per unit of the resource (averaged out over the total quantity produced) be ρ. Then the total subsidy $S = \rho Q$. The actual producer price, $\tilde{P} = P - \rho$. Hence, pre-tax profits are given by

$$\pi_t = \tilde{P}_t Q_t - \hat{C}_t \tag{3}$$

The pre-tax (or operating) profits, however, are subject to further deductions, notably in the form of taxes. Here, it is useful to distinguish between formal and informal taxes. Formal taxes are those prescribed by legislation. Informal taxes are nominally voluntary but in fact mandatory for a business that wants to survive. The most common form of these "taxes" in Russia are bribes paid to government officials and payments made by enterprises to support the social sector of towns and regions, cultural programs, philanthropic giving, etc.[3] Both kinds of taxes are applied to the revenue received. For simplicity, assume that these taxes are levied as a share of profits, and let the formal tax rate be τ and the informal tax rate be τ'. After-tax profits can then be written as:

$$\begin{aligned} \pi_t' &= (1 - \tau - \tau')\pi_t \\ &= (1 - \tau - \tau')[\tilde{P}_t Q_t - \hat{C}_t] \end{aligned} \tag{4}$$

Notice that while π' is what is left over to the owners of the enterprise, it is R that matters to society. The difference between R and π' is distributed over a number of different categories, each accruing to a different claimant or group of claimants. Using the categories we have thus far identified, we see that the total surplus, R, can be divided into five categories: excess extraction costs, price subsidies, formal taxes, informal taxes, and the after-tax profit of the enterprise. Each of the categories represents a share of the total rent. How the shares are allocated has important political consequences. It obviously affects the political economy of a resource-based society. Even more important, as we shall discuss below, it also affects the future path of production.[4]

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[3]See Gaddy and Ickes (2002) for a discussion of formal and informal taxes.

[4]Note that for any country, P and C are exogenous. The former is given by the world market and the latter by the state of technology and the location of deposits. What about Q? Clearly it is endogenous. Typically the time path of production is taken to be given by the Hotelling rule: the production path should yield prices that grow at the rate of interest. A more subtle analysis would follow Adelman (Adelman, 1990) and argue that production depends on the marginal costs of discovery and development, net of taxes. But it is important to emphasize that in a case like Russia it is not the natural costs but the reported costs that matter.

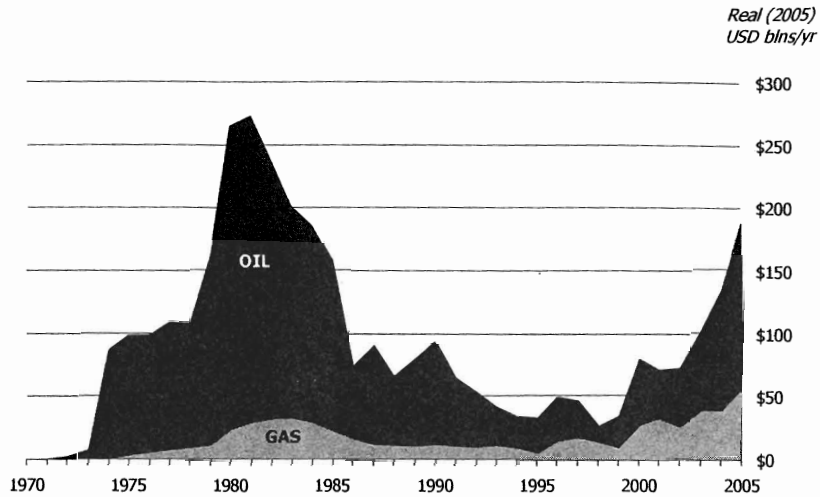

Fig. 1. Russian oil and gas rents, 1970–2005.

THE SIZE OF RENTS

In this section, we estimate the size of total oil and gas rents in Russia and look at their dynamics since 1970. This will give us an idea of the boost that natural resources provide to the economy as well as some idea of the spoils that are fought over.[5] In the estimates below we have used various estimates of reported costs rather than natural costs. In other words, we are omitting the excess cost of extraction, ε, from our empirical measure of rent and therefore are calculating $\hat{R}$ rather than R. This means that our estimates of rent are biased downward, especially, but not exclusively, for the Soviet period.[6]

Figure 1 presents estimates for oil and gas rent in Russia from 1970 to the present. Several points stand out. First is the sheer size of the oil and gas rents. For 2005, the estimated total rents are about 25 percent of Russia's current annual GDP in dollar terms; at their peak in 1981, they were over 40 percent of GDP. The second point is the dramatic movement of the rent total from a peak of well over $250 billion (in 2005 dollars) in 1981 to a low of barely $25 billion in 1998. As the figure shows, after the 1981 peak, the general trajectory was one of decline for 17 years, with a particularly dramatic plunge in the first five years of that period and a continuing milder downward trend through 1998. Since then we have seen just as dramatic a recovery. Indeed, the growth in rents from 1999 to 2005 is eerily similar to the one leading up to 1981.[7] A third point is the growing importance of natural gas. Since 1992 gas has accounted for about one-third of total rents.

A further important point about total rent is that movements in the price of oil dominate fluctuations in costs. This observation is robust to a fairly wide range of assumptions about extraction cost. For example, doubling the cost estimate for oil would only reduce total rents

[5]An alternative way to note the importance of energy to the economy is to attempt to re-evaluate sectoral shares of value added by undoing the effects of transfer pricing in the Russian economy. This produces much higher shares for energy than indicated by official data (e.g., see World Bank, 2004).

[6]See Appendix A for a note on costs and prices.

[7]Figure 1 also provides a different lens through which to view recent Russian history. Rather than see the past six years as a recovery from the 1998 financial crisis, one may view the years since 2000 as a recovery from the rent crisis that began in 1981.

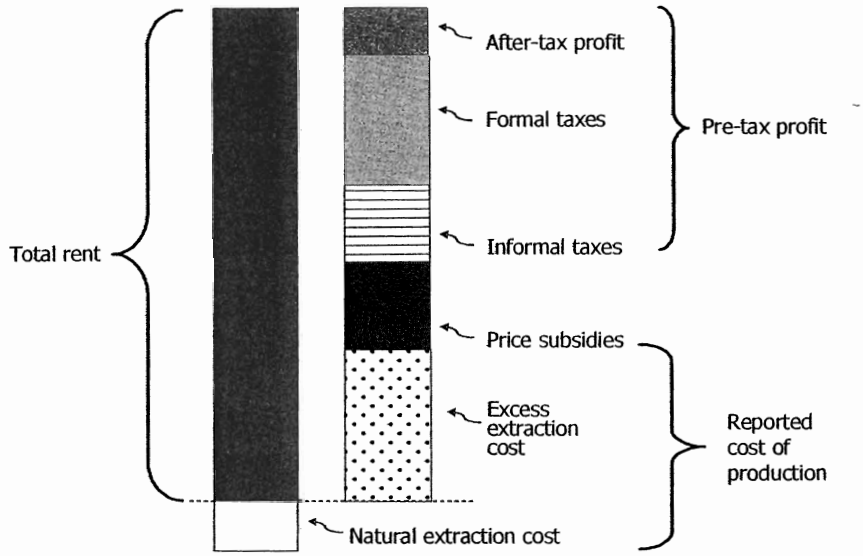

Fig. 2. Total value and its components.

from oil and gas from the peak year level of $270 billion (in 2005 dollars) in our baseline estimate to $240 billion. Costs clearly matter, and $30 billion is a significant figure, but the dynamics of total oil rent are governed primarily by oil prices and production levels.

THE COMPONENTS OF RENT

We have examined the overall size of oil and gas rents in Russia. We now return to the various components of rent identified earlier, as well as to how the rent-sharing mechanisms work and who benefits from them. Figure 2 gives a schematic representation.

This figure is merely a stylized version of the decomposition of rent. Restricting ourselves to five categories of rent is arbitrary. Each of these categories can be further disaggregated, and each resulting subcategory is subjected to further distribution. Furthermore, the relative sizes of the five components are not intended to reflect precise measurements.[8] It is more important to understand that each of the categories is significant and that each has a "constituency"—vested interests. So how the shares are allocated has important political consequences.

There are different ways to think about the components of rents. One way would be to distinguish between the part of the rent that is retained by the owners of the rent-producing assets and the parts that are distributed to other claimants in society. The part retained is the incentive to continue in business and to invest for the future.[9] This would be the true net profit, after deducting the value of subsidized sales, costs of production (natural and excess), and taxes (formal and informal).

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[8]Also, drawing such tidy lines of distinction between categories does not imply that one could as easily make the empirical assignment. For instance, when the oil company provides a high-paying front-office job to the daughter of the region's deputy governor in charge of the security services, is that excess cost of production or part of the informal tax?

[9]This ignores the fact that owners may also benefit from informal rents, for example, by using excess costs to cut formal taxes.

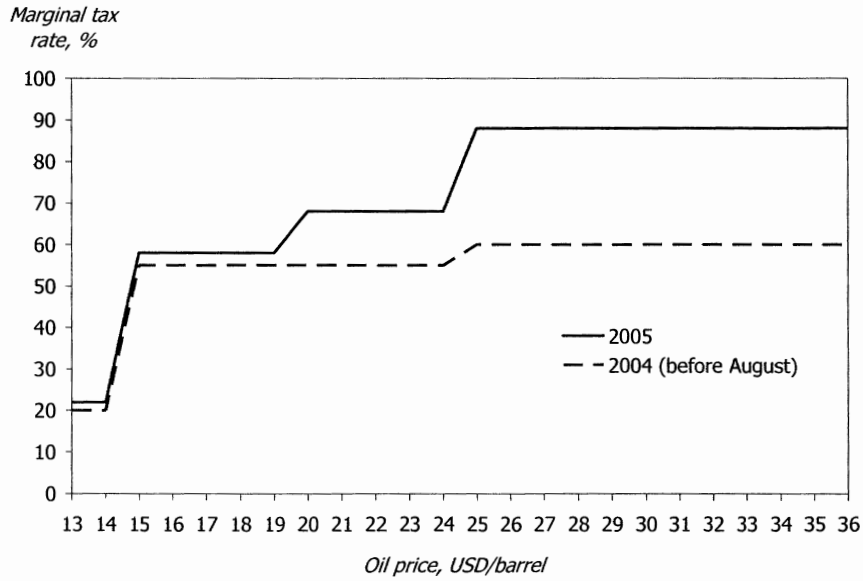

Fig. 3. Marginal oil tax rates.

This distinction is illusory. Owners may also benefit from the shares distributed to other claimants. This fact is critical to a central argument of our paper: For the resource owners, sharing rents with others is a way to enhance the security of their property rights. To put it another way, rent sharing is an investment in property rights protection. Because this is especially true when they share the rent by informal means, it is useful to distinguish rent that is distributed directly and formally from that which is distributed informally and indirectly.

Formal Rent Sharing

The formal categories—that is, profits plus taxes and other payments to the government—comprise those elements most frequently discussed, and are usually treated as the only flows that benefit the economy. This is clearly not the case. What is true is that formal rent is the most transparent element.

Formal Taxes. One of the accomplishments of the regime of President Vladimir Putin has been to increase both the relative and absolute amounts of rent that have been collected by government in the form of taxes and other revenues. Oil companies, whether privately owned, state-owned, or "quasi-state" entities, paid roughly 10 times more in taxes in 2004 than in 1999. Taxes as a share of total corporate revenue grew from 10–15 percent to 30–35 percent for most companies. As Figure 3 shows, the statutory marginal tax rate on oil is 88 percent.[10] The importance of oil on the Russian budget can be easily understood by

[10]Although tax rates are transparent, it is not always easy to know the total effect. For instance, in a nationwide television and internet chat with the nation in October, President Putin made a curious reference to taxation of the oil and gas sector. Replying to a question about high gasoline prices, Putin asserted that one problem was high taxes on the fuel sector: "I want to tell you that of the revenues [*vyruchka*] received by the oil companies, and by the fuel and energy sector companies in general, only 20 percent remains in their hands. The rest goes to the state in the form of taxes and other payments." He may have mistaken the marginal tax rate with the average rate. But consciously or not, he really may be correct. After all, rent is also distributed in the form of informal taxes and excess costs and subsidies.

comparing the fiscal balance at an oil price of $20 per barrel with the actual fiscal balance at current oil prices. The IMF has estimated that for 2004 the difference was equal to 5 percent of GDP, and for 2005 the difference is approximately 10 percent of GDP (IMF, 2005, p. 13).

Profits. Formal profits are clearly of greatest interest to shareholders.[11] Whether those who run oil companies are most interested in formal or informal rents depends, to some extent, on how well equity prices will value formal profits. YUKOS, for example, clearly changed its behavior in the late 1990s when it became clear that the owners could gain more from high equity prices on their shares than from stripping assets from their company. The adoption of new tax rates in the summer of 2004 led to a decline in formal profits for most companies. But this year they have soared again.[12]

Informal Rent Sharing

Informal rents are less transparent than formal rents. This can be valuable because it makes it easier to direct where the rents will go. Profits, for example, must go to shareholders, and the expenditure of formal tax revenue is governed by the political process. Informal rents, on the other hand, may be directed, to varying degrees, by the payee. This is particularly useful when rents are being used to purchase protection.

The use of non-transparent means to distribute the rents from energy windfalls for political purposes is not peculiar to Russia.[13] What is distinctive for Russia, we would argue, is the scale of the informal rent redistribution. Like the part of the iceberg that lies beneath the surface, the informal rent categories may turn out to be most important in assessing current and future economic and political developments. To take one example, one frequently hears statements to the effect that a decline in oil prices would have little impact on the Russian economy. The government's oil stabilization fund, it is said, absorbs the windfall. The core budget is sustainable at much lower oil prices. But this line of thinking is based on looking at formal taxes alone. In fact, we see that the formal taxes and the formal budget are only a part of the picture. Informal rent-sharing sustains a much broader part of the economy and society. Lower oil prices mean smaller overall rents, and thus less to be shared among all the categories—not just the part represented by formal taxes.

Price Subsidies. To some extent price subsidies are an element of formal rent sharing. For example, Russia charges lower prices for energy exported to certain CIS countries. This is part of government policy. But price subsidies are also used informally as a means of buying protection.

Russian oil is sold domestically at prices much lower than the price that same oil brings on the world market. Over the past two years, the domestic price has been anywhere from 31 percent to 46 percent of the world price. The price of oil exported to the CIS countries tends to be about half way between the domestic and world prices.

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[11]We are classifying all profits as part of the formal rent category. A fuller treatment would distinguish formal and informal profits. For a discussion see Gaddy and Ickes (2002, pp. 69-74).

[12]For example, Sibneft's net profits were up 44 percent in the first half of 2005 over the first half of 2004. Lukoil's profits for the period were up 53 percent (information from company websites).

[13]In their review of the political economy of resource abundant states, Auty and Gelb (2001, p. 132) noted that: "[O]ne characteristic of resource-abundant countries is . . . the use of indirect redistribution mechanisms to allocate natural rent." They observed that "the governments of predatory and factional oligarchic states prefer non-transparent methods for deploying the rents in order to maximize the scope for political maneuvering" (Auty and Gelb, 2001, p. 142).

For gas the same pattern holds. Gas is sold much cheaper domestically, and to states of the former Soviet Union, than to Western Europe. Allowing for the difference in delivery costs (so-called netback effects), gas that was sold domestically in 2004 at an average of around $30 per thousand cubic meters (tcm) was sold to FSU customers for around $36/tcm and to Western European clients for around $75/tcm. It would, however, be improper to treat the European price as a benchmark world market price for Russia's gas. Because Russia has such a large share of the European market for natural gas, it does not face a "world price" for gas the way it does for oil. If it were to sell more gas to Europe, it would have to accept a lower price (Tarr and Thomson, 2003). Nevertheless, by even rather conservative estimates of the "normal market price" of gas, implicit subsidies from the gas sector to households and enterprises in Russia are substantial. The OECD (2002) calculated that they were equal to about 5.5 percent of GDP in 2000.[14]

Informal Taxes. Bribes are a major component of informal taxes. One widely cited recent study of the corruption market in Russia (INDEM, 2005) asserts that the volume of bribes paid by businesses in the country increased more than ninefold between 2001 and 2004. This is a growth rate four times that of the federal budget in the same period.[15]

For social spending, there has been an interesting shift toward greater formality and transparency. The examples of companies like Sibneft and Lukoil are instructive. Both companies have made a special effort to publicize their activities. In April 2004 Sibneft released its first-ever "annual social report"—in effect, a public account of its informal taxes. Lukoil published its first such report in September 2005.[16]

Excess Costs. Determining the excess costs of production precisely is difficult. Excess costs are "excess" only in relation to a counterfactual, market-determined benchmark. What we can do is give some examples of the kind of behavior that falls into this category. It is well known that Russia's oil and gas industries are extraordinarily inefficient. Some observers have mused that this is not just due to incompetence but perhaps to conscious choice. One example is gas pipeline construction. Another is the example of rail transport of oil in recent years.

Shipping oil by rail is several times more expensive than by pipeline. The high cost of shipping by rail comes mainly from the high costs of the inputs—materials, labor—used to produce oil tanker cars. In other words, there is greater demand for inputs like steel and for workers in plants that can produce railway freight cars. The big producer of railway tank cars is Uralvagonzavod in Nizhniy Tagil—the tank manufacturer. This company has benefited greatly from the costly decision to ship oil by rail rather than pipeline. As Figure 4 shows, railway tank car production is higher now than it ever was during the Soviet period.

Transporting oil by rail is inefficient. But at the same time, it helps motivate the continued activity at one of the country's key industries left over from the Soviet times. Production itself—higher physical output—is thus part of the way the oil windfall is shared. This insight relates to the issue of "Dutch disease." In the classical form of this illness that affects

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[14]The OECD figure includes subsidies in the form of both cheap gas from Gazprom and cheap electricity from United Energy Systems (UES; mainly generated by gas).

[15]The total amount of bribes paid in 2004 is estimated at $300 billion. That figure seems inordinately high, even for Russia. (Russia's GDP is around $600 billion.) The high figure might be justifiable, however, if one assumes that it includes multiple counting of funds used for bribery. That is, the bribes received by one agent become the source of bribe money paid by that person to others in a possibly long "loot chain."

[16]These examples show that informality does not always mean complete nontransparency. Social and charitable spending are informal forms of rent sharing in the sense that the company can itself choose the recipient of the rents. It often does so in an opaque manner. After the distribution has occurred, however, the company sometimes values publicity about how much was given and to whom.

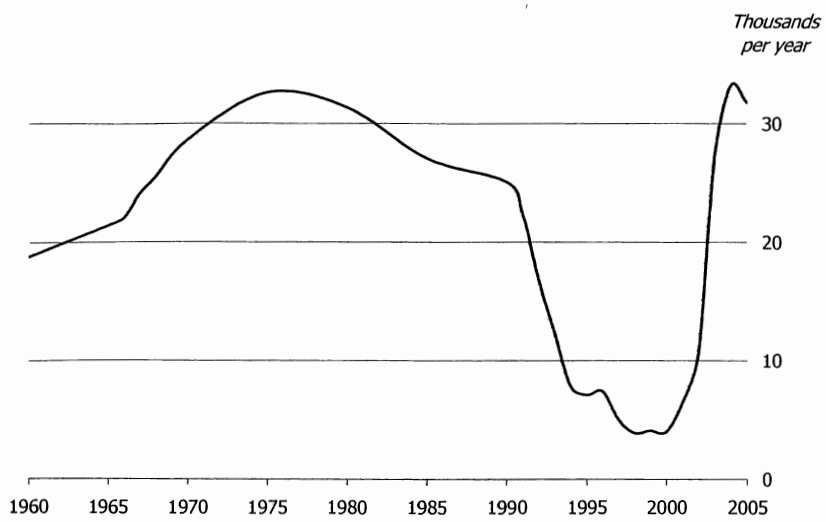

Fig. 4. Russian production of railway freight cars, 1960–2005.

resource-abundant economies, the resource sector squeezes out manufacturing. But when excess costs are an important form of rent sharing, as in Russia, manufacturing industries may benefit, rather than suffer, from the existence of a large resource sector.

So, while "Dutch disease" may afflict some countries, the rent deployment system we are describing means that Russia has a different disease. As a result of the demand from the oil sector firms, those parts of manufacturing that are contributors to excess cost benefit when Russian oil production increases.

There are two important points to note with regard to the "Russian disease." First, although manufacturing as a whole may not be squeezed by real appreciation of the currency, those industries that are in the tradable goods sector will be. Thus, there is a compositional shift in manufacturing, away from tradables and toward those sectors that supply the oil sector. Second, the consequences for the economy of an increase in oil rents differ depending on whether the increase is due to a rise in price or to a rise in production. Excess costs are more sensitive to the latter than the former. If production is stagnant while prices rise, the distribution of rent across components shifts away from what it is with production growing at constant prices.

RENTS AND THE ECONOMIC SYSTEM

Given the huge size of oil and gas rents and the manner in which these rents are then distributed throughout the economy, one would expect the dynamics of rent to impact overall economic performance. It may therefore be useful to compare the increase and decrease of the rents with movements in GDP over time.[17] The picture presented in Figure 5 shows that the two curves broadly trend alike. In the later period, post-1998, the recovery in GDP coincides closely with the recovery in rents. The big difference is that there is a decade-long delay after the sharp decline in rents in the 1980s before overall economic output collapses. We believe the explanation for this lag is that the continued growth of GDP after the rent collapse in the 1980s was partly an illusion. Soviet pricing was not eliminated until 1992.

[17]We use official Soviet indices of real "national income" growth for Russia for 1970–1990.

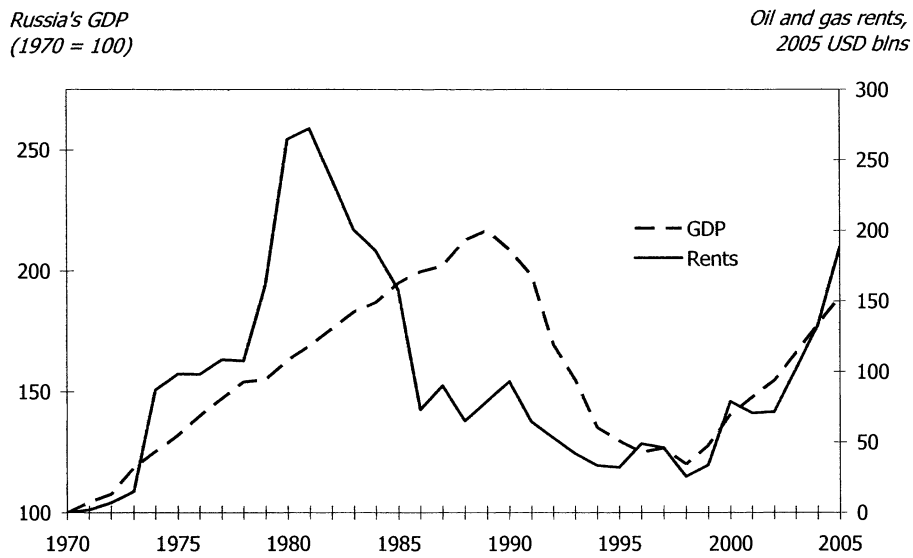

Fig. 5. Oil and gas rents and GDP since 1970.

Continued operation of the Soviet system meant that output could continue to grow in physical terms, even though it proved to be of very low value after price liberalization. In other words, illusory value remained in a large part of Soviet output. It was not until the market reforms of the 1990s that the bubble of fictitious value burst.

More important than matching the time series for GDP and resource rent perfectly, however, is to recognize the extent to which not just the Soviet *economy* but also the Soviet *system* rested on the huge volume of resource rents. This was a fact noted by Gregory Grossman:

> In sum, the Soviet economic system became what it is in part thanks to the country's rich resource base, which permitted the planners largely to ignore the day-to-day discipline of the balance of payments and therefore also the imperatives of the market place and the pains of real economic cost. On this basis an elaborate and rigid institutional edifice sprang up. This economic system thrived for two human generations and achieved marked successes by its own criteria. But inevitably it hardened and came to be supported and protected by powerful vested interests. (Grossman, 1983, p. 202)

If resource abundance was a pillar of the Soviet economic system, that abundance was itself in significant measure the result of another feature of the Soviet system, namely the extreme coercion that permitted the development of noneconomic resources. The prototypical example of this is the GULAG. Such projects as the White Sea Canal were only feasible in an environment in which labor was coerced. Hence some of the costs were shifted onto forced labor.[18]

[18]The appropriate comparison, perhaps, is the cost to the GULAG of keeping forced labor alive versus the compensating differential that the Soviet state paid to free labor to work in northern climates. Many projects that were feasible at the former "wages" would be infeasible at the latter.

The physical presence of a vast quantity of natural resources, in the context of a non-economic environment, jump-started the resource abundance theme in the Soviet Union. Physical resources existed, but they were not economically viable. The coercion of the Soviet system and the failure to recognize true (opportunity) costs developed these resources, providing the wealth that in turn allowed the system to perpetuate the gigantic mistakes it did.

In short, the entire Soviet system was built on the assumption of a persistent stream of available resource rents to keep it going. Once this fundamentally nonviable structure had been created, continued injection of resources was required to sustain it. It became a vicious circle: the more resource wealth there was, the more mistakes could be made. The more mistakes that were made, the more resource wealth was required to perpetuate the system.

In the 1970s this structure received a boost with the rapid, and unexpected, growth in rents that occurred from the West Siberian oil boom and then the OPEC price shock. Not only did the Soviet Union's own rents grow directly as a result of the oil boom, but many OPEC and other oil-producing countries increased their purchases of Soviet military goods.[19]

The windfall moved the Soviet Union away from what might have been a rather stable rent-deployment system to one where all the important political and economic groups drew up increasingly grandiose plans for the use of the windfall: expanding heavy industry domestically; building up a huge arms industry; engaging in adventures abroad that included subsidizing client states, more subsidies to COMECON countries, the war in Afghanistan, and so on. In effect the windfall was oversubscribed: there were too many claimants for too little value.

The lesson is that resource abundance, misapplied, can be addictive. The experience of large rents induces policymakers to expect that these will continue. When prices start to fall—as they did in the 1980s—the only way to maintain rent levels is to increase production.[20] But when opportunity cost is not considered, short-term production increases are likely to come at the expense of future output.[21] Soviet leaders applied extreme measures to maintain high production levels, including postponed maintenance of equipment, excessive use of water and steam injection, and focusing investment on current production rather than development and exploration. As a result, production did rise in the short term, but this was at the expense of a much larger output fall in subsequent years.

Thus, as oil prices collapsed in 1985, and production increases could not offset this fall, rents declined dramatically. This ultimately precipitated the collapse of the entire Soviet system. The Soviet collapse triggered the subsequent aggregate output fall. Part of that was illusory, as we pointed out above. But the decline in oil and gas output was real. Oil output fell from 569 millions tons a year (11.4 million barrels a day) in 1988 to 301 million tons a

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[19]See Kotkin (2001, p. 15) for a discussion of the oil windfall and bust and its impact on the demise of the Soviet Union.

[20]Note that if maintaining total rent, R, is the goal, excess costs, ε, are not an impediment. Value will still be distributed. Of course, the excess costs may not have been going to the constituents favored by Soviet authorities. It is also the case, however, that in the 1980s natural costs were rising due to investment and other mistakes. This did reduce total rents.

[21]Given the price of output and the costs of development and exploration for oil, and given an appropriate interest rate and any taxes, one can calculate an optimal rate of depletion. If prices were to fall, the optimal depletion rate would decrease, not increase. Raising the depletion rate in the wake of falling prices represents the response of authorities required to produce a given level of rents. The only way to increase the depletion rate would be to shift investment from exploration to development. But this is borrowing from the future. The alternative would be if some technological innovation could be applied to increase production, but presumably this would be deployed with or without a fall in prices.

year (6 billion barrels a day) by 1996.[22] The decline in gas production was less severe: from 643 billion cubic meters (bcm) in 1991 to 571 bcm in 1997.

The combination of a decline in both price and quantity meant that oil rents in particular vanished (see Fig. 1). They may even have been negative in the 1990s. Natural gas, on the other hand, continued to yield positive rents throughout the period. Gas sustained the economy—possibly including even the oil sector—during the mid-1990s. The elaborate and curious schemes of barter, mutual offsets, arrears, and other non-monetary settlements that we described as Russia's "virtual economy" evolved as the survival mechanism to allocate those gas rents on the thinnest of margins.[23]

The period of low oil rents and continued stable gas rents extended through the crisis of 1998 (see Fig. 1). In the late summer of 1999, oil prices began to recover, ending a period of sub–$20 per barrel oil prices that had prevailed almost without interruption since 1985–1986. The oil price rise dramatically changed the rent reallocation system. Before, the focus was on how to survive without cash. The burning issue now became how to share the cash produced by the oil export revenue windfall.

But looking back on the period before 1998, it is important to note that thanks to the value-transfer mechanisms of the virtual economy, much of the old, Soviet-style economic structure was preserved. Given that this structure was built up with the rents that were so high during the pre-1985 period, one would have expected that the extended period of low oil rents in the second half of the 1980s and throughout the 1990s would have been sufficient to force a much greater transformation of the Russian economy than actually occurred. That Soviet-era structure was clearly no longer affordable once rents declined. Market reforms should have led to extensive restructuring. That did not happen, primarily because rents from natural gas remained sufficient to support the structure. Thus, when cash flows increased after 1999, the old claimants were still present, demanding their share of the now-burgeoning rents.

EVOLUTION OF RENT SHARING

Rent deployment has always been central to Russia's political economy. In the Soviet era, it was easy: the companies were owned by the state, and the central planners allocated rent by the pricing system. From the planners' standpoint, this top-down system was an efficient means of deploying rent for purposes determined by the central political leadership. The situation in the 1990s was quite different. The resource companies were in private hands, and the government—both central and regional—was far too weak to itself administer rent deployment, whether through formal taxation or informal schemes. Yet rent sharing flourished in the 1990s. It was now a bottom-up scheme, one that culminated in the so-called virtual economy. The virtual economy was, in its essence, about informal rent sharing.

Why did the owners of the resource companies share their rents? It was because they lacked secure *de facto* (economic) property rights to what they legally owned. They needed friends and allies. The rents they shared were a form of investing in what we called relational capital—the political and personal goodwill they had with government officials and other business owners.[24] To avoid losing all their wealth, the owners of resource companies shared some of their rent locally as a means of guaranteeing that they could keep the rest.

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[22]For background, see Sagers (1996)—*Ed., EGE*

[23]See Gaddy and Ickes (2002) for a discussion.

[24]See Gaddy and Ickes (2002) for development of the concept of relational capital.

This was the system inherited by the current Russian leadership under Vladimir Putin. To them, however, it was unacceptable, for reasons separate from any adverse impact it may have had on aggregate economic performance. Putin did not like it because such a huge amount of wealth was controlled and produced in so few companies, with the rest of the economy dependent on them. He could not control, much less run, the country without being able to steer those flows to where he wanted—and, conversely, to prevent them from being used to establish a power independent of the center.

When Putin acceded to the presidency, the so-called oligarchs were on the verge of buying the state. As he came in, they were busy buying it up in regional chunks. He undercut that effort in two ways. First, he removed the object of purchase (the governors), and second, presented a credible threat to the oligarchs' property rights (using Berezovskiy/Gusinskiy as examples).

Note that the new Putin regime did not attempt to eliminate informal rent-sharing. Nor would it desire to do so; informal rent sharing affords the regime flexibility in directing where the rents will flow. The objective rather was to *centralize* informal rent sharing in order to control it. What he therefore has been doing is transforming, step-by-step, the previous schemes into a single, centrally run scheme, very much along the same lines—requiring constant investments by oligarchs to protect property rights.[25]

The current scheme, however, has at least three problems. One is that it is exceedingly wasteful for the entire society: non-transparency increases inefficiency, and excess costs can be wasteful. The second is the high tax burden. Formal taxes alone on resource companies in Russia are considered punitive. Add to that the burden of informal taxes, price subsidies, and excess costs, and the incentives for investing for the future become quite weak.

Third—and this is most subtle, but perhaps most important—the entire scheme requires the deliberate weakening of property rights. Owners with secure property rights have little reason to invest in relational capital (that is, to share their rents). Credible threats of expropriation are required to induce such investments. But this poses a major dilemma.

Economists would argue that the most efficient way to develop the economy as a whole, and the energy sector in particular, is through private ownership with secure property rights. A private sector with insecure property rights biases decisions toward too much current production and too little investment in new deposits. Businesses' time horizons are shortened, and this threatens the future of the sector. We see this occurring now in Russia.

THE CURRENT SITUATION

Oil and gas are the heart of Russia's competitive advantage, and they will remain so for years to come. The ultimate question for Russia is, how can the pie continue to grow, not just in the short term but over time and in a more sustainable way? This is a matter of relevance not just for oil and gas but for the entire economy.

Right now, continued growth of the pie is in doubt. In the first three quarters of 2005, crude oil production increased only 2.2 percent compared to the same period in 2004.[26] Exports were down 1.5 percent in the period (compared to growth of nearly 14 percent a year since 1999). At the same time, the price of Russian oil on world markets has continued to

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[25]Perhaps this process is better described as *Kremlinizing* rather than *centralizing*, as the idea was to enhance control not by the formal state but by the President and his minions. Note the contrast with increasing the formal taxes due the central government.

[26]The average growth rate for the previous five years had been 8.5 percent per year.

soar—up more than 25 percent over a year earlier. Higher prices should motivate companies to exploit new, previously uneconomic reserves. This is especially the case when prices have risen unexpectedly and when the price increase is likely to be temporary—something that the oil futures market seems to indicate.[27] With a higher current price, production should accelerate as petroleum that previously was better stored is now better produced.[28] Why does this process not work in Russia?

An important reason why production responded perversely to price increases is that since 2000 Russia may have prematurely tapped its submarginal reserves. It has in this period been producing oil faster than is economically justifiable.[29] The oil that should have been coming on to the market now as a response to the higher prices has already been produced. There is always an optimal rate of current production, given current expected future prices and costs of extraction versus development of reserves for the future. Russia has been extracting and exporting too much oil in the short term at the expense of long-run development. In this view, the current slowdown is an adjustment in response to past distortions.

The question is why has recent production been excessive? We suggest that the answer lies in two of the peculiarities of the rent-sharing mechanisms we described earlier. First, the resource sectors are overtaxed. They pay not only formal taxes but also the other three categories of informal rent-sharing. Such a high real tax burden leaves no means to invest. Second, property rights are insecure and, as a result, time horizons are short.[30] Because private owners of oil in Russia cannot be sure of their rights to the profits from the oil and even the oil itself, they have an incentive to get as much oil out of the ground and to the most lucrative market as quickly as possible. For them, time is more important than cost. A smaller profit in the hand today is worth more than the shaky prospect of a larger profit down the road. And they will act accordingly, even if it is not optimal in terms of development of long-term reserves.

Optimal Depletion and Property Rights

It is crucial to understand this tradeoff between the security of property rights and the current depletion rate. The rate at which a firm depletes a resource is traditionally thought to depend on the cost of production, current and expected future prices, and the rate of interest. We add to these factors the security of property rights. For any set of these variables, there will be some optimal depletion rate. Let us focus solely on property rights and assume that all the other factors remain constant. With completely insecure property rights, a private firm will undertake no production at all. If the security of property rights is above some critical level, the firm will find that production is feasible. It will, however, deplete the resource at a very high rate, because its discount rate is high. As the security of property rights increases and its discount rate declines, the depletion rate will slow until it reaches the optimal balance between current and future production.

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[27]One could purchase a futures contract for a December 2011 delivery of light crude oil on NYMEX for just less than $55 on November 9, 2005.

[28]We do not literally mean stored in above-ground reservoirs, but rather in undeveloped deposits. The decision problem facing oil producers is how to divide investment between exploration and development. If prices are temporarily low, development could be curtailed to reduce the depletion rate.

[29]Again, recall the Soviet energy crisis of the late 1970s and early 1980s. Through massive investment Brezhnev was able to forestall a dramatic decline in oil production, but this came at the expense of later production (see, for example, Gustafson, 1989, p. 64).

[30]See Adelman (1990) for an analysis of the economics of petroleum depletion. Note that Adelman's discussion of the role of the discount rate on the depletion rate focuses on present value and opportunity cost considerations, but he does not consider the implications of losing rights to the deposit altogether.

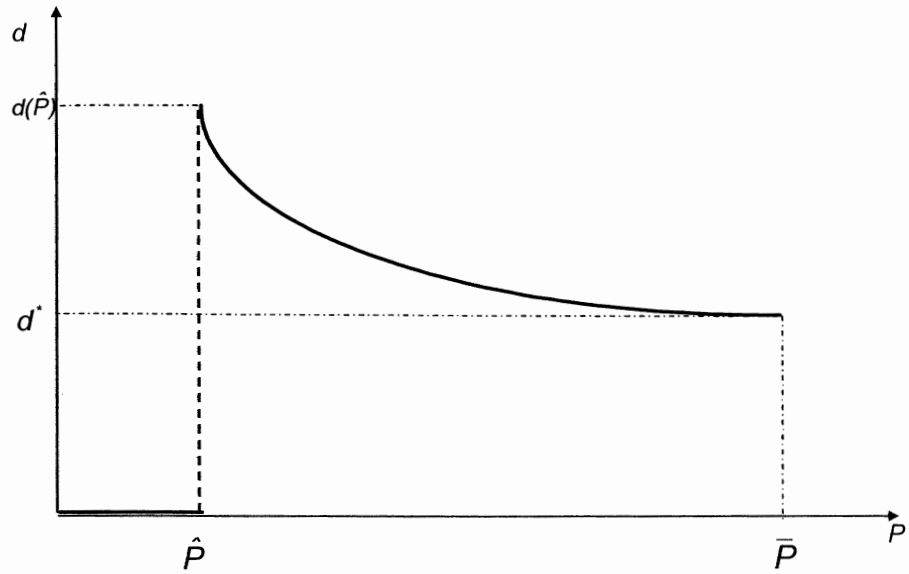

Fig. 6. Optimal depletion and property rights.

We find it useful to describe the relationship between property rights and depletion rates a bit more formally. Suppose that we can treat the security of property rights as a continuum from absolute ($\bar{P}$) to worthless ($\underline{P}$). For very low P the optimal depletion rate may be zero because even development expenditure is too risky. Let $\hat{P}$ be the minimal level of property rights so that depletion is positive. We denote by $d(P)$ the optimal depletion rate as a function of the level of property rights. Then $d(P) = 0$ for $P < \hat{P}$. If $P = \bar{P}$ the depletion rate will be that which maximizes the present value of production (given prices, etc.), so $d(\bar{P}) = d^*$. The interesting question concerns what happens to $d(P)$ for $P \in (\hat{P}, \bar{P})$. Our key result is that $d'(P) < 0$ in this interval, so an improvement in property rights reduces the depletion rate. Hence, we have Figure 6, with security of property rights, P, on the horizontal axis, and the depletion rate, d, on the vertical axis.[31]

Note that the level of P for any individual company depends on the general atmosphere of property rights security and a firm-specific component. The latter is a result of the firm's investment in relational capital in the form of informal taxes, excess costs, and price subsidies—in other words, the firm's rent sharing. By properly targeted rent sharing, the firm can enhance (protect) its property rights and thus move to the right on the P axis. Given the firm's optimal depletion rate curve, each position on the P axis also represents a certain aggregate value of the total resource that the firm is depleting (in present value terms). Any point to the left of $\bar{P}$ of the original thus represents a loss relative to the maximum attainable value of the resource, the one corresponding to d^*. The firm's decision about how much to spend on enhancing the security of its property rights (how much to invest in relational capital) will be based on a comparison of the cost of investing in relational capital, on the one hand, and the benefit of increased total value of the resource resulting from moving further to the right on the P axis as a result of that investment.[32]

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[31]For further analysis of the relationship between property rights protection and the depletion rate, see Appendix B.

[32]A faster rate of depletion leads to a lower present value of the resource. Clearly, any depletion rate greater than the optimal rate must lower the value of the deposit.

It is important to remember that Figure 6 depicts the situation for a single firm, not the entire national economy. At any given point in time, firms are likely to differ in their positions on the P axis. A picture of optimal depletion rates and property rights on the national level would therefore look quite different from Figure 6. In particular, because not all firms will find themselves at $\hat{P}$ at the same time, there may not be a discontinuity in the optimal depletion curve. The aggregate curve will depend on the distribution of firms' Ps. In general, a worsening of the overall property rights climate would shift all firms to the left. In practice it may be difficult to infer the general property rights climate if: (1) there is great variation in the firm-specific component of firms' Ps; or (2) one or two firms are so dominant that their individual Ps shape the overall picture.

What is important about this line of thinking is that it helps avoid the fallacy of viewing "security of property rights" as a uniform characteristic of the entire economy. That uniform, general element does exist. But it can be swamped by the variation in the firm-specific component of P, the part determined by firms' investments in property rights protection.

The YUKOS Example

Our argument about the relationship between property rights security and depletion rates is illustrated in decisions currently being made in Russia about production of oil and about its transport to markets. Look first at production itself. We can think of Russia's oil as two types, "old" oil and "new" oil. The new oil is the oil left in the ground, mostly in Western Siberia, during the late Soviet period and in the chaotic years of the early 1990s.[33] The new oil is in undeveloped fields in the even colder and more remote Eastern Siberian regions. Russian companies have pursued two different policies with regard to these deposits. In general, the companies that focused on the new oil were the state-owned companies and those controlled by Soviet-era insiders. The companies that concentrated on the old oil, in contrast, were private companies like YUKOS and Sibneft'. The state-owned and quasi-state companies had assumed that the old fields had to be abandoned. The new private owners in the oil sector were willing to think differently. They introduced new technology, especially foreign technology, and lifted the old oil.[34]

A key reason why the private owners chose the old oil was that it was easier to extract quickly, even if at a higher cost. The private companies had less secure property rights. Their discount rate was higher. A higher discount rate means that the value of newly developed fields is lower, because the opportunity cost is higher. When there is uncertainty over the future of one's property, the optimal decision is to deplete what you have, not to develop new fields for the future.

A similar argument holds in respect to transportation of the oil to market. Once the oil was out of the ground, the question was how to ship it out for export, given near-capacity utilization of existing infrastructure. As mentioned above, of the two alternatives, rail and pipeline, rail is much more expensive. Nevertheless, companies like YUKOS chose to ship by rail, paying an extra $6–8 per barrel.[35]

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[33]For an interesting analysis of Russia's oil reserves, see Dienes (2004) and Gaddy (2004).

[34]One would classify the TNK-BP partnership as an example of a new private Russian company partnering with a foreign company for this end.

[35]The point, then, is not that YUKOS opposed building new pipelines. It did not. But YUKOS could not wait for the pipeline to be built. Indeed, YUKOS supported the Murmansk pipeline project (now defunct) which would have helped transport West Siberian oil. The eastern route—now chosen—is of value only for East Siberia, primarily new oil.

It is useful to consider the following thought experiment. Suppose that there were another oil company with the same production profile as YUKOS—in other words, the same distribution of resources and assets—but more secure property rights. Would it have made sense for such a company to produce oil as fast as YUKOS in the last few years using tank cars for distribution, or would it have been more profitable to wait for more pipelines to be built? As property rights become more secure, the optimal choice moves towards slower depletion. Therefore, a company that was identical to YUKOS, except that it had more secure property rights, would choose to deplete at a slower rate, and faced with limited pipeline capacity would choose to transport less by rail. To sum up, weak property rights imply a high discount rate, which in turns leads to, first, more rapid depletion at the expense of development of new fields and, second, use of more costly modes of transport to get that oil distributed more quickly.

Now suppose that the assets of YUKOS are delivered to another company with more secure property rights. It follows that this company will choose a slower rate of depletion. In fact, had this company owned these assets before, it would have been depleting at a lower rate for some time. Thus, although prices continue to rise, the margins that would be tapped are already in production. This, indeed, is what can be expected in the real situation in Russia, as the assets of YUKOS fall into the hands of companies closer to the Russian state, and consequently with more secure property rights: they will not want to produce as fast as YUKOS did.

STATE CONTROL VERSUS WEALTH CREATION

The preceding analysis allows us to examine the critical choices of Russia's current leadership with respect to the organization of the energy sector. A convenient way to view the decision problem is to first consider the static problem: the tradeoff between the degree of security of property rights the government confers on private firms, on the one hand, and the volume of rent it can either collect directly or induce the firms to share, on the other. As Figure 6 showed, as long as security of property rights remains above some minimum level (the point we labeled $\hat{P}$), the weaker the firm's property rights, the greater the depletion rate (and thus the more rent that will be produced) in the current period. At the same time, weaker property rights compel the firm to share more of the rent with the rest of the economy in an effort to obtain some security and protection against expropriation. For the central leadership, this means greater revenues. For the short term, then, the answer is straightforward.[36] The optimal solution is to put each firm at its $\hat{P}$.[37]

Choosing the static solution, however, is myopic. A leader with foresight must recognize the intertemporal dimension to the problem. As we have examined, faster depletion means less investment in new deposits as well as more oil left unutilized in existing deposits. Weakening property rights protection shortens the time horizons of the producers, so it leads to less oil produced over the longer term. Distorting the depletion decision from the solution with $\bar{P}$ leads to a lower value for the present value of production. Thus the dilemma for the

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[36]On the practical level, the difficulty is knowing the $\hat{P}$, given the heterogeneity of the firms. Moreover, even knowing them, the government is not able to steer each firm individually. Its decision is to choose a general level of P that maximizes the current aggregate output of all firms—an even more complex problem. Choosing the optimal level of P presumes that the leadership actually knows the shape of the aggregate depletion curve. In practice, such knowledge is highly uncertain. At best, only approximate knowledge will be obtained by trial and error. Hence, one would expect periodic variation in P as the leadership ascertains how production and thus revenue varies. It is always optimal for a government to approach $\hat{P}$ from above. Overshooting would lead to collapse of the industry.

leadership is the tradeoff of revenue today for revenue tomorrow. The solution to this problem, of course, depends on the leaders' discount rate.

For the leader with foresight, it might appear that the complete solution to the problem is to choose $\bar{P}$, maximizing both longer-term viability of the energy sector and long-term formal tax revenue. This solution provides for Russia's energy future, and any shortage of revenue now can be offset by borrowing against future revenues and the foreign direct investment that would be encouraged by a regime of fully secure property rights. There is one problem with this choice, however, at least when viewed from the standpoint of the current Russian leadership: it entails a high risk of loss of control.

The central point about Russia's energy sector is how crucial it is to the entire economy. We have seen the sheer size of rents (Fig. 5) and how fluctuations in rents have buffeted the economy as a whole. Now suppose that the leadership were to choose the $\bar{P}$ solution. With full protection of property rights the power of the energy sector would grow dramatically compared with that of the state. Oligarchs would be able to purchase factions in the Duma and become independent powers.[38] With oil and gas playing such a large role in creating rents, full protection of property rights risks losing the state to the oligarchs.[39]

Consequently, for Russia's rulers the extreme asymmetry of economic power rules out the optimal solution—the $\bar{P}$ solution. This implies continued deviation from the optimal production path. The problems of excessive depletion of current reserves and low investment for the future remain fundamentally unsolvable within the framework of a scheme that allows private property rights in oil and gas but cannot ensure security of those property rights for fear of losing political control.

If neither private ownership with weak property rights nor private ownership with strong property rights serves the objectives of the leadership, the only alternative is still greater state control. This is the most troubling outcome of all. Extreme central control over the oil and gas sectors was the problem that afflicted the Soviets in the 1980s. That approach led to a succession of oil crises, primarily because a central planner cannot process sufficient information—let alone collect or induce truthful revelation of information—to choose optimally how to invest scarce resources in energy production. Without market feedback it is difficult to know whether to invest more in exploration or in development, whether to prospect for new reserves or develop existing ones, whether to seek out new regions or to use technology

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[37]If weaker property rights lead to more rent sharing then the decision maker's indifference curves in *d-P* space would be positively sloped; stronger property rights require greater depletion to create indifference. Given the kink in the depletion curve at $\hat{P}$, this means that the optimal solution must be at $\hat{P}$. Notice that even if the decision maker counted on no extra rent payments from weakening P we would still have the same outcome. This follows because in this case the indifference curves would be horizontal and the optimum would still be at $\hat{P}$. The only way that the optimal solution to the static problem could be in the interior of $(\hat{P}, \bar{P}]$, is if decision makers valued stronger property rights sufficiently to create negatively sloped indifference curves that were sufficiently steep to move the optimum to the right—that is, the (absolute value of the) slope of the indifference curve near the kink would have to be greater than the slope of the depletion curve in that neighborhood. What could cause this? Perhaps if formal taxes were *sufficiently* preferred to informal taxes, or if there was an ideological attachment to property rights independent of revenue. But this seems unlikely to be true in general; hence, we assume that the solution to the static problem is at $\hat{P}$.

[38]One might be tempted to argue that with the $\bar{P}$ solution the government could still obtain formal revenues. But if the oligarchs have full protection of their property, and if they buy control of the legislature, then they can set tax rates that lower their overall burden.

[39]It is instructive to recall the extent to which the robber barons in the United States were able to dominate politics even though they controlled a smaller share of the total economy.

to get more out of already producing wells. But the key problem is that a planner chooses one solution. Market competition allows many paths, and with more diversified choices there is a greater likelihood that the correct solution will be identified,[40]and that mistakes will not be made on a colossal scale.

CONCLUSION

Our story began by examining the way in which resource wealth is redistributed in Russia. We ended by showing how the peculiar manner of rent distribution negatively impacts production. Although it might seem self-evident that the question of how to make the production of Russia's oil and gas wealth sustainable is ultimately more important than how to redistribute that wealth, little of this awareness is reflected in Russian policy. High oil and gas prices keep rents high despite flagging output. And as long as rents remain extraordinarily high, political actors continue to be consumed by the struggle for control of distribution of rents.

In the longer term, a decline in prices is bound eventually to shift attention toward production. But even then, to seriously address the challenge of maintaining the resource base, attitudes towards resources will need to change. In large measure, the lesser importance attached to production compared to distribution flows from the prevailing view of resource wealth. Throughout history, resource extraction has often been viewed as an inferior economic activity.[41] That view is strong in Russia. It was Soviet tradition to regard the value that is produced in the resource sector as rent—a gift of nature—rather than as an inventory that has to be added to. Soviet attitudes also live on in the popular fear that if Russia remains primarily a producer of oil and gas, it will be merely "a raw materials appendage of world capitalism."[42] An emphasis on commodities production, it is argued, is incompatible with modernization. Investing in oil and gas will somehow make Russia more backward and dependent.

In such a view, the task of reproduction of raw materials wealth must be subordinated to that of using the rents for the benefit of the rest of the economy. For those who view

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[40]It was Friedrich von Hayek who argued that the true advantage of competition in an economic system is in discovering the right solution (rather than in most efficiently reaching a known solution). In his classic essay, "Competition as a Discovery Procedure," he noted that competition is especially important wherever "the primary objective is to discover the still unknown possibilities in a society where competition was previously limited. . . . [I]t seems incredible to me to hold that we can determine in advance the future structure of a society in which the major problem is still to find out what kinds of material and human productive forces are present, or that we should be in a position, in such a country, to predict the particular consequences of a given measure" (Hayek, 2002, p. 13). Certainly Russia qualifies as such a society.

[41]Even Adam Smith expressed such a negative view of resource wealth. The quest for mineral wealth, he wrote in *The Wealth of Nations*, was "perhaps the most disadvantageous lottery in the world." He continued: "Projects of mining, instead of replacing the capital employed in them, together with the ordinary profits of stock, commonly absorb both capital and stock. They are the projects, therefore, to which of all others a prudent law-giver, who desired to increase the capital of his nation, would least choose to give any extraordinary encouragement. . ." (Smith, 1937, p. 529)

[42]The application of that particular phrase to Russia appears to have originated with Joseph Stalin. In his speech at the 14th Congress of the Bolshevik Party (December 1925), Stalin fulminated against the plans of Trotsky, Zinov'yev, Sokolnikov, and others and defended industrialization: "Thus it follows that we must build our economy in such a way as to prevent our country from being turned into an appendage of the world capitalist system, prevent it from being included in the general system of capitalist development as its auxiliary enterprise, ensure that our economy develops not as an auxiliary shop of world capitalism but as an independent economic entity that relies principally on the domestic market" (Stalin, 1952, pp. 354-356).

resources as a gift of nature (not to mention those who believe resources are a curse), it is only logical to pursue policies aimed at harvesting the wealth and using it to reduce the dependency on resources as quickly as possible.[43] The economy must be diversified away from the resource sectors. The more heavily taxed the resources are, the better—provided that the proceeds from the resources accrue to other industries.

The histories of the leading resource-rich economies of the developed world suggest that this view is wrong. The economic historian Gavin Wright (2001, p. 3) has written that "the main failing of the recent literature is to regard natural resources as 'endowments' whose economic essence is fixed by nature. This characterization was not appropriate for U.S. history, and it is no more appropriate for the resource-based economies of today."

The United States became abundant in natural resources not though endowment alone but through extensive exploration and the application of technology. Its resource intensity increased historically as a response to market conditions. This created forward and backward linkages: forward to sectors such as petrochemicals that were based on the resource produced and backward to such industries as petroleum engineering and oil services that fueled future growth.[44]

Russia could follow such a path. But to do so would require abandoning the idea of resources as fixed sources of wealth worthy only of redistribution. And it would require proper organization of the sector. This would mean a sector open to new entrants, both Russian and foreign. The old and new companies would be free to compete (and be subject to the discipline of competition). They would be unburdened by the demands of onerous and opaque rent-sharing schemes. They would have secure property rights.

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[43]The gift of nature view is closely allied to the exhaustible resource view. If oil and gas are an exhaustible resource, the only question is when to distribute this wealth. The alternative view is that oil and gas represent an inventory that must be added to by investing in exploration and development (see Adelman, 1990).

[44]Wright describes the process for the United States: "In direct contrast to the notion of mineral deposits as a nonrenewable 'resource endowment' in fixed supply, new deposits were continually discovered, and production of nearly all major minerals continued to rise well into the twentieth century—for the country as a whole, if not for every mining area considered separately. To be sure, this growth was to some extent a function of the size of the country and its relatively unexplored condition prior to the westward migration of the nineteenth century. But mineral discoveries were not mere byproducts of territorial expansion. Some of the most dramatic production growth occurred not in the Far West but in older parts of the country: copper in Michigan, coal in Pennsylvania and Illinois, oil in Pennsylvania and Indiana. Many other countries of the world were large, and (as we now know) well endowed with minerals. But no other country exploited its geological potential to the same extent. Using modern geological estimates, David and Wright show that the U.S. share of world mineral production in 1913 was far in excess of its share of world reserves . . . Mineral development was thus an integral part of the broader process of national development" (Wright, 2001, p. 6).

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APPENDIX A. NOTE ON COSTS AND PRICES FOR OIL AND GAS

Estimating total rent from oil or gas requires knowing the market price for the resource and the cost of its extraction. We have made a number of simplifying assumptions in order to create the time series for rents from 1970–2005.

Prices

The world market price of oil we use is based on a combination of two sources. For 1970–1993, we use data from the U.S. Government's Energy Information Administration (EIA) [www.eia.doe.gov] for the price of oil imported into the United States. For 1994–2005 we use the world market price for Urals oil from the Scotia Group [www.scotia-group.com].

For natural gas we have assumed the market value of Russian gas to be the so-called net-back price of gas it exports to Western Europe. One could argue that this is too high a price.

Since Russia has a large share of the European market for natural gas, expanding its exports would depress the market price. Moreover, current pipeline capacity is such that increasing exports significantly is not feasible. To the extent this is true, the price we use overstates the opportunity cost of gas. This argument, however, ignores the fact that the timing of production could be altered. An alternative to using the gas domestically at low-value uses is to invest in export and pipeline facilities and export the gas in the future at higher prices.

Only from 1993 onward were we able to use official Russian government data for the gas price. For the preceding years we used the imported price of natural gas to the United States. For all years we adjusted prices to account for the cost of delivery of the gas to market. For the 1996–2005 period our estimates of these so-called netback effects are based on data provided in Gazprom financial reports. For earlier years we apply a slightly lower cost of transportation to the export markets than reflected in Gazprom's accounts of the past decade. In general, we suspect that our estimates of the delivery costs include a very large portion of excess costs.

Costs

For both oil and gas we have used the simplest possible assumptions of extraction costs. We assume a constant $8 dollars a barrel cost of oil and a constant $18 per thousand cubic meters of gas.

As noted in the text, we did not attempt to separate out what we have described as excess costs of extraction from the "natural" costs. A careful accounting of total rent would need to do this. We know that total (reported) costs have varied over the 35-year period examined. Gustafson (1989, p. 35) presented compelling evidence that costs of production rose rapidly for energy during the late 1970s and early 1980s. For example, the increase in energy investment between 1981 and 1985 absorbed nearly 90 percent of the increment allotted to all industry (Gustafson, 1989, p. 39). Similarly, Sagers (1987) reported that the marginal cost of production quadrupled between the 1970s and 1980 and continued to increase thereafter.

How much of these increases were necessary, and how much were excess? On the one hand, there were objective factors. We know that a major contributor to the cost increase was the movement of the center of the energy industry to West Siberia. This raised development and transport costs dramatically over what they had been in European Russia (Gustafson, 1989, p. 60).[45] At the same time, the oil and gas sector was plagued by the inherent waste and inefficiency of the Soviet system, and it is likely that the inefficiency grew worse in this period.[46] In fact, the post-Soviet experience of privatized Russian oil companies and the fact that numerous Western oil companies have tried to enter Russia suggest that the rapid increase in costs of production in the late Soviet period reflected inefficiency, not an increase in natural costs.[47]

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[45]This observation is highly relevant for the current situation today as well. Today, the center of production is moving farther east and north, and transport costs are even more important than before.

[46]Adelman (1995, p. 314) pointed out that many outside observers assumed that "aside from much incidental waste, the Soviet oil industry was not radically inefficient as compared with the capitalist world. Hence the 'rapidly rising marginal cost' was a fact of nature. But this was not true."

[47]Again, Adelman (1995, p. 314) noticed this at the time: "But what proved it . . . was the fact of numerous private oil companies' crowding into the FSU, trying to obtain production rights . . ."

APPENDIX B. UNCERTAINTY AND THE DEPLETION RATE

We are interested in how uncertainty over property rights affects the time path of depletion. Normally, one might think that uncertainty lowers current production. The intuition would be that there is an option value to waiting. But this intuition typically applies to uncertainty over prices. It could also apply to uncertainty about future costs. If prices or costs are volatile there may be an advantage to postponing costly actions today. For example, if there is a chance of higher future prices one may wish to deplete at a slower rate. Our concern, however, is with uncertainty over future expropriation. How might we think about this?

One might think that fisheries would be a good model to examine. The problem there is that there is no investment tradeoff. Weak property rights—a common pool—does lead to excessive production today, but this is a tragedy of the commons. Common to our problem is the fact that what is not harvested today is lost. But this is due to the competition from other fisherman. There is no serious investment decision involved in the fishery case. Our concern is with the production-investment margin, with a situation where the uncertainty is not over current but future property rights.

Consider an agent deciding at time t how much capital, k_t, to invest in a given deposit.[48] Returns at $t+1$ depend on investment and property rights in $t+1$, denoted by R_{T+1}, and are given by the function $V(k_t, R_{t+1})$ where $V(\cdot,\cdot)$ is increasing in both arguments and concave in k_t. Let the cost of investment be given by $c(k_t, R_{t+1})$ with $c_1 > 0$ and $c_2 \leq 0$. Optimal investment choice thus satisfies

$$\max_{k_t} \{W(k_t, R_{t+1})\} \equiv V(k_t, R_{t+1}) - c(k_t, R_{t+1}) \tag{5}$$

It follows that

$$\frac{\partial k_t}{\partial R_{t+1}} = -\frac{W_{12}(k_t, R_{t+1})}{W_{12}(k_t, R_{t+1})} . \tag{6}$$

How does an improvement in property rights effect investment? Since $W_{11} < 0$ at a maximum, $\frac{\partial k_t}{\partial R_{t+1}} > 0$ iff $W_{12} > 0$.

Suppose that in period $t+1$ there is some chance that the deposit will be expropriated, and let the probability of this event τ be a decreasing function of R_{t+1}; $\tau(R_{t+1}) \in [0,1]$, with $\tau'(R_{t+1}) < 0$. Then the expected return to investing is

$$V(k_t, R_{t+1}) = [1 - \tau(R_{t+1})]G(k_t), \tag{7}$$

where $G(k_t)$ is the physical return to investing. We should probably really use revenue here and write $F(k_t) = p_{t+1}G(k_t)$, and then we could also note that the future price is uncertain. But we do not need to consider that right now. It is then straightforward to calculate that

[48]The following is based on Besley (1995).

$$V_{12} = -\tau'(R_{t+1})G'(k_t) > 0. \quad (8)$$

Hence, as long as costs are independent of R_{t+1},[49] $W_{12} < 0$, so investment decreases with uncertainty over property rights.

This expropriation risk is acting like a random tax on future production. What does this mean in the Russian energy context? It means that increasing τ implies less investment in developing or exploration for future production. Instead, more resources are devoted to current production.

The complication might be if τ is a function of current production. That is, what if the likelihood of expropriation next period is increasing in current production and decreasing in investment in exploration? This is very complex.

Adelman Approach

In Adelman's model, investment plays a central role in the development of deposits. The agent equates the marginal costs of adding to inventories via finding new deposits, developing existing deposits, or buying developed deposits.

In Adelman's model, the optimal depletion rate, a^*, is that rate at which there is no gain from moving production between present and future. He shows that the interest (discount) rate has two offsetting effects on a^*. A higher discount rate raises the premium on near-term revenues. But it also raises the opportunity cost of investment to obtain those resources. These two effects tend to balance out, so the discount factor has little effect on depletion rates.

One might assume that if the interest rate has an ambiguous effect on depletion rates then the security of property rights does as well. But this is incorrect. The reason is that while insecurity of property rights implies that future revenues are discounted at a higher rate, it leaves the opportunity cost of investment unaffected. Unlike the standard case that Adelman considers, a change in property rights protection has an asymmetric effect. The agent is still faced with the given cost of funds, so a higher depletion rate will be optimal with an increased fear of expropriation.

The preceding argument presumes that that interest rate firms face are independent of future expropriation risk. One might suppose that they could be related. But if so, this strengthens our argument. Suppose the firm has to finance externally two types of projects: (1) a development project for future production; and (2) a development project for current production. If the firm faces expropriation risk, the value of its collateral is lower in the case of the first project. Hence, it will face a higher cost of funds in the first case than in the second. Because the expropriation risk also means future revenues are discounted faster, this leads to an even higher a^*.

Options Approach

One way to value a developed reserve is as a call option.[50] The problem is when to develop a reserve that has been explored. If development is delayed one postpones the net revenue (accounting for depletion) from production. To exercise the option one must pay the

[49]Of course, it is very hard to see how an improvement in property rights could raise costs.

[50]See Dixit and Pindyck (1994) for an analysis.

development cost. The time to maturity is governed by the relinquishment requirement—the time at which one loses the right to develop if no investment has taken place. Uncertainty could concern either future prices or costs of development. The important result is that the value of a developed reserve is greater than the net present value calculated using current prices.

By producing today (exercising the option) one loses the value of waiting. The benefit of waiting is that prices may be higher in the future. In this type of analysis the relinquishment requirement does not play an important role. The reason is that in this model the firm only relinquishes an undeveloped reserve. Hence, the loss from current production is the potential of higher future profits. But if there is expropriation risk, the cost of waiting is higher as well. Even if greater price volatility implies that one may want to wait, delay in development means that there is a greater chance that the *developed* asset will be expropriated. This is a risk not considered in the standard analysis. This suggests that when expropriation risk is important development may occur sooner than otherwise.