

Tax Rights in Transition Economies: A Tragedy of the Commons?¹

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July 1999

¹This paper was previously entitled “Decentralization in Transition Economies: A Tragedy of the Commons?” We thank David DeJong, Kent Engelmeier, Roger Gordon, Steve Huddart, Jack Hughes, Thomas Rawski, Gerard Roland, Andrei Shleifer, Christine Wallich, an anonymous referee and participants in the Davidson Institute Research Workshop on the Economics of Transition and the Public Choice Meetings for their comments. We gratefully acknowledge financial support from the National Science Foundation under grant SBR9730499 (Berkowitz), the University Center for International Studies at the University of Pittsburgh (Berkowitz) and the Center for International Business Education and Research at Duke University (Li).

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Abstract

This paper develops the concept of tax rights to analyze the impact of fiscal institutions on economic development in transition economies. A government's tax rights are poorly defined when it and other governments and agencies can unilaterally levy taxes on the same tax base. Existing evidence suggests that Chinese local governments have gained more clearly defined tax rights than their Russian counterparts. Using the "big push" model of industrialization (Murphy, Shleifer and Vishny (1989)) within a common-property resource framework, we show that this difference in tax rights helps explain why China has been significantly more successful than Russia.

JEL No. H32 H77 O23 P52

Keywords: tax rights, economic transition, economic development, China, Russia

1 Introduction

China initiated its economic reform in the late 1970s; Russia began a more radical reform program in the early 1990s. The performance difference of these two economies is striking. Since 1978, GDP per capita in China has grown at a remarkable average annual rate of 9 percent. However, according to official statistics, real GDP in Russia fell by almost 40 percent between 1990 and 1995, was flat in 1996 and 1997 and has been declining during 1998. Investor confidence in both countries is also quite different. Fixed investment in Russia fell even more rapidly than output, lowering its share of GDP from 28.7% in 1990 to 18.8% in 1997. In contrast, fixed investment in China grew faster than GDP between 1990 and 1997, raising its share of GDP from 24.3% to 32.8%. Between 1990 and 1997, cumulative foreign direct investment was about 11 billion dollars in Russia (or about .6% of GDP), but 204 billion dollars in China (or about 5% of GDP).¹ These investment figures are consistent with survey and anecdotal data: while new factories and offices are being developed in coastal cities and are penetrating the interior of China, even potentially profitable sectors in Russia such as crude oil production and transport are short on investment capital.

Recently, several scholars have argued that the emerging partnership between local governments and state and non-state enterprises is an important reason for China's remarkable growth performance. Walder (1995) argues that local governments in China operate as "helping hands" in promoting economic activity for enterprises. Local governments provide important services such as obtaining credits, export and import licenses and adjudicating informal business contracts. There is evidence that local governments have used their power both to tax and to provide essential business services in such a way that the efficiency of firms under their jurisdiction is enhanced (see Chang and Wang (1994), Weitzman and Xu (1994), Qian and Weingast (1996), Che and Qian (1997), and Chow (1997)).

However, there is evidence that governments in Russia impede the efficient operation of firms and operate as "grabbing hands." Frye and Shleifer (1997) show that shop owners in Moscow are subject to significantly more inspections, pay significantly more fines and bribes than their counterparts in Warsaw. In a survey of Russian and American firms operating in the Russian Far East, Thornton and Mikheeva (1996, p. 91) find that "government policies actively impeded productive activity through excessive regulation, confiscatory taxation, and corruption." According to Shleifer and Treisman (1999, p. V-9), "[e]ntrepreneurs complained about the bewildering number of taxes, whose aggregate rates, they suggested, added up to close to 100 percent of enterprise profits or even revenues." There is now strong

¹These statistics are obtained from Datastream.

evidence (Johnson, Kaufman and Shleifer (1997)) that high tax and regulatory burdens in post-communist countries drive an increasing share of economic activity into the unofficial economy.

In this paper, we develop the concept of tax rights to address the importance of fiscal institutions on economic development and to explain the striking performance difference between Russia and China. Tax rights are the property rights that a government appropriates over its own tax base. Like property rights in general, the essence of tax rights is the right to exclude. Thus, a government's tax rights are attenuated or poorly defined when it and other governments and agencies can unilaterally levy taxes on the same tax base. When tax rights over a tax base are divided among more than one government, the tax base becomes a common-property resource. We show that the difference in the definition of tax rights in Russia and China helps explain observed differences in economic performance in the two countries. The basic idea is that, as more independent tax agencies share the same tax base, the standard tragedy of the commons problem (Gordon (1954) and Hardin (1968)) emerges and the commons — the tax base — is “over-grazed,” leading to an equilibrium with an excessively high aggregate tax rate, meager aggregate tax collections, deficient provision of public goods, low investment and low output.

In China and Russia, enterprises are the most important source of tax revenue. Under socialism, central governments in both countries had *de jure* claims to all tax revenues. In practice, local governments and various ministries in both countries, to a certain extent, could divert or seize revenues and in-kind resources from enterprises under their jurisdiction. Between 1978 and 1993, China's fiscal decentralization process gradually consolidated tax rights to local governments. While the central government continued to set tax bases and rates, the actual implementation of tax policy was left to local governments, who could decide how much of each tax to collect. Under the decentralized fiscal system, local governments collected taxes in their jurisdictions, and turned over part of the revenues to the center according to pre-negotiated sharing contracts. Thus, decentralization in China tangibly clarified the definition of tax rights. Since 1994, China has established a new inter-governmental tax sharing system based on a clearly delineated tax assignment between central and local governments (see Wong (1997) and Hsu (1999)). Because it assigns central and local governments separate tax bases, this reform, in principle, further improves the definition of tax rights in China.²

The Russian reform has failed to improve the definition of tax rights. The decentralization

²The fact that the Chinese government has maintained its unitary structure helps explain why the fiscal decentralization in China has proceeded in a more controlled and orderly fashion. We thank Andrei Shleifer for suggesting this point.

process has been rapid and chaotic, and the emerging system of federalism is highly non-transparent and fluid. Survey evidence from Russia suggests that governments at all levels and non-governmental groups such as mafias compete in an uncoordinated fashion to extract rents from the same tax base using both legal and illegal levies (Frye and Shleifer (1997)). Indeed, after a comprehensive analysis of Russia's evolving fiscal institutions, Shleifer and Treisman (1999) conclude that tax rights were poorly defined in that different levels of government can unilaterally impose additional taxes or raise tax rates on the same tax base.

In order to understand the impact of the difference in the definition of tax rights, we develop a model that combines two strands of economics literature: the "big push" model of industrialization (Murphy, Shleifer and Vishny (1989)), and the common property resource paradigm (Gordon (1954) and Hardin (1968)). In our model, investors can choose between a growth-oriented activity, or a less productive unofficial activity. A growth-oriented activity operates in the official economy, exhibits increasing returns to scale (IRS), and does not facilitate tax evasion. An unofficial activity operates in the unofficial economy, exhibits constant returns to scale (CRS), and facilitates tax evasion. The growth-oriented activity requires a fixed private investment that can be partially offset by public investment in infrastructure. Because fiscal institutions are under-developed, each level of the government (henceforth tax agency) is unable to commit to a tax policy, and therefore exercises its discretion by setting its tax rate after investors have sunk their investments. When each tax agency unilaterally sets its tax rate on the common tax base, it ignores the negative impact of an increase in its own tax rate on the other agencies and therefore tends to set an excessively high tax rate. We show, however, that when the number of independent agencies is sufficiently small, the economy can sustain a high equilibrium where all firms engage in growth-oriented activities, there is substantial aggregate tax collection and provision of public goods and the economy "takes off." When the number of independent tax agencies is sufficiently high, the economy falls into a low equilibrium where all firms engage in unofficial activities, aggregate tax revenues are relatively low, public goods provision is relatively low and the economy stagnates.

Our paper is related to the work of Shleifer and Vishny (1993), who argue that the stagnation in Russia can be explained by the emergence of a chain of bureaucrats, each of whom can "hold-up" productive business activities by erecting a regulatory barrier in order to elicit bribes from would-be entrepreneurs. Shleifer and Vishny's analysis is formally an application of the complementary-good monopoly model in industrial organization. Our analysis is formally an application of the common-property resource model in public economics. The two ideas are closely related because the inefficiency in both problems arises from the externality inherent in them. But there is a subtle but important difference in policy implication. In

Shleifer and Vishny (1993), introducing competition for the each of the existing officials, who provide complementary “services” for bribes, can lower corruption and its negative economic impact. In our model, the only way to improve efficiency is to reduce the number of *independent* tax agencies through either a collusive arrangement (such as fiscal contracts between central and local governments in China) or a clearly delineated and enforced tax assignment. In addition, by adopting Murphy, Shleifer and Vishny’s (1989) “big push” industrialization model, we can show formally how even a relatively small difference in the definition of tax rights can determine whether an economy stagnates or prospers. Our work is also related to Johnson, Kaufmann and Shleifer (1997), who show that a high tax burden drives businesses into the unofficial economy. Our paper offers an equilibrium explanation of how the existence of multiple independent tax agencies can create this high tax burden.

There are also other explanations for the difference between Chinese and Russian local government behavior. Shleifer (1997) argues that local governments in Russia are “grabbing hands” because of the lack of fiscal and electoral incentives. Gordon and Li (1991), Qian and Weingast (1996) and Che and Qian (1997) argue that local governments in China depend on their enterprises for the bulk of their revenues for financing public projects. Thus, Chinese local governments have an incentive to improve productivity of enterprises under their jurisdiction. In order to stress the role of fiscal institutions, we assume that local governments in China and Russia have similar preferences for constituent welfare and for extracting rent, and show how vaguely (well) defined tax rights give local governments an incentive to become “grabbing (helping) hands.”

The rest of the paper is organized as follows: The next section briefly compares the process of decentralization in China and Russia. Section 3 develops a model of a local economy where many independent agencies can tax regional enterprises. Section 4 analyzes the economic impact of the difference in the definition of tax rights. Section 5 concludes by surveying the empirical evidence supporting our analysis.

2 Tax Rights: China and Russia Compared

In pre-1978 China, a multitude of bureaucrats in both central ministries and various levels of local government, often referred to as “grandmothers-in-law,” controlled a typical enterprise. These bureaucrats shared not only control rights, but also rights to intercept cash flows and to extract in-kind resources from enterprises under their jurisdictions. Property rights in state enterprises were ill-defined. The reform that began in 1978 transferred the administration of the vast majority of state enterprises to local governments. It also granted

state enterprises autonomy in making output, pricing and, increasingly, investment decisions, and gave enterprise managers and workers financial incentives (Gordon and Li (1991, 1995), Groves *et al.* (1994), and Li (1997)). The reform also gradually liberalized product markets and encouraged massive entry of profit-oriented non-state firms.

Parallel to these changes, China also decentralized its fiscal structure. Between 1978 and 1994, China adopted a fiscal contract system (Oi (1992) and Wong (1997)). Under the new system, the central government codified a set of tax laws and regulations that defined tax bases and tax rates, but left the actual implementation of the tax policy to local authorities. Based on its forecasted revenue needs and historical trends, the central government would in each year set up a tax plan and allocate tax collection quotas among local governments, irrespective of the potential for revenue collection as stipulated in the tax law. Locally collected taxes were then shared between the central and local governments according to pre-negotiated sharing contracts. Given the stipulated high tax rates, many local governments opted to use their discretion to give special tax concessions to enterprises and foreign investors so as to encourage investment in their jurisdiction. This effectively allowed local governments to set their own tax rates, with little interference from higher level governments. This reform in general improved the definition of tax rights as it concentrated tax rights on specific local governments.

The fiscal contract system put the central government at a relative disadvantage in revenue sharing and led to a steady decline in central government's share of national tax revenue.³ To arrest the decline and further clarify the definition of tax rights, China introduced a new fiscal system based on a clearly delineated tax assignment between central and local governments on January 1, 1994 (Wong (1997) and Hsu (1999)). Under the new system, the personal income tax and the corporate income tax on locally-owned state enterprises and non-state enterprises were assigned to the local government, while the income tax on centrally-owned enterprises was assigned to the central government. The value-added tax was shared (75% central and 25% local). The government also created a nationwide State Administration of Taxation, separate from the Local Administration of Taxation. This new fiscal system represents, at least in theory, an additional improvement in the definition of tax rights because it assigns each level of the government its own tax base.

In Russia, the economic changes started in the late 1980's have also given enterprises similar autonomy, but have failed to clarify the definition of tax rights (Wallich (1994), Shleifer and Treisman (1999)). During the formation of the Russian Federation, a chaotic system of

³The central government's share of total tax revenue fell from 41% in 1984 to 22% in 1993 (State Statistical Bureau, 1997).

inter-budgetary relations emerged. Formal inter-governmental tax sharing laws were ignored as federal, regional and local tax collections were determined spontaneously based on political competition, conflicts and compromises between established federal, regional and local powers. Governments in different levels became involved in struggles with each other and with mafias for tax rights over the same tax base. Without a clearly delineated and enforced tax assignment, different levels of the Russian government could unilaterally impose additional taxes or raise tax rates on the same tax base. In 1994, regional and local governments “introduced more than one hundred different types of local taxes and fees” (Morozov, 1996, p. 43). Enterprise managers frequently complained about the heavy burdens and complexities involved in paying taxes to many different governments. It was very difficult for firms to keep abreast with all of the changes in the local, regional and federal tax code, especially since many of the changes were put into force retroactively. Overlapping tax bases and uncoordinated tax competition among multiple levels of the government had become an important feature of Russian fiscal federalism.

Direct evidence that there are multiple independent tax agencies sharing the same tax base in Russia is provided in a survey of 60 small firms conducted in the Fall of 1998 in the six provincial capital cities (Berkowitz, de Melo and Ofer (1998)).⁴ The firms were asked whether during the past year (1997) a particular government agency had “control” over them, meaning that these agencies, during the course of a planned or surprise visit, could tax or fine the firms, or could shut the firms down. These government agencies include the tax inspectorate, the tax police, the fire inspectorate, the sanitation inspectorate, the trade inspectorate and the militia, operating at the provincial, local and sub-local government level. A total of 18 governmental agencies, out of a presumably much larger set of potential “agencies” were included in the survey.⁵

The survey results are summarized in Table 1. The number of controlling agencies per firm is the total number of government agencies identified as controlling agencies divided by the firm sample size (60). Since the sample included only small firms (average full-time employment is 42), it is not surprising that most of their tax and regulatory burdens are levied by the lowest level of the government. Aggregating all three levels of the government, the average firm faces tax and regulatory burdens simultaneously from 5.42 government agencies (out of a maximum of 18 agencies listed on the questionnaire). For all government levels, 88 percent of the “controlling” agencies could tax or fine the sample firms in 1997, while 48.6

⁴They are the Volga cities of Astrakhan, Kazan, Samara, Saratov, Ulyanovsk and Volgograd.

⁵Excluded are federal agencies, which have little direct contact with small firms that on average employed 42 people. Mafia were excluded from the questionnaire: a pretest of the survey indicated that firm directors were uneasy answering whether a mafia group had visited them.

percent could shutdown their operations. Thus, the average firm faced 4.80 agencies that could tax or fine it, and 2.63 agencies that could shut it down. If these different government agencies coordinated their activities, multiple-government control would not necessarily be problematic. However, when asked whether the group of agencies worked together in a consistent fashion, most firms (51.7%) responded no, 28.3% responded that they did not know, while only 20% responded yes.

In both China and Russia, the fiscal system is still primitive and local governments can tax firms on a somewhat discretionary basis. However, our review of fiscal institutions in the two countries suggests Chinese local governments have more clearly defined tax rights than Russian local governments. In the rest of this paper we show that this difference, even when it is relatively small, can help explain the observed large performance difference between the Russian and Chinese economies.

3 A Local Economy

Consider a one-period closed local economy.⁶ There is a representative consumer, with a utility function defined over a unit interval of private goods, $x(q)$, indexed by q ,

$$U^c(x(q)) = \int_0^1 \ln x(q) dq \quad (1)$$

The consumer's income is comprised of payments for labor services, L , that she supplies inelastically, and profit shares. If the consumer's wage rate is normalized at one and she owns all of the locally generated after-tax profits, then her budget constraint is

$$\int_0^1 p(q)x(q) dq = Y \equiv \Pi + L \quad (2)$$

where Π denotes aggregate after-tax profits and $p(q)$ is the consumer price of good q .

Production in each sector q is conducted with either growth-oriented activities or unofficial activities. Unofficial activities are convenient for evading taxes. They are "characterized by short horizons, small scale and limited investment" (Ickes *et al.* (1997)), producing wealth for stakeholders without generating on the book profits. These activities operate in the unofficial sector of the economy. Growth-oriented activities require substantial investment, operate at a larger scale in the official economy, and are hence more visible to tax authorities than

⁶The model extends the big push model developed by Murphy, Shleifer and Vishny (1989) by incorporating taxation and public infrastructure spillovers.

unofficial activities. For simplicity, and with no loss of generality, we assume that all output from a firm using growth-oriented activities is observed and taxed, whereas only a fraction $\theta < 1$ of the output from firms in the unofficial economy is observed and taxed.⁷

Each growth-oriented activity uses an increasing returns to scale (IRS) technology that requires a fixed initial investment of $F > 0$ labor units. Once the investment is sunk, the IRS technology converts $a < 1$ units of labor into a unit of output. An unofficial activity uses a constant returns to scale (CRS) technology that turns a unit of labor into a unit of output without any initial investment. For brevity, we adopt the convention that an IRS firm engages in growth-oriented activities and a CRS firm engages in unofficial activities. We assume that each IRS technology is proprietary and that only one firm in each sector has access to it, while all CRS technologies are in the public domain. Each sector's product market thus consists of either a monopoly IRS firm or many competitive CRS firms.

There are $J \geq 1$ independent tax agencies; each tax agency sets a tax rate t_j on observed output and the aggregate tax rate is $t = \sum_{j=1}^J t_j$. Equilibrium prices in the economy are determined as follows. In a sector with many competitive CRS firms, each firm sells at a producer price equal to marginal cost of one and earns zero post-tax profits. Since the tax agencies observe a share $\theta < 1$ of sales, the consumer price is $1/(1 - t\theta)$. If an IRS firm becomes the monopoly supplier in the sector, it would not charge a price higher than $1/(1 - t\theta)$ because it would be under-cut by a competitive fringe of CRS firms. The IRS firm would not want to set a price less than $1/(1 - t\theta)$ since demand for the private good is unit elastic. Therefore, the IRS firm will charge a consumer price at, or just infinitesimally below $1/(1 - t\theta)$, in order to maximize profits. In equilibrium, all sectors have the same consumer price of $1/(1 - t\theta)$. It follows that aggregate expenditure on each good equals aggregate income divided by the consumer price: $x(q) = Y(1 - t\theta)$. Since there is a unit interval of consumers, $x(q)$ is also per capita consumption.

Because an IRS firm does not evade taxes, its producer price, $(1 - t)/(1 - t\theta)$, is lower than the producer price of a CRS firm that is one. The IRS firm earns profits of

$$\begin{aligned} \pi &= \left(\frac{1 - t}{1 - t\theta} - a \right) Y(1 - t\theta) - F \\ &= [1 - t - a(1 - t\theta)]Y - F \end{aligned} \tag{3}$$

⁷This is a limiting case. What is important, is that unofficial activities are less visible than growth-oriented activities.

When a fraction of n sectors use the IRS technology, aggregate tax collections are

$$T = t[n + (1 - n)\theta]Y \quad (4)$$

Each tax agency uses a share $s_j \in [0, 1]$ of its tax revenue to finance investment in public infrastructure, and diverts the rest as rents. Consistent with the observed massive capital flight from Russia and to a lesser extent from China, we assume that the collected rents are transferred into “Swiss accounts.” Assuming that part of the rents are spent in the local economy does not alter our results.

Public infrastructure investments may include, for example, transportation networks and/or a legal system that protects property rights. In general, s_j differs from one tax agency to another. A mafia that receives protection money makes little contribution to public infrastructure, while a local politician who faces active scrutiny from a free press or the disciplinary organ of the central government would have a higher s_j . For simplicity, we do not endogenize s_j . We take s_j as given and treat all tax agencies symmetrically: $s_j = s$.

Public infrastructure investments reduce private production costs. While CRS firms involved in the unofficial sector benefit from public infrastructure investments, it is reasonable to expect that larger IRS firms derive substantially more benefit from the same public infrastructure investments. For simplicity, we assume that the benefits of public infrastructure investments spill over only to IRS firms by reducing their fixed costs:

$$F = F_0 - sT \quad (5)$$

where F_0 is the required private investment in an IRS technology in the absence of public infrastructure investments.⁸

For the IRS technology to be feasible, the required private investment F must not exceed L . We limit our analysis to economies where public infrastructure investment cannot replace private investment even when all labor in the economy is taxed away and invested in public infrastructure. That is,

$$F_0 - sL > 0 \quad \text{or} \quad s < F_0/L \quad (6)$$

We also assume that a unilateral investment by any IRS firm is profitable in the absence of

⁸The model can be generalized so that public infrastructure investments decrease an IRS firm’s variable costs more than it decreases a CRS firm’s variable costs. Our results are robust to this generalization.

taxation and public infrastructure investments:

$$L(1 - a) - F_0 > 0 \quad \text{or} \quad 1 - a > F_0/L \quad (7)$$

The assumptions in (6) and (7) imply that $1 - a > s$, that is, the net output of one unit of labor in an IRS firm exceeds the reduction in fixed costs from allocating one unit of labor to the provision of infrastructure. This inequality thus implies that private production is more efficient than public production on the margin, although private production itself has no spillover effects. Given these assumptions, the first best allocation that maximizes consumer welfare is one where $t = 0$ and there is no government, and no provision of public infrastructure.⁹

Substituting (4) and (5) into (3), each IRS firm's profit can be written as,

$$\pi = [1 - a - t(1 - a\theta) + ts(n + (1 - n)\theta)]Y - F_0 \quad (8)$$

where $ts(n + (1 - n)\theta)$ measures contribution to private profitability of public infrastructure. The marginal rate of after-tax profit as a function of n and t is

$$r(n, t) = 1 - a - t(1 - a\theta) + ts(n + (1 - n)\theta) \quad (9)$$

Aggregate profits are $\Pi = nr(n, t)Y - nF_0$.

Combining the definition of aggregate profits with equations (2) and (8), aggregate income can be expressed as a function of n and t ,

$$Y(n, t) = \frac{L - nF_0}{1 - nr(n, t)} \quad (10)$$

The numerator, $L - nF_0$, measures total wage income less investment outlays in the economy. When this *disposable* income is spent on all private goods, it generates the following aggregate profits from the n IRS firms

$$\Pi(n, t) = [nr + (nr)^2 + (nr)^3 + \dots](L - nF_0) - nF_0 \quad (11)$$

$$= \frac{nr(n, t)}{1 - nr(n, t)}(L - nF_0) - nF_0 \quad (12)$$

The recursive computation in (11) arises because any profits generated by the IRS firms

⁹The model can be generalized so that it is optimal to finance some public infrastructure investments, by assuming that public infrastructure enters consumers' utility function. This extension does not change our qualitative results.

are turned into consumer spending, which raises each IRS firm's profits directly each time in proportion to $(1 - a - t(1 - a\theta))$. The first term in (9) thus measures the profit effect of demand spillovers on each IRS firm. The increase in consumer spending also leads to increased tax collection and hence increased infrastructure investment, which in turn raises each IRS firm's profits indirectly each time in proportion to $st(n + (1 - n)\theta)$. The second term in (9) thus measures the profit effect of infrastructure spillovers on each IRS firm.

The aggregate profit effect of both demand and infrastructure spillovers on all IRS firms for each marginal increase in consumer spending is $nr(n, t)$. Under a sufficiently moderate tax rate, the aggregate spillover effect, $nr(n, t)$, is positive.¹⁰ The compounded aggregate effect of demand and infrastructure spillovers on aggregate income is thus $1/(1 - nr(n, t))$, as is shown in (10). Since it can be verified that $1 - nr(n, t) \geq a$ for all n and t , if $r(n, t) > 0$, we have $1/(1 - nr) > 1$, because the expansion of the more efficient IRS firms in the economy raises income by increasing profits and contributing more to public infrastructure. The term $1/(1 - nr)$ thus represents an income multiplier that shows the effects of demand and infrastructure spillovers.

By substituting in (10), per capita consumption can be expressed as,

$$x(n, t) = (1 - t\theta) \frac{L - nF_0}{1 - nr(n, t)} \quad (13)$$

To capture the spillover effects more explicitly, we consider the marginal effect on aggregate income of an additional firm investing in the IRS technology:

$$\frac{\partial Y(n, t)}{\partial n} = \frac{\pi(n, t) + nst(1 - \theta)Y(n, t)}{1 - nr(n, t)} \quad (14)$$

Profitable investment in the marginal IRS firm raises aggregate income directly by $\pi(n, t)$, which is the first term on the numerator in (14). The investment in the marginal IRS firm also raises tax revenue because the IRS firm pays more taxes than the CRS firms that it has replaced. Since the IRS firms pays $tY(n, t)$ in taxes while the CRS firms that it has replaced would have paid only $t\theta Y(n, t)$, the marginal increase in tax revenue is simply $t(1 - \theta)Y(n, t)$. This additional tax revenue increases public infrastructure investment by $st(1 - \theta)Y(n, t)$, which in turn reduces the private investment cost for each of the n IRS firms by an equal

¹⁰A sufficient condition is that

$$t < \min \left\{ \frac{1 - a}{1 - a\theta - s(n + (1 - n)\theta)}, 1 \right\}$$

amount. The savings in private investment investment costs imply an increase aggregate income by $nst(1 - \theta)Y(n, t)$, which is the second term on the numerator. The increases in aggregate income in the numerator raise aggregate income by raising the profits of all IRS firms through demand spillovers, and raising aggregate profits further through infrastructure spillovers when part of the increased tax revenues are invested in public infrastructure. The magnifying effects of demand and infrastructure spillovers are represented by the income multiplier.

Note that the marginal contribution of infrastructure spillovers from an increase in investment, $nst(1 - \theta)Y(n, t)/(1 - nr(n, t))$, is always positive. Equation (14) thus implies that even an unprofitable private investment (i.e., $\pi(n, t) < 0$) can increase aggregate income if the positive impact of infrastructure spillovers dominates private investment loss. In this situation, private investment is unprofitable for the marginal firm but is socially beneficial. However, the IRS firm that cares only about its profits will ignore the social benefits of its investment and forego a socially beneficial but unprofitable investment. In the aggregate, the IRS firms' socially inefficient investment decisions may lead to inefficient equilibrium outcomes. In what follows, we show how the definition of local government-tax rights impacts on the IRS firm's investment choices and equilibrium outcomes.

4 Tax Rights

Since contracts and legal institutions are underdeveloped in transition economies, governments typically cannot commit to a tax policy. In both China and Russia, the ex post tax rates that firms face are often different from the published ex ante rates. Federal and local governments in both countries often exercise discretion in changing tax rates. In order to capture the governments' inability to commit, we model firms' investment decisions and the tax agencies' policy decisions as a two stage game. In the first stage, each IRS firm simultaneously decides whether or not to invest. Let n denote the fraction of sectors that invest in the IRS technology in the first stage; the other $1 - n$ share of sectors is comprised solely of CRS firms. In stage two, each tax agency observes n and each simultaneously chooses its tax rate. Once the J agencies set their taxes, production and consumption take place.

In transition economies, decentralization of power has forced local governments to become more receptive to their constituents. Thus, we assume that each tax agency maximizes a geometric weighted average of consumer welfare and its own diverted tax revenue (or rents):

$$U_j = \ln[(1 - s)t_j(n + (1 - n)\theta)Y(n, t_j + t_{-j})] + \lambda \ln[x(n, t) - x(n, 1)] \quad (15)$$

where $\lambda > 0$ is the tax agency's weight on consumer welfare,¹¹ and $(1-s)t_j(n+(1-n)\theta)Y(n, t)$ is agency j 's rents. We use relative consumer welfare, $\ln[x(n, t) - x(n, 1)]$, instead of absolute consumer welfare, $\ln[x(n, t)]$. Relative consumer welfare captures the political economy constraints faced by all tax agencies. When the aggregate tax rate is one, consumption falls to an absolute minimum,¹² a situation that is unlikely to be politically sustainable. Such an extreme tax policy would possibly trigger a voter revolt in a democracy or a revolution in a non-democratic society. Our specification gives an infinitely low utility for such an outcome, effectively restricting the aggregate tax rate to be less than one. For simplicity, we assume that the tax agencies have symmetric preferences so λ is identical among all tax agencies.

Our specification is general: an economy populated by completely corrupt tax agencies can be represented by setting $\lambda \rightarrow 0$, while an economy populated by completely benevolent tax agencies can be represented by setting $\lambda \rightarrow +\infty$. The utility function is well-defined and strictly quasi-concave, as shown in Appendix A.1.

In order to study the impact of the number of independent tax agencies, J , on economic performance, we first analyze the second stage game where all J agencies take n as given and simultaneously choose t_j to maximize their utility. The second stage equilibrium is characterized by the following first order conditions:

$$\frac{1}{t_j} + \frac{1}{Y(n, t)} \frac{\partial Y(n, t)}{\partial t} = -\frac{1}{x(n, t) - x(n, 1)} \frac{\partial x(n, t)}{\partial t}, \quad \text{for } j = 1, \dots, J. \quad (16)$$

The left hand side of (16) is agency j 's marginal utility of revenue from a marginal increase in its tax rate. This must balance the marginal disutility arising from the deterioration in consumer welfare as a result of the tax increase, that is on the right hand side of (16).

When $J = 1$, *i.e.*, there is only one tax agency, $t_{-j} = 0$ and the first order condition gives the monopoly agency's optimal tax rate for any given n in the second stage. When $J \geq 2$, *i.e.*, there are multiple tax agencies, the first order conditions can be rewritten in the form of reaction functions that characterize the Nash equilibrium in the second stage. (The reaction functions are given explicitly in Appendix A.1.)

We focus on symmetric equilibria in the model. Given the number of agencies $J \geq 1$, symmetry implies that $t_j = t/J$ and $t_{-j} = t - t_j$ for all $j \leq J$. Proposition 1 characterizes the second-stage equilibrium.

¹¹We thank an anonymous referee for suggesting the weighting parameter.

¹²When the tax rate is one, there is positive consumption only if the CRS firms have some market share. The reason is that CRS firms evade tax obligations while IRS firms do not evade.

Proposition 1 Given assumptions (6) and (7), there exists a unique symmetric Nash equilibrium in the second stage. The equilibrium tax rate, $t(n; J, \lambda) = Jt_j(n; J, \lambda) \in (0, 1)$, has the following properties:

1. $t(n; J, \lambda) < t(0; J, \lambda) \equiv J/(J + \lambda)$ for $n > 0$.
2. $\partial t/\partial \lambda < 0$, $\lim_{\lambda \rightarrow +\infty} t(n; J, \lambda) = 0$, $\lim_{\lambda \rightarrow 0} t(n; J, \lambda) = 1$, and
3. $\partial t/\partial J > 0$.

Proof. See Appendix A.2.

Proposition 1 provides an upper bound for the second stage equilibrium tax rate. Note that as long as the tax agencies are not completely corrupt, the equilibrium tax rate is strictly less than one.

The second property in Proposition 1 establishes formally that the equilibrium tax rate declines if the tax agencies becomes more concerned about consumer welfare. In the limit, when all tax agencies maximize only consumer welfare, the equilibrium tax rate falls to zero and the economy achieves the first best allocation. This result suggests that for the definition of tax rights to matter for resource allocation, each tax agency's preferences must not be identical to those of the consumer. In another extreme, when each tax agency maximizes only its rents, the equilibrium tax rate would approach one.

The last property in Proposition 1 establishes the connection between a local government's tax rights and the tragedy of the commons. When a local government's tax rights are vaguely defined, multiple independent tax agencies simultaneously tax firms and the tax base is a common pool resource. An independent agency that raises its tax rate increases its own income. However, such a rate increase imposes an external cost on the other agencies because it reduces both the tax base and consumer welfare. (See (16) and recall that $\partial Y/\partial t < 0$ and $\partial x/\partial t < 0$.) Each independent tax agency ignores the external costs and sets its tax rate higher than socially optimal level which is zero. The result is over-taxation in a Nash equilibrium. The equilibrium tax rate is lowest when $J = 1$ and the local government has the most clearly defined tax rights that are possible. As the number of independent tax agencies increases, the negative impact of the externality is exacerbated and the aggregate tax rate increases while aggregate income, profits, consumption, and hence consumer welfare fall. Thus, as tax rights become more vaguely defined, competing tax agencies become part of a predatory tax system. The following corollary formalizes this finding.

Corollary 1 *In the second stage equilibrium,*

$$\frac{\partial Y}{\partial J} < 0, \quad \frac{\partial \pi}{\partial J} < 0, \quad \frac{\partial x}{\partial J} < 0.$$

Proof. Since aggregate income, Y , aggregate profits, π , and aggregate consumption, x , are all decreasing functions of t , the results are implied by Proposition 1. *Q.E.D.*

We now turn to the first stage of the game. Rationally anticipating the aggregate tax rate in stage two, each IRS firm chooses whether or not to invest, taking n , the fraction of IRS firms it expects to invest, as given. An IRS firm does not invest if investing is unprofitable, *i.e.*, $\pi(n, t(n; J, \lambda)) \leq 0$. In this case, many CRS firms enter the sector. The IRS firm invests if $\pi(n, t(n; J, \lambda)) > 0$. The firms' individual choices in the first stage determine, in a subgame-perfect equilibrium, the share of sectors with IRS firms. Thus, the equilibrium outcome depends on the properties of the profit function. A useful property of the profit function is stated in the following lemma.

Lemma 1 The profit function, $\pi(n, t(n; J, \lambda))$, is a strictly increasing function in n .

Proof. See Appendix A.3. *Q.E.D.*

Because the profit function is monotonically increasing in n , there cannot exist a subgame perfect equilibrium where only a fraction of the IRS firms invest. If some fraction of the IRS firms can profitably invest, Lemma 1 implies that all IRS firms can invest and earn positive profits. In this case, all IRS firms expect that investing is profitable and this expectation is self-fulfilling. Hence, a subgame perfect equilibrium exists where all sectors invest. However, if investing is unprofitable for some fraction of the IRS firms, then each of them will avoid losses and refrain from investing. In this case, all IRS firms expect a low level of income and sales and are consequently reluctant to invest. This expectation is also self-fulfilling, resulting in a subgame perfect equilibrium where all sectors are comprised solely of CRS firms. The following proposition summarizes these results.

Proposition 2 There exists a subgame perfect equilibrium where either the IRS firm in each sector invests or there is no investment in each sector.

Proof. It follows directly from Lemma 1 and the above discussion. *Q.E.D.*

The model thus gives rise to potentially two types of equilibrium. We call the equilibrium where all sectors adopt IRS technologies (growth-oriented activities) the *high equilibrium*; the

equilibrium where all sectors adopt CRS technologies (unofficial activities) the *low equilibrium*.

For the *high equilibrium* to be sustainable, all IRS firms must make profitable investments:

$$\pi(1, t(1; J, \lambda)) = \frac{L[1 - a - t(1; J, \lambda)(1 - a\theta - s)] - F_0}{a + t(1; J, \lambda)(1 - a\theta - s\theta)} > 0 \quad (17)$$

Solving for $t(1; J, \lambda)$ yields,

$$t(1; J, \lambda) < t_H \equiv \frac{1 - a - F_0/L}{1 - a\theta - s} \quad (18)$$

where t_H represents a threshold tax rate below which the high equilibrium is sustainable. Given assumptions (6) and (7), it can be shown that $t_H < 1$. Therefore, $t(1; J, \lambda) < t_H$ is a necessary condition for the high equilibrium to exist in an economy with J tax agencies.

Let \mathcal{J} denote the set of all positive integers. Then, the set $\mathcal{J}_H = \{J \in \mathcal{J} | t(1; J, \lambda) < t_H\}$ represents the collection of all possible configurations of tax agencies such that the high equilibrium can be sustained in the economy. Since $t(1; J, \lambda)$ is increasing in J , the set \mathcal{J}_H must be bounded from above. Therefore for the high equilibrium to be sustainable, the number of tax agencies must be sufficiently small.

For the *low equilibrium* to be sustainable, no IRS firm can profitably invest *alone*:

$$\pi(0, t(0; J, \lambda)) = L[1 - a - t(0; J, \lambda)(1 - a\theta - s\theta)] - F_0 \leq 0 \quad (19)$$

Solving for $t(0; J, \lambda)$ yields,

$$t(0; J, \lambda) \geq t_L \equiv \frac{1 - a - F_0/L}{1 - a\theta - s\theta} \quad (20)$$

where t_L represents a threshold tax rate above which the low equilibrium is sustainable. Assumptions (6) and (7) implies that $t_L < 1$. Therefore $t(0; J, \lambda) \geq t_L$ is a necessary condition for the low equilibrium to exist in an economy with J tax agencies. The set $\mathcal{J}_L = \{J \in \mathcal{J} | t(0; J, \lambda) \geq t_L\}$ thus represents the collection of all possible configurations of tax agencies such that the low equilibrium can be sustained. Since $t(0; J, \lambda)$ is increasing in J , the set \mathcal{J}_L must be bounded from below. Therefore, for the low equilibrium to be sustainable, the number of tax agencies must be sufficiently large.

By inspection, $t_L < t_H$. From Proposition 1, we know that $t(0; J, \lambda) > t(1; J, \lambda)$. It is thus possible that the intersection of \mathcal{J}_H and \mathcal{J}_L is non-empty and the economy can sustain both the high and the low equilibria. Since the intersection of \mathcal{J}_H and \mathcal{J}_L is bounded from

both above and below, multiple equilibria can be sustained when J is an intermediate range. The next proposition characterizes the relationship between equilibrium regimes and J .

Proposition 3 Given the number of tax agencies $J \in \mathcal{J}$ in the economy,

1. the high equilibrium is unique if J is sufficiently low: $t(0; J, \lambda) < t_L$ or $J \in \mathcal{J} \setminus \mathcal{J}_L$;¹³
2. the low equilibrium is unique if J is sufficiently high: $t(1; J, \lambda) \geq t_H$ or $J \in \mathcal{J} \setminus \mathcal{J}_H$;
3. the economy can sustain both the low and the high equilibria if $\mathcal{J}_H \cap \mathcal{J}_L \neq \emptyset$ and $J \in \mathcal{J}_H \cap \mathcal{J}_L$.

Proof. The claims follow directly from the discussion above.

Q.E.D.

Figure 1 illustrates the results of Proposition 3. Tax rates are on the vertical axis and the number of tax agencies, J , is on the horizontal axis. The parameters are $a = .1$, $s = .3$, $F_0/L = .32$, $\theta = .6$, and $\lambda = 1$. Consistent with Proposition 1, we have $t(0; J, \lambda) > t(1; J, \lambda)$ and both tax rates are increasing J . In this example, $t_L = .76$ and $t_H = .91$. As is illustrated, the set of the numbers of tax agencies under which the high equilibrium is sustainable is $\mathcal{J}_H = \{J | 1 \leq J \leq 11\}$, and the set of the numbers of tax agencies under which the low equilibrium is sustainable is $\mathcal{J}_L = \{J | J \geq 4\}$. The high equilibrium is unique when $J \in \mathcal{J} \setminus \mathcal{J}_L = \{1, 2, 3\}$ (marked by H). Both the high and the low equilibrium can be sustained when $J \in \mathcal{J}_H \cap \mathcal{J}_L = \{J | 4 \leq J \leq 11\}$ (marked by M). The low equilibrium is unique when $J \in \mathcal{J} \setminus \mathcal{J}_H = \{J | J \geq 12\}$ (marked by L).

Proposition 3 implies that when both equilibria are sustainable, the economy inevitably moves into the high equilibrium if a sufficiently large fraction of the IRS firms invest simultaneously. This indicates that there exists a critical mass $m(J)$ for $J \in \mathcal{J}_H \cap \mathcal{J}_L$ such that when $n > m(J)$ we have $\pi(n, t(n; J, \lambda)) > 0$. When more than a share $m(J)$ of the IRS firms invest simultaneously, their investments generate sufficient income to make investment profitable for all IRS firms, and the economy inevitably moves into the high equilibrium. More formally, the critical mass $m(J)$ is the unique solution to $\pi(m, t(m; J, \lambda)) = 0$. The critical mass signifies the importance of investment coordination in equilibrium selection. It suggests that there is a role for public policy or simply self-fulfilling euphoria among investors in coordinating investments and generating the condition for reaching the high equilibrium (Murphy, Shleifer and Vishny (1989)). Policies and actions that elevate investor optimism and confidence about future profits can push the economy towards the high equilibrium.

The size of the critical mass reveals the difficulty with which the high equilibrium can be coordinated among potential IRS firms. A small critical mass, say $m(J) = .1$, means that one

¹³ $\mathcal{J} \setminus \mathcal{J}_L$ denotes the complement of the set \mathcal{J}_L .

only needs to coordinate the investments of slightly more than 10 percent of the IRS firms in order to generate sufficient income such that the high equilibrium becomes inevitable. A larger critical mass, on the other hand, means that one needs to coordinate the investments of a higher fraction of the IRS firms in order to reach the high equilibrium. Intuitively, we expect that the critical mass $m(J)$ to be an increasing function in J since a higher J implies a higher equilibrium tax rate and lower profits. The next Proposition shows that this is indeed the case.

Proposition 4 The critical mass, $m(J)$, is increasing in J , for all $J \in \mathcal{J}_H \cap \mathcal{J}_L$.

Proof. See Appendix A.4.

Q.E.D.

When there are multiple equilibria, then, *ceteris paribus*, the high equilibrium Pareto dominates the low equilibrium for the following reasons. First, aggregate income is higher in the high equilibrium since consumers receive profits in addition to the wage income, which is their only source of income in the low equilibrium. Second, since the tax rate is lower ($t(1; J, \lambda) < t(0; J, \lambda)$) and there is no evasion in the high equilibrium, consumer prices of $1/(1 - t\theta)$ are lower in the high equilibrium. Higher income coupled with lower consumer prices implies that private consumption is more buoyant in the high equilibrium. Finally, even though the tax rate is higher in the low equilibrium, there is a larger tax base in the high equilibrium because there is no evasion and aggregate income is higher. It can be shown that the higher tax base in the high equilibrium more than compensates for the lower tax rate (Appendix A.5). As a result, tax collections and the provision of public infrastructure are larger in the high equilibrium than in the low equilibrium. Furthermore, each of the J tax agencies is strictly better off in the high equilibrium because aggregate tax collections and rents are higher than in the low equilibrium.

Proposition 5 When the economy is capable of sustaining both the high and the low equilibrium, the high equilibrium is always Pareto superior to the low equilibrium.

Proof. See Appendix A.5.

Q.E.D.

We have argued that a typical Chinese local government has more clearly defined tax rights than a typical Russian local government: $J^C < J^R$, where superscripts C and R denote China and Russia. Abstracting from differences in demand, technology, consumer preferences and tax agency preferences, our model predicts that, when the high equilibrium emerges either uniquely or because investment coordination can be done more easily in the Chinese

economy, the Russian economy may get trapped in the low equilibrium either uniquely or because investments are much more difficult to coordinate. Since the high equilibrium is always Pareto superior to the low equilibrium, our model also predicts that the tax rates will tend to be higher in a typical Russian local economy, while investment, aggregate tax collections and, thus, the provision of public infrastructure will be higher in a typical Chinese local economy.

We have performed the analysis under the assumption that that capital is immobile. It is important, however, to check if our results are robust to relaxing this assumption since firms, financial capital and human capital have become more mobile in China and Russia (see, for example, Qian and Roland (1998) for China and Treisman (1999) for Russia). To incorporate mobility, suppose that the best profit opportunity net of moving costs for any IRS firm is $\pi^* > 0$. Since there are no moving costs associated with investing in the home region, π^* is the profit hurdle that any mobile IRS firm must achieve in order to invest in its home region. We assume that all IRS firms are mobile.¹⁴ Since IRS firms' investments are sunk, capital mobility has no direct impact on the second-stage equilibrium. Therefore, the results for Proposition 1 and Corollary 1 do not change when capital is mobile. However, capital mobility alters each IRS firm's investment rule in the first stage of the game: an IRS firm invests in the home region if and only if $\pi(n, t(n; J, \lambda)) - \pi^* > 0$. Specifically, because an IRS firm must earn more than π^* in profits before it will commit to invest in the region, capital mobility decreases each IRS firm's incentive to invest at home and thus makes it harder for IRS firms to coordinate on the high equilibrium. From Proposition 5, we conclude that capital mobility can in fact reduce welfare in the regional economy by increasing the likelihood that the low equilibrium is reached.¹⁵

5 Conclusions

The evolution of local governance has been very different in China and Russia. The number of independent tax agencies in China has decreased and tax rights have become more clearly defined. There is evidence suggesting that the number of independent tax agencies in Russia (including different levels of governments, different layers within governments and mafias) has

¹⁴Allowing only a fraction of the IRS firms to be mobile would have no substantial impact on our results.

¹⁵By focusing on a small regional economy, our analysis makes no predictions about the strategic interactions between regional tax agencies and the impact of capital mobility on national welfare. Since capital mobility within a fiscal federation can in general restrain tax rates set by subnational governments (e.g., Gordon (1983) and Wildasin (1989)), it may partially mitigate the problem of multiple tax agencies. However, Keen and Kotsogiannis (1996) show when capital mobility is combined with many governments taxing the same tax base, the equilibrium tax rate is still excessive.

increased and tax rights are less clearly defined. This paper has analyzed the implications of the difference in the definition of tax rights. Abstracting from differences in technology, consumer preferences and capital mobility, one clear prediction of the model is that investment is higher in economies where tax rights are more clearly defined. The model also predicts that aggregate tax collections and provision of public goods and infrastructure are higher when tax rights are more clearly defined, whereas aggregate tax collections fall and tax evasion rises when tax rights become more vaguely defined. The predictions are consistent with the observed differences in economic performance in China and Russia.

In the case of China, there has been a conscious effort among various levels of governments to cut taxes in order to bolster investment. Tax rebates, concessions, and holidays have been routinely offered to township and village enterprises and foreign investors. As a result, these enterprises have become the engine of growth. Between 1987 and 1998, China's non-state sector, consisting of collective, private and foreign invested enterprises, has grown at an average annual rate of 26%. The non-state sector's share of total industrial output has risen from 24% in 1980 to 68% in 1998.

There is evidence that even state enterprises have seen cuts in their tax burden. Based on a survey of 769 state enterprises (Li (1997)), taxes and remitted profits as a percentage of value-added fell from 48 percent in 1980 to 33 percent in 1989. With more clearly defined tax rights, local governments had the incentive to cut taxes on enterprises in their jurisdictions. Gordon and W. Li (1991) argue further that, since local governments shared their collected taxes with the central government, they had the incentive to under-report their tax collections and hide some of their revenues in the enterprises that they control.

In addition, evasion of tax obligations to all government levels in China is no worse than in other developing countries. For example, according to analysis conducted by the World Bank (1996, p 42), the compliance of value-added tax payments in China is about 70 percent, and "is comparable to that in other developing countries, but falls short of the 90-95 percent compliance rates achieved by top tax performers." As a result of tax cuts, official under-reporting, and tax evasion, consolidated government revenue as a share of GDP fell from 33 percent in 1979 to 13 percent in 1993.

But, in absolute terms, consolidated government revenue in China actually *rose* more than 40 percent after adjusting for inflation between 1978 and 1993. The increase in tax revenue was the result of a dramatic enlargement of the tax base driven by rapid economic growth that more than offset the decrease in tax rates. As a result of the absolute increases in revenues, Chinese governments at various levels increased spending on public goods and

infrastructure such as education, public health,¹⁶ transportation and communications.¹⁷

In the case of Russia, taxation of enterprises is typically burdensome. Enterprise managers complain about the excessive tax burden as well the complexities involved in paying taxes to many different governments. In 1994, regional and local governments “introduced more than one hundred different types of local taxes and fees.” (Morozov, 1996, p.43) It is very difficult for firms to keep abreast with all of the changes in the local, regional and federal tax code, especially since many of the changes are put into force retroactively. Finally, besides paying taxes to different government organizations, many enterprises also make substantial payments to the mafia. Foreign investors, especially in the energy sector, complain that the complexities of the tax laws and the problems of coming to agreement with the federal, regional and various local governments are also costly.

There is strong evidence in support of our theoretical prediction that excessive taxation in Russia forced many businesses underground (Johnson, Kaufman and Shleifer (1997)). There is also evidence (Shleifer and Treisman (1999)) that the entry of registered small enterprises — the engine of growth in China and other transition economies — has been stagnant in Russia. Small firms also reported falling output and a worsening economic situation more frequently than medium or large firms. Based on a survey conducted in 1998, Shleifer and Treisman (1999, p. V-13) found that “[e]ntrepreneurs in retail trade pointed to the high tax burden more often than any other factor (81 percent of respondents) to explain the limited development in small businesses.”

Excessive taxation also encouraged widespread evasion. In a survey of 1700 small companies conducted in 1994 throughout Russia, 33.1 percent reported that they concealed up to one fourth of their transactions from tax authorities; 28.9 percent hid up to one half and, 18.4 percent hid all of their business activities (Morozov, 1996, p. 45). In a detailed survey of fifteen manufacturing enterprises in two major cities, Hendley *et al.* (1996) learned that from 1992 till 1996, barter as a share of total sales increased from 5 percent to 40 percent! General directors reported that barter, while an awkward method of conducting business, was a convenient way to evade tax obligations (pp.19-23).

High tax rates in Russia encouraged evasion and discouraged investment, reducing the tax base and aggregate tax collections. Federal and local tax collections had declined steadily, forcing governments at various levels to slash expenditures on public goods such as education, police protection, public health, transport infrastructure and legal operations. As a result,

¹⁶ According to World Bank (1996), “China’s social indicators are higher than in most low-income countries and approach those in middle-income countries.”

¹⁷ For example, the Ministry of Post and Telecommunications invested heavily in China’s national telephone network, expanding its capacity by 100 times in the past twenty years (China News Agency, August 27, 1997).

with the exception of perhaps the cities of Moscow and St. Petersburg, the quality of these services has deteriorated during the transition. Thornton and Mikheeva's (1996) survey of Russian and American firms documents this observation in the Russian Far East (RFE):

“[T]he public provision of infrastructure was considered disastrous. Supplies of electric power and heat are critically short and frequently interrupted. Some joint ventures invested in their own power generators, furnaces and water tanks. Others report sitting in the cold in the dark unable to function until service is restored... Even basic local mail delivery services were inadequate. One local telecommunications company, like many other businesses in the RFE, provided hand delivery of their monthly service bills. Business users that couldn't arrange a bank transfer paid in person. Rail service was deemed costly and poor...”
(p.99)

The performance difference of the Chinese and Russian economic reforms is striking. Our comparative analysis of Chinese and Russian fiscal institutions suggests that the difference in the definition of tax rights is an important factor driving this observed performance difference.

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A Appendix

A.1 Quasi-Concavity of U_j

We prove that the tax collector's utility function

$$U_j = \ln[(1-s)t_j(n + (1-n)\theta)Y(n, t_j + t_{-j})] + \lambda \ln[x(n, t) - x(n, 1)] \quad (\text{A.21})$$

is strictly quasi-concave given assumptions (6) and (7).

Note that the utility function is twice continuously differentiable in t_j . Quasi-concavity of U_j holds if U_j is strictly concave in t_j along j 's reaction curve. To obtain the reaction curve, solve for the first order condition $\partial U_j / \partial t_j = 0$:

$$t_j^* := \frac{(1-t_{-j})(1-n+na+nt_{-j}A)}{1-n+na+nt_{-j}A+\lambda(1-n+na+nA)} \quad (\text{A.22})$$

where $A = 1 - s - a\theta + (1-n)s(1-\theta) > 0$. Substituting (A.22) into the second order derivative, we obtain

$$\left. \frac{\partial^2 U_j}{\partial t_j^2} \right|_{t_j=t_j^*} = -\frac{[1-n+na+nt_{-j}A+\lambda(1-n+na+nA)]^4}{(1-n+na+nt_{-j}A)^2(1-n+na+nA)^2(1+\lambda)(1-t_{-j})^2\lambda} \quad (\text{A.23})$$

which is negative for all $n \geq 0$, $t_{-j} < 1$, and $\lambda > 0$. So $\partial^2 U_j / \partial t_j^2 < 0$ along j 's reaction curve. *Q.E.D.*

A.2 Proof of Proposition 1

In the second stage, the symmetric equilibrium tax rate is determined by the following first order condition:

$$\frac{f(n, t; J, \lambda)}{B(n, t)} \equiv \frac{\alpha t^2 + \beta t + \delta}{B(n, t)} = 0 \quad (\text{A.24})$$

where

$$\begin{aligned} \alpha(n, J) &= -nA(J-1) \leq 0 \\ \beta(n, J) &= (J-1-\lambda)nA - (J+\lambda)(1-n+na) \\ \delta(n, J) &= J(1-n+na) > 0 \\ B(n, t) &= (1-t)t(1-n+na+ntA) > 0 \end{aligned}$$

The sign of β is ambiguous. However, it can be verified that

$$f(n, 1; J, \lambda) = \alpha + \beta + \delta = -\lambda(1-n+na+nA) < 0 \quad (\text{A.25})$$

Existence

We first prove the existence of the symmetric equilibrium by solving the first order condition. There are three cases to consider.

Case 1: $J = 1$ and $n \geq 0$

In this case, $\alpha(n, 1) = 0$, $\beta(n, 1) < 0$, and $\delta(n, 1) > 0$. The equilibrium tax rate is

$$t(n; 1, \lambda) = \frac{1 - n + na}{(1 - n + na) + \lambda(1 - n + na + nA)} \quad (\text{A.26})$$

It thus follows that $t(n; 1, \lambda) \in (0, 1)$, $\lim_{\lambda \rightarrow +\infty} t(n; 1, \lambda) = 0$, and $\lim_{\lambda \rightarrow 0} t(n; 1, \lambda) = 1$ for all $n \geq 0$.

Case 2: $n = 0$ and $J \geq 1$

In this case, $\alpha(n, 1) = 0$, $\beta(n, 1) < 0$, and $\delta(n, 1) > 0$. The tax rate in an equilibrium is

$$t(0; J, \lambda) = \frac{J}{J + \lambda} \quad (\text{A.27})$$

Clearly, $t(0; J, \lambda) \in (0, 1)$, $\lim_{\lambda \rightarrow +\infty} t(0; J, \lambda) = 0$, and $\lim_{\lambda \rightarrow 0} t(0; J, \lambda) = 1$ for all $J \geq 1$.

Case 3: $n > 0$ and $J \geq 2$

In this case, $\alpha(n, J) < 0$ and $\delta(n, J) > 0$. An equilibrium tax rate is thus a root of the quadratic equation $\alpha t^2 + \beta t + \delta = 0$.

First note that the roots of the equation are real since $\beta^2 - 4\alpha\delta > 0$. Because $\delta/\alpha < 0$, one of the roots is positive and the other one is negative. The positive root below is a second-stage equilibrium tax rate:

$$t(n; J, \lambda) = \frac{-\beta - \sqrt{\beta^2 - 4\alpha\delta}}{2\alpha} \quad (\text{A.28})$$

Given that $f(n, 1; J, \lambda) = \alpha + \beta + \delta < 0$ from inequality (A.25), one can verify that $t(n; J, \lambda) < 1$.

Uniqueness

Suppose to the contrary that there exists a different equilibrium tax rate $t_* \neq t \equiv t(n; J, \lambda)$. By definition, $f(n, t_*; J, \lambda) = 0$, $f(n, t; J, \lambda) = 0$. So

$$f(n, t_*; J, \lambda) - f(n, t; J, \lambda) = \alpha(t_*^2 - t^2) + \beta(t_* - t) = 0 \quad (\text{A.29})$$

For $n = 0$ or $J = 1$, we have $\alpha = 0$ and $\beta < 0$; so $t_* = t$ and we have a contradiction.

For $n > 0$ and $J \geq 2$, we have $\alpha < 0$ and $\delta > 0$, so t_* and t must be the two positive roots of the quadratic equation $f(n, t; J, \lambda) = 0$. Since we have shown that one of the two roots must be negative, we again have a contradiction. The equilibrium is thus unique.

Comparative statics properties

First note that at the equilibrium,

$$\begin{aligned} \frac{\partial f(n, t; J, \lambda)}{\partial t} &= 2\alpha t + \beta \\ &= \begin{cases} -J + \lambda & \text{if } n = 0 \text{ and } J \geq 1 \\ -nA - (1 + \lambda)(1 - n + na) & \text{if } J = 1 \text{ and } n \geq 0 \\ -\sqrt{\beta^2 - 4\alpha\delta} & \text{if } n > 0 \text{ and } J \geq 2. \end{cases} \end{aligned}$$

is negative.

To show the second property that $\partial t / \partial \lambda < 0$, we use the implicit function theorem to get

$$\frac{\partial t}{\partial \lambda} = -\frac{\partial f(n, t; J, \lambda)}{\partial \lambda} \bigg/ \frac{\partial f(n, t; J, \lambda)}{\partial t} \quad (\text{A.30})$$

It remains to establish that $\partial f / \partial \lambda > 0$. But this is apparent since

$$\frac{\partial f(n, t; J, \lambda)}{\partial \lambda} = -t(n; J, \lambda)(1 - n + na + nA) < 0 \quad (\text{A.31})$$

We have already shown that $\lim_{\lambda \rightarrow +\infty} t(n; J, \lambda) = 0$ and $\lim_{\lambda \rightarrow 0} t(n; J, \lambda) = 1$ for $J = 1$ or $n = 0$. For $J \geq 2$ and $n > 0$, we can show that $\lim_{\lambda \rightarrow 0} t(n; J, \lambda) = 1$ by directly taking the limit on (A.28). To show that $\lim_{\lambda \rightarrow +\infty} t(n; J, \lambda) = 0$, note that for sufficiently large λ , β is negative, so

$$t(n; J, \lambda) = \frac{-\beta}{2\alpha} \left(1 - \sqrt{1 - \frac{4\alpha\delta}{\beta^2}} \right) = \frac{1 - \sqrt{1 - (\delta/\alpha)z^2}}{z}$$

where $z = -2\alpha/\beta$. Since $\lambda \rightarrow +\infty$ is equivalent to $z \rightarrow 0$, using l'Hopital's Rule, it follows immediately that $\lim_{\lambda \rightarrow +\infty} t(n; J, \lambda) = 0$. This concludes the proof for the second property.

The third comparative statics property can be shown analogously.

To show the first property that $J/(J + \lambda)$ is an upper bound of $t(n; J, \lambda)$, we substitute $t = J/(J + \lambda)$ into $f(n, t; J, \lambda)$ to get that for $n > 0$,

$$f\left(n, \frac{J}{J + \lambda}; J, \lambda\right) = -\frac{2Jn}{(1 + J)^2} A < 0 \quad (\text{A.32})$$

We therefore need only to establish that $f(n, t; J, \lambda)$ is a decreasing function in t in the

relevant range. This is done by differentiating $f(n, t; J, \lambda)$ with respect to t ,

$$\begin{aligned}\frac{\partial f}{\partial t} &= 2\alpha t + \beta \\ &= -2nA(J-1) \left(t - \frac{J-1-\lambda}{2(J-1)} \right) - (J+1)(1-n+na) \\ &< 0\end{aligned}$$

if $J = 1$ or if $(J-1-\lambda)/2(J-1) \leq t < 1$ for all $J \geq 2$. Since $J/(J+\lambda) > (J-1-\lambda)/[2(J-1)]$, it follows that $t(n; J, \lambda) < J/(J+\lambda)$ for $n > 0$.

Q.E.D.

A.3 Proof of Lemma 1

A total differentiation of $\pi(n, t(n; J, \lambda))$ with respect to n gives:

$$\frac{\partial \pi}{\partial n} = \frac{Lst(1-\theta)}{1-nr(n,t)} - \frac{AL}{1-nr(n,t)} \frac{\partial t}{\partial n}$$

Hence $\partial \pi / \partial n > 0$ if and only if $\partial t / \partial n < st(1-\theta)/A$. For the case where $J = 1$, we have $\partial \pi / \partial n > 0$ since

$$\frac{\partial t(n; 1, \lambda)}{\partial n} = -\frac{(1+a\theta+s\theta) + 2ns(1-\theta) + n^2s(1-\theta)(1-a)}{(-na\theta + n^2s\theta - n - ns\theta - n^2s + 2 + 2na)^2} < 0$$

For $J \geq 2$, we use the implicit function theorem to get

$$\frac{\partial t(n; J, \lambda)}{\partial n} = -\frac{\partial f(n, t; J, \lambda)}{\partial n} \bigg/ \frac{\partial f(n, t; J, \lambda)}{\partial t}$$

We therefore need to show that

$$st(1-\theta)\partial f/\partial t + A\partial f/\partial n < 0$$

The expression on the left-hand side is a quadratic function in t , which can be shown to have a negative maximum for $t \in [0, 1]$. This concludes the proof. *Q.E.D.*

A.4 Proof of Proposition 4

Totally differentiating $\pi(m(J), t(m(J); J, \lambda)) = 0$ with respect to J yields,

$$\frac{\partial \pi}{\partial m} \frac{\partial m}{\partial J} + \frac{\partial \pi}{\partial t} \frac{\partial t}{\partial J} = 0 \tag{A.33}$$

Since $\partial\pi/\partial m > 0$ (Lemma 1), $\partial t/\partial J > 0$ (Proposition 1) and $\partial\pi/\partial t < 0$, it follows that $\partial m/\partial J > 0$. *Q.E.D.*

A.5 Proof of Proposition 5

Since $t(0; J, \lambda) > t(1; J, \lambda)$, it is apparent that private income and consumption are higher in the high equilibrium than in the low equilibrium. It remains to be shown that total tax collections in the high equilibrium (T_H) exceed those in the low equilibrium (T_L). Consider the ratio of

$$\frac{T_H}{T_L} = \frac{t(1; J, \lambda)Y(1, t(1; J, \lambda))}{t(0; J, \lambda)Y(0, t(0; J, \lambda))} \quad (\text{A.34})$$

Substituting in (9) and (10), we have

$$\frac{T_H}{T_L} = \frac{t(1; J, \lambda)}{t(0; J, \lambda)} \frac{1 - F_0/L}{a + t(1; J, \lambda)(1 - a\theta - s)} \quad (\text{A.35})$$

Since at the high equilibrium $t(1; J, \lambda) < \frac{1-a-F_0/L}{1-a\theta-s}$ must hold and at the low equilibrium $t(0; J, \lambda) > \frac{1-a-F_0/L}{1-a\theta-s}$ must hold, we have

$$\frac{T_H}{T_L} > \frac{1 - a\theta - s\theta}{1 - a\theta - s} > 1 \quad (\text{A.36})$$

Q.E.D.

Table 1: Overlapping government taxation and regulation faced by a sample of 60 small firms in six Volga cities (Astrakhan, Kazan, Samara, Saratov, Ulyanovsk and Volgograd). The survey asked each firm to check from a list of government agencies the ones that “controlled” them during the past year (1997). The list of government agencies at each level of government includes the tax inspectorate, the tax police, the fire inspectorate, the sanitation inspectorate, the trade inspectorate and the militia.

Level of government	Number of controlling agencies per firm	Proportion of the controlling agencies that could collect taxes, fees or fines, could shutdown firm’s operation	
Regional	0.50	73.3%	40.0%
Local	1.22	94.5%	41.1%
Sub-local	3.70	87.8%	52.3%
All levels	5.42	88.0%	48.6%

Figure 1: **The Relationship Between J and Equilibrium Regimes.** Tax rates are on the vertical axis and the number of tax agencies, J , is on the horizontal axis. The parameters are $a = .1$, $s = .3$, $F_0/L = .32$, $\theta = .6$, and $\lambda = 1$.

