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Implications of Revenue Sharing for the Problem of Insecure Property Rights


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В данной работе исследуется эффективность трех типов собственности: “частной собственности”, “региональной собственности” и “федеральной собственности”, при отсутствии надлежащей защиты прав собственности от посягательств государства. В работе проанализировано, как разделение наблюдаемых доходов между двумя уровнями правительства государства-Левиафана влияет на экономику. Показано, что изменения в распределении переговорной силы между центром и регионами могут привести к существенным изменениям в уровне общественного благосостояния. Когда регионы получают достаточно большую долю налоговых поступлений, частная собственность может стать более эффективной, чем прочие формы собственности даже в экономике с неразвитыми рыночными институтами.


The paper analyzes efficiency of three types of ownership: “private ownership”, “regional ownership” and “national ownership” in an environment without protection of property rights against state encroachment. It is explored how sharing of observable returns between two tiers of a Leviathan state affects the economy. It is shown that changes in the distribution of bargaining power among the center and regions can lead to substantial changes in the total social surplus. When regions obtain a sufficient share of tax returns private ownership can become more efficient than other forms of ownership even in an immature market environment.

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1. Introduction

It is widely believed that clearly defined property rights are necessary for economic prosperity. Four characteristics of property rights systems that most strongly affect economic behavior can be distinguished (Weimar, 1997): clarity of allocation, cost of alienation, credibility of persistence, and security from trespass. However, property rights systems existing in Russia and other transition economies have features that adversely affect economic efficiency.

The Soviet Union had less clear allocations of use rights than do market economies due to predominant shares of state and common property. The weakening of the central political and economic planning institutions in Russia exacerbated the problem of clarity of allocation. This problem unavoidably results in a rise of costs of alienation. The more costly is to alienate property, the less effectively market forces can move commodities and assets to their highest-valued uses. Investors in Russian companies sometimes face the necessity to be involved in long and costly negotiations with third parties, if not in wars with them, to acquire actual control over the property, for which they already paid money. One of the last striking examples of such an increase in costs of alienation is a purchase of Vyborg pulp and paper mill (Kommersant, December 23, 1999).

Currently held property rights are only a part of the picture, credibility of their persistence is also important for efficiency and economic growth. In Russia, in particular, credibility of property rights is undermined by widespread perception that the Russian privatization was unfair, and, for this reason, can be revised (see Polishchuk, 1999). The fact that legality of the privatization of Norilsk Nickel is contested in court may serve as an example (Kommersant, June 21, 2000).

If state predation, which is the main focus of this paper, occurs in Russian regions, it often takes form of bankruptcies of fully viable enterprises, initiated by
regional governments. The central government not only fails to prevent such abuses, but itself can be engaged in violation of shareholders’ rights, as it was with Transneft Company in Moscow (Itogi, September 28, 1999).

The problem of insecure property rights is therefore highly important for Russia, and calls for analysis of economic institutions under insecure property rights. Development of the theory of insecure property rights was recently inspired by the relative success of Chinese economy (Chang and Wang, 1994, Che and Qian, 1998, and Li, 1996). However, the problem of application of theories constructed to describe Chinese experience to Russian situation requires a thorough analysis.

Li (1996) argues that ambiguous property rights in an immature market environment can be more efficient than unambiguously defined private property rights. Ambiguous property rights are a response to high transaction costs and high uncertainties in the market place. The intuition behind this conclusion is as follows. Agent $E$ identifies a profitable project and makes initial investment $k_E$ in the project. In the next period, either the effort of $E$ or the effort of another agent $G$ is needed in the project, depending on the realization of uncertainty. Unable to enter into contingent contracts, $E$ decides whether to own the firm solely, or to bring in $G$ as an ambiguous owner and then fight against $G$ for actual control in the next period. For $E$, the benefit of being a sole owner is that when the project is productive in the next period, $E$ can reap all the profit, instead of engaging in bargaining with $G$. On the other hand, the cost of being the sole owner is that if, in the next period, $G$’s effort is needed, $E$ has to negotiate with $G$. Not being in the same firm, such negotiations may be more costly than those may when $E$ and $G$ share the ownership. As a result, $E$ may not get the services of $G$. To summarize,
the choice of ownership form is dependent on how likely $G$ is to be productive and how $E$ and $G$ negotiate when $G$ is not an ambiguous owner.

Che and Qian (1998) consider ownership of firms in an environment without secure protection against state encroachment. In this situation nothing prevents the central government to rob both enterprises and an intermediate, regional tier of the government. Three major problems can arise. First, underprovision of efficient efforts by managers. Second, underprovision of public goods. And third, costly revenue hiding. The importance of each of these problems depends on the form of ownership. Three forms of ownership are considered: private ownership, regional ownership and national ownership. Under private ownership an owner has no choice except for revenue hiding, the public good is not provided, but managerial efforts are exerted. Under the other forms of ownership managers have no incentive to exert efforts. But while national ownership fails to provide incentives for the regional governments in a credible way, regional ownership integrates government activities and business activities, therefore it may credibly limit state predation, increase public goods provision, and reduce costly revenue hiding.

While it may seems natural to consider one major predatory (alas) force – a central government – in China, Russian entrenched regional elites can be perceived as another, comparable to the center, predatory force. Only several months ago it was a widespread opinion that the central government does not have enough power to decide by itself what to take from the regions. The federal center has to negotiate with regional leaders the terms of fiscal policy and to set up a share of taxes that is left in the regions. Today it is argued that devolution stopped and new centralization is in progress. Therefore, the problem how the distribution of power among several predatory forces affects the economy becomes highly important.
In this paper it is assumed that the national and regional governments share revenue extracted from enterprises. Revenue sharing brings about results that are quite different from those of Che and Qian. For, the regional government receives a part of revenue extracted by the state, it carries out efficient government activities under private ownership, while managers of firms exert required efforts. Moreover, the level of revenue hiding may also diminish. Revenue sharing in a federal state with imperfect law enforcement was also examined in Treisman (1999).

Papers by Li, and Che and Qian underline importance of the ownership forms that combine both business and government activities in the imperfect market environment. In this paper we consider how pure private ownership can be made more efficient in the case when there are two smaller Leviathans in the economy instead of big one. It is a widespread opinion (see Brennan and Buchanan, 1990, Inman and Rubinfeld, 1997, McKinnon and Nechyba, 1997, Polishchuk, 1998) that insufficient separation between the central government and the regional governments resulting in so called “cooperative” federalism leads to serious distortions in policies of governments of both levels and consequently economic losses. Clear-cut separation between areas of control of different levels of the government is supposed to be a prerequisite for “market preserving” federalism. However we show that according to “the tragedy of commons” phenomenon loss caused by predatory activity of governments is reduced under revenue sharing. Incentives of both managers and bureaucrats become more aligned with activities that increase economic efficiency.

The paper is organized as follows. Section 2 presents a basic model of insecure property rights developed by Che and Qian. Section 3 examines three forms of ownership when revenue sharing is incorporated in the model. In Section 4 comparison of social welfare under different ownership forms is carried out. In
Section 5 robustness of results is checked. In the final section concluding comments are presented.

2. The model
The model presented in this section is based on the model developed by Che and Qian (1998).

One business project is considered. The technology of the economy consists of two activities and covers two periods. The first activity is “business activity”. An individual who operates a business project is called “manager” (denoted by $M$). The manager’s (unobservable) “effort” $a$ enhances the first-period return, $R_1 = R(a) > 0$ for all $a \geq 0$, which is increasing and concave in $a$, at cost $D(a)$, which is increasing and convex in $a$. The second-period return $R_2$ is assumed to be independent of $a$ for simplicity.

Returns in both periods have an “observable” and an “unobservable” part. The division of $R_2$ is fixed, $(1 - \lambda)R_2$ is observable, and $\lambda R_2$ is not. The division of the first-period return is determined by project type $q$ ($0 \leq q \leq 1$), $(1 - q)R_1$ is observable, and $\alpha(q)R_1$ is not. The “control decision” of choosing $q$ reflects the right to control over the books and accounts of a firm, and ultimately to determine revenue hiding.

The right of undertaking the task of control over the project type is the first right of an owner of the business project. The other feature of ownership of the

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1 Revenue hiding is costly, and the net hidden revenue $\alpha(q)$ is such that $\alpha(q)$ is concave, $\alpha(0) = 0$, $\alpha'(q) < 1$ for all $q$. The dissipated part of the revenue $q - \alpha(q)$ is increasing in $q$. The idea that hiding every penny (i.e., $q = 1$) is extremely costly is captured by the condition $\alpha'(1) < 0$. 
project is the right of receiving an unobservable part of the revenue. That is the definition of ownership combines rights of control and for return.

The second activity is “government activity” that involves the task of providing local public goods. Local public good allows increasing the second-period return $R_2$. Local public good is provided by an agent called the “local (or regional) government” (denoted by $G$). Two factors determine the effectiveness of local public good provision in enhancing business projects: the local government’s (unobservable) effort $g$ and total expenditure $A$ on the government activity:

$$R_2 = gh(A),$$

where $h$ is an increasing and concave function of $A$. Expenditures are allocated by the national government (denoted by $S$) and by the owner of the business project.\(^2\) For simplicity, only two levels of $g$ are allowed: $g = 0$ and $\bar{g} > 0$, with the associated costs $C(0) = 0$ and $C(\bar{g}) = C > 0$.

Che and Qian model the situation of insecure property rights where both the national and local governments are not constrained by the rule of law, i.e. they assume that the local government can tax away any observable revenue from the manager, and the national government can tax away any observable revenue from both the manager and the local government. We modify this assumption by allowing the national and local governments to share taxes extracted from the manager. We assume that the national government receives a share $1 - r$ of all observable revenue, and the local one receives a share $r$ ($0 \leq r \leq 1$). In other words, we consider the federal state with revenue sharing, so it would be more correct to call the local government the regional government, and $r$ can be seen as a measure of bargaining power of the regional government. It should be noted that it is,

\(^2\) The last assumption reflects widespread participation of Russian firms in provision of local public goods, such as utilities, roads, building houses for their workers that was reduced but not eliminated since the Soviet times.
certainly, not a conventional federal state but a Leviathan state with two centers of power.

Three types of ownership are considered: private ownership, when $M$ has control over project type $q$ and receives unobservable revenue; regional ownership when $G$ has those rights; and national ownership when $S$ has those rights. The sequence of events is as follows. At the beginning of period 1, the owner of the business project selects project type $q$, and $M$ makes an effort decision. Then the first-period return is realized, $(1-q)R_1$ is observable, and $\alpha(q)R_1$ is not. At the end of period 1, the national government preys on observable revenue from the manager and the regional government, but returns a share $r$ of it to the regional government, and decides how much revenue $E$ to give to $G$ for government activities. Simultaneously, the owner receives unobservable revenue and decides how much of its revenue $e$ to spend for government activities. This determines the total expenditure $A = e + E$. In the second period the regional government decides on whether to exert efforts for government activities, and then the second period return is realized, $(1-\lambda)R_2$ is observable, and $\lambda R_2$ is not.

To carry out comparison of the social welfare between different forms of ownership, it is necessary to specify the utility functions of the three players. Let $I_k$ and $J_k$ be the consumption by $k$ ($k = M, G, S$) in period 1 and period 2, respectively, and $\delta$ be the common discount factor. We assume that the agent’s utility equals the discounted sum of its consumption. The utility functions of the agents depending on the form of ownership are presented in the table.
The total social surplus is equal to $U_M + U_G + U_S$. In the case when the regional government exerts the effort level $\bar{g}$, the total social surplus is equal to

$$(1 - q + \alpha(q))R(a) - D(a) - A + \delta(\bar{g}h(A) - C).$$

When $g = 0$, the total social surplus is equal to

$$(1 - q + \alpha(q))R(a) - D(a).$$

3. Equilibria

In this section we prove propositions that describe functioning of the economy under three types of ownership. In the next section we compare social welfare under different forms of ownership according to these results.

From now on we assume that the national government has more incentives to contribute to financing of the public good than the owner (if other) of the business project.

**Assumption 1.** $\lambda < (1 - \lambda)(1 - 2r)$. 
The following assumption shows that provided for positive efforts by the regional government it is profitable for the national government to spend on the public good.

**Assumption 2.** \( \frac{1}{2} \delta g'(0) > 1. \)

**Private Ownership**

Let \((q_M, a_M, e_M, E_M, g_M)\) be an equilibrium under private ownership. Now the manager has control over \(q\). The regional government exerts effort \(\bar{g}\) if and only if

\[
r(1 - \lambda)\bar{g}h(e + E) > C.
\]

At the end of period 1, after \(q\) and \(a\) are chosen and \(R_1\) is realized, the national government and the manager simultaneously allocate a part of their revenues for government activities. For any given \(e\), the national government chooses \(E\) and \(I_S\) to

\[
\text{max} \quad I_S + \delta(1 - r)(1 - \lambda)\bar{g}h(e + E) \\
\text{subject to} \quad E + I_S \leq (1 - r)(1 - q)R(a), \\
E \geq 0 \text{ and } I_S \geq 0.
\]

For any given \(E\), the manager chooses \(e\) and \(I_M\) to

\[
\text{max} \quad I_M + \delta \lambda \bar{g}h(e + E) \\
\text{subject to} \quad e + I_M \leq \alpha(q)R(a), \\
e \geq 0 \text{ and } I_M \geq 0.
\]

Let \(E_M^* = \text{argmax}\{\delta(1 - r)(1 - \lambda)\bar{g}h(E) - E\}\) be the amount of revenue that the national government would like to spend on local public goods provision in a situation without liquidity constraint and without any contribution by the manager. Analogously, \(e_M^* = \text{argmax}\{\bar{a}\bar{g}h(e) - e\}\) can be defined for the manager.
If the manager were interested only in her utility in the first period, she would choose the level of revenue hiding \( q_1 : \alpha'(q_1) = 0 \) and the level of efforts \( a_1 : \alpha(q_1)R'(a_1) = D'(a_1) \). We define \( q_2 \) as the project type when the manager realizes that revenue sharing affects the amount of expenditures by the national government on government activities in the second period. From the equation \( \alpha'(q_2) = 1 - r \) \( q_2 \) can be found,\(^3\) obviously \( q_2 < q_1 \). The corresponding level of efforts is \( a_2 : \)

\[
(\alpha(q_2) + (1 - r)(1 - q_2))R'(a_2) = D'(a_2), \ a_2 > a_1.
\]

**Proposition 1.** Under private ownership and Assumptions 1, 2:

1. the regional government has an incentive for the government activity \((g_M = \bar{g})\) for sufficiently small \( C > 0 \);
2. the national government leaves the regional government with \( E_M > 0 \) for the government activity;
3. if \( E_M^* \leq (1 - r)(1 - q_1)R(a_1) \) the manager hides revenue to the maximum degree \( q_M = q_1 \), and chooses the level of efforts \( a_M = a_1 \), contribution to the government activity equals \( A = E_M^* \);
4. if \( e_M^* \leq (1 - r)(1 - q_1)R(a_1) < E_M^* \) the manager chooses \( q_M = q_1 \), \( a_M = a_1 \), contribution to the government activity equals \( A = (1 - r)(1 - q_1)R(a_1) \);
5. if \( (1 - r)(1 - q_2)R(a_2) < e_M^* \leq ((1 - r)(1 - q_2) + \alpha(q_2))R(a_2) \) the manager chooses \( q_M = q_2 < q_1 \), \( a_M = a_2 > a_1 \), contribution to the government activity equals \( A = e_M^* \);
6. if \( ((1 - r)(1 - q_2) + \alpha(q_2))R(a_2) < e_M^* \) the manager exerts even more efforts \( a_M = a_3 > a_2 \), contribution to the government activity equals \( A = ((1 - r)(1 - q_2) + \alpha(q_2))R(a_2) \).

**Proof.** See in the Appendix.

It is worth comparing these results with results obtained under private ownership by Che and Qian that correspond to the case \( r = 0 \). The regional

\(^3\) \( q_2 = 0 \), if \( \alpha'(0) < 1 - r \).
government under revenue sharing is motivated to exert efforts for government activities, also the national government leaves a part of its revenue for it. Revenue sharing allows avoiding underprovision of effective government services, although under private ownership excessive revenue hiding is likely to happen. The fact that the manager’s efforts are strictly positive and government activities are carried out allows us to hope that private ownership may be more effective than regional ownership under state predation.

**Regional Ownership**

Let \((q_G, a_G, e_G, E_G, g_G)\) be an equilibrium under regional ownership. Now the regional government has control over \(q\) and unobservable revenues. For this reason, the manager receives nothing and has no incentive to make any effort \((a_G = 0)\). The regional government exerts effort \(\bar{g}\) if and only if

\[(\lambda + r(1 - \lambda))\bar{g} h(e + E) > C.\]

At the end of period 1, after \(q\) is chosen and \(R_1\) is realized, the national and regional governments simultaneously allocate a part of their revenues for government activities. For any given \(e\), the national government chooses \(E\) and \(I_s\) to

\[
\max I_s + \delta(1 - r)(1 - \lambda)\bar{g} h(e + E)
\]

subject to \(E + I_s \leq (1 - r)(1 - q)R(0)\),

\[E \geq 0 \text{ and } I_s \geq 0.\]

For any given \(E\), the regional government chooses \(e\) and \(I_G\) to

\[
\max I_G + \delta(\lambda + r(1 - \lambda))\bar{g} h(e + E)
\]

subject to \(e + I_G \leq (r(1 - q) + \alpha(q))R(0)\),

\[e \geq 0 \text{ and } I_G \geq 0.\]
As in the previous section we denote $E_G^* = \arg\max\{\delta(1-r)(1-\lambda)g\bar{h}(E) - E\}$ and $e_G^* = \arg\max\{\delta(\lambda + r(1-\lambda))\bar{g}h(e) - e\}$.

We define $q_4 = q_4(r)$ as the project type that maximizes the regional government budget, i.e. $\alpha'(q_4) = r, \quad q_4'(r) < 0$. Now, we can prove a proposition that is close to the case without revenue sharing.

**Proposition 2.**

*Under regional ownership and Assumptions 1, 2:*

1. *the manager has no incentive to exert efforts* ($a_G = 0$);
2. *the regional government has an incentive for the government activity* ($g_G = \bar{g}$)
   for sufficiently small $C > 0$;
3. *the national government leaves the regional government with* $E_G > 0$ *for the government activity;*
4. *if* $E_G^* \leq (1-r)(1-q_4)R(0)$ *the regional government chooses* $q_G = q_4$,
   *contribution to the government activity equals* $A = E_G^*$;
5. *if* $e_G^* \leq (1-r)(1-q_4)R(0) < E_G^*$ *the regional government chooses* $q_G = q_4$,
   *contribution to the government activity equals* $A = (1-r)(1-q_4)R(0)$;
6. *if* $R(0) < e_G^*$ *the regional government does not hide revenue at all (i.e.,* $q_G = 0$),
   *contribution to the government activity equals* $A = R(0)$.

*Proof.* See in the Appendix.

Under revenue sharing ($r > 0$) the regional government always chooses to hide less revenue than the maximum level. The major inefficiency that arises under the regional ownership is the lack of efforts by the manager. However, when managerial efforts are important, i.e. if $R(0)$ is small, and $R(a_i)$ is large, the regional government hides no revenue, while the manager hides revenue to the maximum degree. Which form of ownership under insecure property rights is more efficient in the terms of the social welfare depends on which kind of inefficiency -
the lack of the manager’s efforts or revenue-hiding - is less detrimental to the society.

National Ownership

Let \((q_s,a_s,e_s,E_s,g_s)\) be an equilibrium under national ownership. The manager again receives nothing and has no incentive to take any effort \((a_s = 0)\). The regional government exerts effort \(g\) if and only if

\[
(\lambda + r(1-\lambda))\overline{g}h(e + E) > C.
\]

Under national ownership only the national government can finance government activities. Therefore, it chooses \(E\) and \(I_s\) to

\[
\max I_s + \delta(\lambda + (1-r)(1-\lambda))\overline{g}h(E)
\]

subject to \(E + I_s \leq (\alpha(q) + (1-r)(1-q))R(0), E \geq 0\) and \(I_s \geq 0\).

Denote \(E_s^* = \arg\max\{\delta(\lambda + (1-r)(1-\lambda))\overline{g}h(E) - E\}\)

Proposition 3. Under national ownership and Assumptions 1,2:

1. the manager has no incentive to exert efforts \((a_s = 0)\);  
2. for sufficiently small \(C > 0\) the regional government has an incentive for the government activity \(g_G = \overline{g}\);
3. the national government hides a part of its revenue \(q_s = q_2\);
4. if \(E_s^* \leq (\alpha(q) + (1-r)(1-q))R(0)\) contribution on the public good equals \(A = E_s^*\);
5. if \(E_s^* > (\alpha(q) + (1-r)(1-q))R(0)\) contribution on the public good equals \(A = (\alpha(q) + (1-r)(1-q))R(0)\);
Proof. See in the Appendix.

Part 3 of Proposition 3 asserts that revenue sharing within the enlarged government does not prevent revenue-hiding under national ownership. The national government tries to reduce the observable part of revenue so as not to transfer too much to the regional government. The cost \( C \) should be less under national ownership than under regional ownership so as government activities to be carried out by the regional government.

4. Comparative Analysis
In this section we try to summarize the results obtained in Propositions 1, 2, 3 and analyze relative efficiency of the forms of ownership depending on the distribution of bargaining power between the national and regional governments. In this comparative analysis we focus on the case explicitly demonstrating that revenue sharing may bring about an improvement in efficiency of private ownership and in turn an increase in the total social surplus.

From now on we assume that \( h(A) = \sqrt{A} \), other functional forms would not strongly change subsequent conclusions but complicate computations heavily.

**Assumption 3.** \( h(A) = \sqrt{A} \).

As in the previous section we consider \( r < \frac{1-2\lambda}{2(1-\lambda)} \). To reflect high efficiency of managerial efforts we make

**Assumption 4.** \( (1-r)(1-q_1)R(a_1) > E^*_M = \left(\frac{1}{2} \delta \tilde{g}(1-\lambda)(1-r)\right)^2 \), and

\[ e^*_G = \left(\frac{1}{2} \delta \tilde{g}(\lambda + r(1-\lambda))\right)^2 < (1-r)(1-q_4(r))R(0) < E^*_G = E^*_M. \]
Then due to Proposition 1 under private ownership \( a = a_1, \; q = q_1, \; A = E_M^* \); due to Proposition 2 under regional ownership \( a = 0, \; q = q_4(r), \; A = (1 - r)(1 - q_4(r))R(0) \). The following claims are proven in the appendix.

**Claim 1.** Under Assumptions 1 through 4 the local public good is provided under regional ownership for all \( r \) if \( \lambda g \sqrt{(1 - q_1)R(0)} > C \).

**Claim 2.** Under Assumptions 1 through 4 there exists \( \tilde{r} \), \( 0 < \tilde{r} < \frac{1 - 2\lambda}{2(1 - \lambda)} \) that under private ownership for \( r < \tilde{r} \) the local public good is not provided, and for \( r \geq \tilde{r} \) it is provided if \( \frac{1}{8} \delta g^2 (1 - 2\lambda) > C \).

Therefore, we impose a restriction on \( C \).

**Assumption 5.** \( C < \min\{\lambda g \sqrt{(1 - q_1)R(0)}, \frac{1}{8} \delta g^2 (1 - 2\lambda)\} \).

National ownership is dominated by the other forms of ownership, since in this case the regional government has as weak incentives to perform government activities as under private ownership, and managerial efforts are not exerted as under regional ownership. For this reason, we neglect welfare analysis of this form of ownership. Now we are in a position to write down the total social surplus under private and regional ownership.

**Proposition 4.** Under Assumptions 1 through 5 the total social surplus under private ownership is equal to

\[
(1 - q_1 + \alpha(q_1))R(a_1) - D(a_1), \text{ when } r < \tilde{r} \text{ and }
\]

\[
(1 - q_1 + \alpha(q_1))R(a_1) - D(a_1) + \frac{1}{2} (\delta g)^2 (1 - \lambda)(1 - r)(1 - \frac{1}{2}(1 - \lambda)(1 - r)) - \delta C,
\]

when \( r \geq \tilde{r} \);

under regional ownership the total social surplus is equal to
\[(1 - q_4 + \alpha(q_4))R(0) - (1 - r)(1 - q_4)R(0) + \delta \sqrt{(1 - r)(1 - q_4)}R(0) - \delta C.\]

When \( r \ (r > \tilde{r}) \) rises, the surplus declines under private ownership, since the national government’s incentives to finance the public good decrease. The behavior of the surplus under regional ownership, when \( r \) rises, is affected by two opposite forces. First, a reduction in the national government expenditures on the public good, that lowers the surplus. Second, a reduction of the revenue hiding, that raises the surplus, see Figure 1.

It can be seen from Figure 1 that private ownership is more efficient than regional ownership if managerial efforts happen to be relatively more important than inefficiency caused by revenue hiding. Also it can be noted that for large enough \( r \) a reduction in the region’s bargaining power may have a positive effect on the economy welfare since the national government gets more incentives to
finance the public good. But a larger contraction of \( r \) may lead to a strong negative effect in the form of a drop of the private ownership efficiency.

5. Extensions of the model
In this section we examine how robust our results are. First we deviate from the basic model assuming that there are \( N > 1 \) (identical) business projects in the region instead of one. As before at the beginning of period 1 a manager of project \( i \) chooses efforts \( a^i \) and the level of revenue hiding \( q^i, \ i = 1, \ldots, N \). Consider how presence of many business projects affects conclusions obtained under private ownership. The national government optimization problem given \( e^i, \ i = 1, \ldots, N \) becomes

\[
\max_{E_i, I_s} \quad I_s + \delta(1-r)(1-\lambda)\bar{g}Nh\left(\sum_i e^i + E\right)
\]

subject to \( E + I_s \leq (1-r)\sum_i (1-q^i)R(a^i) \),

\( E \geq 0 \) and \( I_s \geq 0 \).

For any given \( E \) and \( e^j, \ j \neq i \), the manager of project \( i \) chooses \( e^i \) and \( I_M^i \) to

\[
\max \quad I_M^i + \delta\lambda\bar{g}h(e^i + \sum_{j \neq i} e^j + E)
\]

subject to \( e^i + I_M^i \leq \alpha(q^i)R(a^i) \),

\( e^i \geq 0 \) and \( I_M^i \geq 0 \),

\( i = 1, \ldots, N \). We assume that the economy becomes \( N \) times larger. Another approach would be to assume that production functions \( R \) and \( h \) shrink \( N \) times while the number of projects rises, however both approaches bring about the same conclusions. While the number of firms increases the national government tends to spend more on local public goods provision, i.e.,
$E_M^*(N) = \arg\max\{\delta(1-r)(1-\lambda)\bar{\gamma}Nh(E) - E\}$ rises with respect to $N$. The corresponding value for any project, $e^*_M = \arg\max\{\delta\lambda\bar{\gamma}h(e) - e\}$, obviously does not change. Following the line of Proposition 1 we can prove that for sufficiently small $C > 0$ the regional government carries out government activities. The fact that the national government finances the public good can be proven under less strict condition $\lambda < N(1-r)(1-\lambda)$. If $E_M^* \leq (1-r)(1-q_i)NR(a_i)$ managers in symmetric equilibrium choose $q_i$ and $a_i$. However, it is less likely to expect that the level of revenue hiding diminishes, because each manager faces a great deal less marginal incentives to care about financing the public good. When $N$ converges to infinity managers will always stick to maximum revenue hiding. Under regional government and national ownership a rise of the number of business projects leads to scale effect only. Hence, we may conclude that in the setup with many business projects revenue sharing still allows avoiding underprovision of the public good but favorable effect on the problem of revenue hiding turns out to be not persistent. Indeed, it makes sense to expect that a firm participates in government activities only if it is a big one.

Now we consider $K > 1$ (identical) regions, each of them has a unique business project. Then under private ownership a manager in each region determines $a^i$ and $q^i$. After the first-period returns are realized the national government chooses $I_s$ and subsidies for local public goods $E^i$ provided $e^i$ from all regions to

\[
\max I_s + \delta(1-r)(1-\lambda)\bar{\gamma}\sum_i h(e^i + E^i) \\
\text{subject to } \sum_i E^i + I_s \leq (1-r)\sum_i (1-q^i)R(a^i), \\
E^i \geq 0 \text{ and } I_s \geq 0.
\]
The manager from region $i$ chooses $e^i$ and $I_M^i$ to

$$\max \quad I_M^i + \delta \lambda g h(e^i + E^i)$$

subject to

$$e^i + I_M^i \leq \alpha(q^i)R(a^i),$$

$$e^i \geq 0 \text{ and } I_M^i \geq 0.$$  

$i = 1, \ldots, K$. It can be easily checked that Proposition 1 remains valid at a symmetric equilibrium in the setup with many regions. Analogously counterparts for symmetric equilibria of Propositions 2 and 3 can be proven. In other words presence of many regions does not change the results. It justifies the claim that we deal with substantially different tiers of bureaucracy: a central bureaucracy and a number of regional ones.
6. Conclusion
The work considers a modification of Che and Qian (1998) model of insecure property rights that allows for sharing of revenue between the national and regional governments. Non-conventional institutional setups that take into account state encroachment were examined. It was proven that revenue sharing motivates the regional government to exert government services under private ownership, that eliminates the serious source of inefficiency of private ownership under insecure property rights. This result was shown to be robust to incorporating of multiple business projects and regions in the model. Under reasonable assumptions it was shown how under different forms of ownership the total social surplus changes with respect to the distribution of bargaining power between the national and regional governments. Non-trivial behavior of social welfare depending on \( r \) explains why a relatively moderate strengthening of the central government can lead to a rise of the welfare, but a stronger one can bring about a sharp decline in the welfare.
Appendix

Proof of Proposition 1.

1. $M$ has no incentive to choose $q$ more than $q_1$. For all $r < 1$ $S$ has nonzero budget and by the condition $\delta(1-r)(1-\lambda)\bar{g}h'(0) > 1$ leaves $G$ a positive amount $E_M$ for government expenditures. For this reason, when $C > 0$ is sufficiently small $G$ has incentive for government activities, i.e. $g_M = \bar{g}$.

2. $e_M + E_M > 0$ by 1. For any $e_M$ the Kuhn-Tucker necessary conditions of the national government optimization problem yield

\[ \delta(1-r)(1-\lambda)\bar{g}h'(e_M + E_M) \leq \xi \quad (< \text{if and only if } E_M = 0), \]

\[ 1 \leq \xi \quad (< \text{if and only if } I_S = 0). \]

For any $E_M$ the Kuhn-Tucker necessary conditions of the manager's optimization problem yield

\[ \delta \lambda \bar{g}h'(e_M + E_M) \leq \eta \quad (< \text{if and only if } e_M = 0), \]

\[ 1 \leq \eta \quad (< \text{if and only if } I_M = 0). \]

If $e_M = 0$ then $E_M > 0$ because of $e_M + E_M > 0$. Let $e_M > 0$ but $E_M = 0$. We have

\[ \delta(1-r)(1-\lambda)\bar{g}h'(e_M + E_M) < \xi = 1, \]

\[ \delta \lambda \bar{g}h'(e_M + E_M) = \eta \geq 1. \]

This contradicts the assumption that $\lambda < (1-\lambda)(1-r)$. Hence, $E_M > 0$.

3.4. By the condition $\lambda < (1-\lambda)(1-r)$, $e_M^* < E_M^*$. If $e_M > 0$ then by (3)

\[ \delta \lambda \bar{g}h'(e_M + E_M) = \eta. \]

Due to Part 2 and (1)
\[ \delta(1-r)(1-\lambda)\bar{g}h'(e_m + E_m) = \xi. \]

So \( \xi > \eta \geq 1 \) by (4). By (2) we get that \( I_s = 0 \) and \( E_m = (1-r)(1-q)R(a) \).

Therefore, if \( e_m = 0 \) then \( E_m = \min\{E^*_m, (1-r)(1-q)R(a)\} \), and if \( e_m > 0 \) then \( E_m = (1-r)(1-q)R(a) \). When \( E_m = E^*_m \), \( M \) chooses \( e = 0 \) and maximizes

\[ \alpha(q)R(a) - D(a) + \delta\lambda\bar{g}h(E^*_m). \]

The optimal solution is \( q = q_1, \ a = a_1 \). When the choice of \( E \) by \( S \) depends on \( q \) and \( a \) the marginal utility of efforts and disutility of revenue hiding for the manager increase, so \( M \) can choose \( q \leq q_1 \) and \( a \geq a_1 \). Therefore, if \( E_m^* \leq (1-r)(1-q_1)R(a_i) \) then the budget of \( S \) cannot decrease, and it chooses \( E_m = E^*_m \), and \( M \) chooses \( q = q_1, \ a = a_1 \).

5. If \( (1-r)(1-q)R(a) \leq e^*_m < E^*_m, \) \( M \) wants to spend on government activities, so she has to

\[ \max_{a,q} \alpha(q)R(a) - D(a) - e + \delta\lambda\bar{g}h(e + (1-r)(1-q)R(a)). \]

If \( e^* - (1-r)(1-q)R(a) < \alpha(q)R(a) \) \( M \) chooses \( e = e^* - (1-r)(1-q)R(a) \), and anticipating that she chooses \( q_m = q_2 \) and \( a_m = a_2 \) at the beginning of period 1 maximizing

\[ (\alpha(q) + (1-r)(1-q))R(a) - D(a). \]

6. If \( M \) prefers to spend all her budget on the government activity then she chooses \( a \) and \( q \) to

\[ \max a, q \] D(a) + \delta\lambda\bar{g}h((\alpha(q) + (1-r)(1-q))R(a)), \]

the optimal solution is \( a_m = a_3 > a_2 \) and \( q_m = q_2 \). □
Proof of Proposition 2.

1. obvious.

The proofs of Parts 2 through 5 follow the proof of Proposition 1.

6. Due to the condition \( \lambda < (1-\lambda)(1-2r) \), \( e^* < E^* \). Hence, 
\[
(1-r)(1-q)R(0) \leq R(0) < e^* < E^* 
\]
for all \( 0 \leq q \leq 1 \). By the proof of Proposition 1 
\[ E_G = (1-r)(1-q)R(0) \]. Since \( e_G + E_G \leq R(0) < e^* \), then for all \( q \)
\[
\delta(\lambda + r(1-\lambda))\bar{g}'(e_G + E_G) > \delta(\lambda + r(1-\lambda))\bar{g}'(e^*) = 1.
\]
Therefore, \( I_G = 0 \), and \( e_G = (r(1-q) + \alpha(q))R(0) \). In the first period \( G \) chooses \( q \) to 
\[
\max \delta(\lambda + r(1-\lambda))\bar{g}h((1-q + \alpha(q))R(0)) 
\]
and the optimal solution is \( q = 0 \). \( \square \)

Proof of Proposition 3

3. \( S \) maximizes \( \alpha(q) + (1-r)(1-q) \) over \( q \), that leads to the optimal level of \( q_S : \)
\[
\alpha'(q_S) = 1-r . \quad \square
\]

Proof of Claim 1.

\( G \) obtains \( (\lambda + r(1-\lambda))\bar{g}\sqrt{(1-r)(1-q_4(r))R(0)} \). For all \( r \), \( 1-q_4(r) > 1-q_1 \), since 
that  
\[
(\lambda + r(1-\lambda))\bar{g}\sqrt{(1-r)(1-q_4(r))R(0)} > (\lambda + r(1-\lambda))\bar{g}\sqrt{(1-r)(1-q_1)R(0)} .
\]
The derivative of the right-hand side of the inequality with respect to \( r \) is proportional to  
\[ (1-\lambda)\sqrt{1-r} - \frac{1}{2\sqrt{1-r}}(\lambda + r(1-\lambda)) = \frac{(1-\lambda)(2-3r)-\lambda}{2\sqrt{1-r}} . \] It is positive as \( 2-3r = (1-r) + (1-2r) > \frac{\lambda}{1-\lambda} \) by Assumption 1. Therefore, if
\[ \lambda \bar{g} \sqrt{(1 - q_4)R(0)} > C \quad \text{then} \quad (\lambda + r(1 - \lambda))\bar{g} \sqrt{(1 - r)(1 - q_4(r))}R(0) > C \quad \text{for all relevant} \; r. \quad \square \]

**Proof of Claim 2.**

G obtains \( \frac{1}{2} \delta \bar{g}^2 (1 - \lambda)^2 r(1 - r) \). It is an increasing function of \( r \) for all \( r < \frac{1 - 2\lambda}{2(1 - \lambda)} \). If \( C \) is less than \( \frac{1}{2} \delta \bar{g}^2 (1 - \lambda)^2 r(1 - r) \bigg|_{r = \frac{1 - 2\lambda}{2(1 - \lambda)}} = \frac{1}{8} \delta \bar{g}^2 (1 - 2\lambda) \) then there exists \( \bar{r} : 0 < r < \frac{1 - 2\lambda}{2(1 - \lambda)} \) that for \( r < \bar{r} : \frac{1}{2} \delta \bar{g}^2 (1 - \lambda)^2 r(1 - r) < C \), and for \( r \geq \bar{r} : \frac{1}{2} \delta \bar{g}^2 (1 - \lambda)^2 r(1 - r) \geq C. \quad \square \)
References


