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A TRAGEDY OF THE COMMONS?

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Decentralization in Transition Economies:
A Tragedy of the Commons?¹

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Abstract

China began its gradual economic reform in the late 1970s; Russia initiated radical reform in the early 1990s. During the course of reform, China has enjoyed rapid growth while Russia has contracted. This paper argues that an important explanation for the striking performance difference in China and Russia is that, during the course of reform, Chinese local governments have gained much more clearly defined tax rights than their counterparts in Russia. When tax rights are sharply defined, a local government has the exclusive right to tax enterprises located within its territory. These rights become fuzzier as the number of agencies which independently tax enterprises increases. The implications of these differences in government tax rights are analyzed using a model of a local economy which predicts that: 1) investment is higher when tax rights are more clearly defined; 2) local tax collections and local provision of public goods and infrastructure are higher when tax rights are more sharply defined; 3) the effective tax rate for investors increases as tax rights become fuzzier; 4) tax evasion is higher when tax rights are fuzzier. It is argued that these four points capture important differences in the performance of local Chinese and Russian economies. The model also predicts that capital mobility tends to encourage local and regional governments to limit cross-border capital flows. This prediction is consistent with local and regional government policies observed in both China and 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 9.5 percent. However, according to one conservative estimate, real GDP in Russia fell by 37.8 percent between 1990 and 1995 (EIU, 1996, p.5). Investor confidence in both countries is also quite different. Between 1990 and 1994, gross and fixed investment in Russia rubles fell by an astounding 53.8 and 59.3 percent (Gavrilenkov and Koen, 1995, p.112). Investment in China has grown at a rate of 11.6 per annum between 1984-93 and has continued at an impressive rate of 12.7 and 10.5 percent in 1994 and 1995 (World Bank, 1996a, p.5). The upper bound on estimated foreign direct investment in Russia is 5.3 billion dollars between 1989 and 1995 (EIU, 1996, p.39); foreign direct investment in China was about 37.7 billion dollars in 1995 (World Bank, 1996a, p.80). These investment figures are consistent with survey and anecdotal data: while new factories and major buildings 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) states that local governments in China operate as a "helping hand" 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), Gordon and Li (1997), Li (1996), Qian and Weingast (1996), Che and Qian (1997), and Chow (1997)).

However, there is evidence that many local governments in Russia impede the efficient operation of firms and operate as a "grabbing hand". Frye and Shleifer (1997) show that new firms in Moscow are subject to significantly more inspections, pay significantly more fines and bribes to multiple collectors and regulators than their counterparts in Warsaw. In a survey of Russian and American firms operating in the Russian Far East, Thornton and Mikheeva (1996) find that "government policies actively impeded productive activity through excessive regulation, confiscatory taxation, and corruption." (p.91) Ickes et al. (1997) argue that at "a superficial level, tax rates appear reasonable. Yet, firms complain that the
fiscal system imposes an unreasonable burden. Taxes are proliferating, particularly at lower levels of government. This excessive burden has driven an important part of the economy underground, lowering the tax base, creating pressure on the government to increase the tax rates.

In this paper, we argue that differences in government tax rights provide an important explanation for the striking performance difference in China and Russia during their reforms. In both China and Russia, enterprises are the most important source of tax revenue. Under socialism, central governments in both countries had de jure claim 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. In China, decentralization and recentralization campaigns carried out under Mao virtually made common pool resources out of enterprise revenues among various levels of local governments, ministries and bureaus. Since 1978, China's fiscal decentralization process has gradually consolidated tax rights to local governments, primarily at the municipal level. While the central government continues to set tax bases and rates, the actual implementation of tax policy is left to the local governments, which can decide how much of each tax to collect. Sharing rules between local, provincial and federal governments are clear and operational. Thus, decentralization in China has tangibly improved the definition of government tax rights. However, the fiscal decentralization process in Russia has been rapid and chaotic, and the emerging system of federalism is highly non-transparent and fluid (Wallich, 1994). Survey evidence suggests that local governments, county (oblast) governments, federal government, and non-governmental groups such as mafias compete in an uncoordinated fashion for the same tax base. Our model analyzes the implications of these differences in government tax rights and makes the following predictions:

1. Investment is higher when tax rights are more clearly defined;

2. Local tax collections and local provision of public goods and infrastructure are higher when tax rights are more sharply defined;

3. The effective tax rate for investors increases as tax rights become fuzzier;

4. Tax evasion is higher when tax rights are fuzzier;

5. An increase in capital mobility tends to lower investment, local tax collections and local provision of public goods while increasing tax evasion. Thus, an increase in capital mobility tends to encourage governments to impose capital controls.
This analysis begins with the premise that each government strives to be a “helping hand” and analyzes institutional conditions under which it becomes a “grabbing hand”. In the case of Russia, there is evidence that, with the advent of democratic local elections in 1990, many local politicians have become much more responsive to constituent interests (see Berkowitz (1996); for a contrasting view, see Shleifer (1996)). Chinese local governments are not democratically elected. However, local governments that have failed to represent constituent interests have been removed from office following expressions of popular discontent such as street demonstrations.

Much of the discussion of reform in transition economies has focused on the importance of establishing well-defined ownership of firms (see Boycko et al. (1995), Groves et al. (1994), and Weitzman and Xu (1994)). Using the case of China and Russia, this paper makes the point that even when a firm’s management or corporate board has attained well defined control and ownership rights, the definition of government tax rights is also critical for economic performance.

The analysis in our paper relates to recent work on tax concurrency in which distinct levels of government have discretion in setting tax rates on essentially the same base. In this literature, a federal and subnational government simultaneously set tax rates and the total tax rate in equilibrium is excessive from the standpoint of social welfare and/or overall tax collections. Early contributions include Cassing and Hillman (1982), Flowers (1988) and Johnson (1988); recent contributions include Besley and Rosen (1996), Boadway and Keen (1996), Boadway, Marchand and Vigneault (1996), Dahlby (1994, 1996), Hoyt (1996), Keen (1996) and Wrede (1995). In a related paper in which corrupt government officials extract bribes from firms in exchange for supplies of complementary inputs, Shleifer and Vishny (1993) show that the equilibrium tax/bribe rate increases while output decreases as the number of officials who independently collect bribes grows. Our model analyzes the implications of concurrency for investment, local tax collections and provision of local public goods and infrastructure.

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 regional economy in which many independent agencies can tax regional enterprises. Section 4 analyzes the impact of tax rights on investment, evasion and overall welfare in equilibrium. Section 5 incorporates capital mobility. Section 6 concludes with a discussion of some of the empirical implications of the analysis.
2 Decentralization: China and Russia Compared

In China, the reform that began in 1978 appeared well coordinated ex post. The reform transferred the administration of the vast majority of state enterprises to local governments. Most of these governments had jurisdiction over municipalities. This decentralization has also granted state enterprises autonomy in making output, pricing and, increasingly, investment decisions. Furthermore, enterprise managers and workers have effective incentives to maximize profits (see Groves et al. (1994)). By the mid-1980s, there was significant entry of non-state industrial firms. The consensus among scholars of the Chinese economy is that these firms have always had a great deal of autonomy in their decision making and are highly profit oriented.

Parallel to these changes, China has also decentralized its fiscal structure. Prior to 1978, a multitude of bureaucrats in both central ministries and various levels of local government controlled a typical enterprise. In principle, the central government had the right to collect enterprise cash flows and output in-kind. However, in practice residual claims were ill-defined. At various times during Mao's decentralization campaigns, local governments and ministries were allowed to retain some shares of cash flows and in-kind output from enterprises under their jurisdiction. Furthermore, these agencies often managed to exceed their legally specified shares simply by seizing enterprise resources. In effect, governmental agencies treated the enterprises as common pool resources.

Starting in 1978, the Chinese federal government effectively transferred tax rights to the local governments. The central government designed a unified tax structure which defined tax bases and tax rates that, in principle, should apply to all localities. The actual implementation of tax policy was left to the local governments, which decided how much of each tax to collect. Given the central government's high stipulated 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 assigned local governments the right to set their own tax rates (see Gordon and Li (1991)). Local governments often set an annual revenue quota for its tax bureaus, irrespective of the potential for revenue collection as stipulated in the current centrally set tax law. As fiscal redistribution among regions in China is small, the source of local government revenue is locally collected taxes. In addition to collecting the profits and revenues generated in centrally administered state enterprises in strategic sectors such as energy and defense, the central government is entitled to a share of the locally collected taxes. The sharing arrangement is negotiated between local and central governments and is often fixed for three to five years (Oi, 1993).
Typically, the central government's marginal tax rate over the local tax base is low since it receives most of its revenues in the form of lump sum payments. Thus, local governments have an almost exclusive right to tax within a jurisdiction. Since the overwhelming share of local revenue comes from local taxes, local governments have an incentive to increase the value of their tax base.

Starting in the late 1980s, managers of state owned firms in the Former Soviet Union (FSU) gained more control over the operations in their enterprises. The reforms (perestrojka) eventually destroyed the traditional system in which ministerial officials and party functionaries monitored state enterprises. As no new and effective regulatory institutions replaced the old system, a process of spontaneous privatization was unleashed in which enterprise managers seized their firm's assets. In order to mitigate the "grabbing" of state assets, the Russian federal government instituted a formal privatization program in 1992. Most of the shops and small businesses under local governments jurisdiction were privatized by the end of 1993. Since 1992, many medium and large state owned enterprises have been sold in the mass privatization process. This development allowed many insiders, who had already seized assets, to legalize their de facto ownership rights.

A Russian local government's tax rights are often ill-defined. During both the disintegration of the Former Soviet Union and the formation of the Russian Federation, a chaotic system of inter-budgetary relations emerged (Berkowitz and Mitchneck (1992), Wallich (1994) and World Bank (1996b)). Tax laws were ignored as federal, regional and local tax payments were determined spontaneously based on political competition, conflicts and compromises between established federal, regional and local powers and elite. Many local governments became involved in struggles with other provincial governments, mafias and the federal government for tax rights over the same enterprise. In theory, the Federal Parliament determines formal sharing rules that assign each government level a specific tax base share. However, in practice, the sharing rates are often determined on an ad hoc basis in which different government levels negotiate with the Federal government and with each other. The formal rules set an upper bound on the tax rate that local governments can charge enterprises. However, many local governments effectively exceed the maximum and transfer their additional revenues to "extra-budgetary funds" that are not included in the unified Russian budget. Local governments, which are obligated to pay a large share of their tax base to the federation, typically shift collections to extra-budgetary funds. Local governments also use in-kind taxes, even though this instrument is not part of the formal system.

In China and Russia, the fiscal system is still primitive and governments can tax firms on a somewhat discretionary basis. In China, a local government's tax rights are well-defined
since it has either exclusive rights to determine that tax base and set rates or it competes
with a small number of independent tax agencies. In Russia, tax rights are often ill-defined.
Local governments often compete in an uncoordinated fashion with many other agencies to
collect revenue from the same enterprise. In the next section, we develop a model which
analyzes the implications of these differences in tax rights.

3 A Local Economy

We initially consider a one-period closed local economy.\(^1\) There is a representative consumer,
with a utility function defined over a unit interval of private goods, \(x(q)\), that are indexed by
\(q\), and a public good, \(g\):

\[
U^e(x(q), g) = \int_0^1 \ln x(q) dq + \ln g
\]  

(1)

The public good, \(g\), is supplied by \(J \geq 1\) independent tax agencies: \(g = \sum_{j=1}^J g_j\). The public
good represents social infrastructure such as transportation and communications, banking
and financial sectors, and a legal system.

A consumer’s income is comprised of payments for labor services, \(L\), which she supplies
inelastically, and profit shares. If the consumer’s wage rate is normalized at unity and she
owns all of the locally generated profits, then aggregate expenditure on private goods equals
income:

\[
\int_0^1 p(q) x(q) dq = Y = \Pi + L
\]  

(2)

where \(\Pi\) denotes aggregate profits and \(p(q)\) is the consumer price of good \(q\). The public good
is financed with sales taxes.

Production in each sector \(q\) is conducted with either a single “growth-oriented” activity or
many “informal profit-seeking” activities. An informal profit-seeking activity is convenient for
evading taxes and produces “… wealth for management, without generating official profits.
These activities are characterized by short horizons, small scale and limited investment.”
(Ickes et al. (1997)). A growth-oriented activity requires substantial investment, operates at
a larger scale, and is more visible to tax authorities than an informal profit-seeking activity.
For simplicity, and with no loss of generality, we assume that output from a firm using a
growth-oriented activity is completely visible, while the tax agencies can observe only a share
\(\theta < 1\) of the output from firms that use the informal profit-seeking activity.\(^2\) The tax base is

\(^1\)This model in this section extends the big push model developed by Murphy, Shleifer and Vishny (1989)
by incorporating taxation and public infrastructure spillovers.

\(^2\)This is a limiting case. What is important, is that output from the informal profit-seeking activity is less
sales (output). Each tax agency sets a rate of $t_j$ and the overall tax rate is $t = \sum_{j=1}^{J} t_j$.

To capture this distinction between production activities, we assume that, once fixed costs of $F > 0$ labor units are sunk, the growth-oriented activity converts $a < 1$ units of labor into a unit of output. Thus, the growth-oriented activity exhibits increasing returns to scale (IRS). We initially assume that investment capital is immobile, but relax this assumption later. A firm that uses an informal profit-seeking activity makes no investment and turns a unit of labor into a unit of output. Therefore, the informal profit-seeking activity exhibits constant returns to scale (CRS). For brevity, an IRS firm is one that uses the growth-oriented activity and a CRS firm which uses the informal profit-seeking activity. We assume that the growth-oriented activity is proprietary and that only one firm in each sector has access to it. The informal profit-seeking activity is in the public domain and all firms in each sector have access to it. Each sector’s market structure thus consists of either a monopoly IRS firm or many competitive CRS firms.

Prices are determined as follows. In a sector with many competitive CRS firms, each firm sells at a producer price equal to marginal cost of unity 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 expenditures equal aggregate income divided by the consumer goods 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 of $(1 - t)/(1 - t\theta)$ is lower than the producer price of a CRS firm which is one. The IRS firm earns profits of

$$\pi = [1 - t - a(1 - t\theta)]Y - F$$

When a fraction of $n$ sectors use the growth-oriented activity, overall tax collections are

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

Each tax agency converts its tax collections into public goods according to the linear visible than output from the growth-oriented activity.
production function of \( g_j = s_j t_j \left[ n + (1 - n) \theta \right] Y \). When \( s_j \) is close to zero, the agency is an inefficient supplier of public goods. For example, a mafia that receives protection bribes from a firm makes only a very small contribution to social infrastructure. However, a local government that uses tax revenue to improve local transportation, banking and the court system makes a much larger social contribution. We assume, for simplicity, that \( s_j = s \) and that all agencies have the same production function.

Investment in social infrastructure reduces production costs. In the Former Soviet Union and in China, an underground economy has always operated, even when the government tried to exclude this sector from the benefits of the social infrastructure. Private farmers operating in city markets thrived even when denied access to transport and banking systems. Private construction flourished, even though builders had to bribe officials in order to conduct business. While the underground firms have operated and even thrived, even when denied access to key public goods; new and larger scale businesses, with substantial fixed costs, depend on modern banking, transport and legal systems. For these reasons, we assume that the benefits of social infrastructure spill over only to the IRS firms by reducing their investment costs:

\[
F = F_0 - sT
\]

However, private investment in general cannot be completely replaced by public infrastructure. To ensure that this under all possible circumstances, we assume that even in the limiting case where all the labor in the economy is devoted to the provision of infrastructure, the IRS firm still needs to make private investment:

\[
F_0 - sL > 0 \quad \text{or} \quad s < F_0 / L
\]

We also assume that unilateral investment by any IRS firm is profitable in the absence of taxation and infrastructure spillovers:

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

Assumptions (6) and (7) imply that \( 1 - a > s \), which means that 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. Thus, the inequality \( 1 - a > s \) implies that private production is more productive than public production on the margin, although private production itself
has no spillover effects. Substituting (4) and (5) into (3), each IRS firm’s profit is

$$\pi = [1 - a - t(1 - a\theta) + ts(n + (1 - n)\theta)]Y - F_0$$  \hspace{1cm} (8)$$

where $t(1 - a\theta) - ts(n + (1 - n)\theta)$ is the marginal tax burden per unit of output, after taking into account tax evasion and infrastructure spillovers. The marginal tax burden is positive under assumptions (6) and (7). The marginal rate of after-tax profit as a function of $n$ and $t$ is

$$r(n, t) = 1 - a - t[1 - a\theta - s(n + (1 - n)\theta)]$$  \hspace{1cm} (9)$$

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

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

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

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

$$\Pi(n, t) = \frac{nr + (nr)^2 + (nr)^3 + \cdots}[L - nF_0] - nF_0$$

$$= \frac{nr(n, t)}{1 - nr(n, t)}(L - nF_0) - nF_0$$  \hspace{1cm} (11)$$

The recursive computation in (11) arises because any profits generated by the IRS firms are turned into consumer spending, which in turn leads to more profits. It can be verified that $1 - nr(n, t) \geq a$ for all $n$ and $t$.

Under a sufficiently moderate tax rate, the after-tax profit rate, $r(n, t)$, is positive. When this is the case, $1/(1 - nr) > 1$, because the expansion of the more efficient growth-oriented activity in the economy raises income by increasing profits and contributing more to infrastructure. Thus, the term $1/(1 - nr)$ is an income multiplier that shows the demand and infrastructure spillover effects of an additional dollar of income.

To capture the spillover effects more explicitly, we consider the marginal effect on aggre-
gate income of an additional firm investing in the growth oriented activity:

$$\frac{\partial Y(n, t)}{\partial n} = \frac{\pi(n, t)}{1 - nr(n, t)} + \frac{nst(1 - \theta)Y(n, t)}{1 - nr(n, t)}$$  \(13\)

The first term measures the effect of demand spillovers arising from consumers' spending the marginal firm's profit, \(\pi(n, t)\), on all goods. Since this increased spending then raises the profits of all other IRS firms, and hence aggregate income, the effect of the marginal firm's profit on aggregate income is magnified by the income multiplier \(1/(1 - nr)\). The second term measures the effect of infrastructure spillovers. To see this, note that as the last IRS firm invests, it produces \(Y(n, t)\) in output and pays \(tY(n, t)\) in taxes. However, the CRS firms that it replaces would have paid \(t\theta Y(n, t)\) in taxes since only a fraction \(\theta\) of their output \(Y(n, t)\) would be visible. Therefore, through investment, the marginal IRS firm raises aggregate tax revenue by \(t(1 - \theta)Y(n, t)\). In turn, this increased tax revenue leads to an increase in the provision of public infrastructure in the amount of \(st(1 - \theta)Y(n, t)\). This increase in infrastructure reduces the investment cost for each of the \(n\) IRS firms by \(nst(1 - \theta)Y(n, t)\), which is the numerator of the second term in \(13\). The effect of this profit increase on income is also enhanced by income multiplier \(1/(1 - nr)\).

This suggests that there are two channels through which investment by an IRS firm increases aggregate income: 1) The firm can contribute directly through its profits and the resulting enlarged consumer demand and 2) The firm can also contribute indirectly by paying more taxes which, when used to increase the provision of infrastructure, raises other IRS firms' profits by reducing their investment costs. By inspection of \(13\), it is clear that there are situations in which investment by an IRS firm increases social infrastructure, even though it is unprofitable for the firm. In this situation, investment is socially beneficial if the gains in social infrastructure dominate the loss in profits. However, the IRS firm ignores the social benefits of its investment and tends to under-invest. In the aggregate, the IRS firms' socially inefficient investment decisions may lead to inefficient equilibrium outcomes. In what follows, we focus on how the definition of tax rights determines investment and welfare.

4 Taxation and Property Rights

Since contracts and legal institutions are underdeveloped in transition economies, governments often cannot commit to a tax policy. In Russia, the de jure tax rates are very different from the de facto rates that enterprises face. In the Russian crude oil industry, transit rates
charged by the federal pipeline agency, the federal customs agency and the regional and local governments on whose territory the oil flows are constantly changing and are often unpublished. Legislated sharing arrangements between different levels of government are often ignored. In China, while the federal government publishes tax rates that are uniform across regions, local governments in practice exercise much discretion in taxing enterprises under their jurisdiction. Enterprises and investors often complain about uncertain and changing tax policies.

In order to capture this institutional feature, 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 in which IRS firms invest 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 trades off social order and own tax revenues. We define an indicator of social order \( \Omega(n, t) \) as the distance between the realized consumption per capita \( x(n, t) = Y(n, t)(1 - t\bar{\theta}) \) and the bare minimum consumption per capita \( x(n, 1) = Y(n, 1)(1 - \bar{\theta}) \), or \( \Omega(n, t) = x(n, t) - x(n, 1) \). Per capita consumption falls to the minimum when the tax rate is unity, since \( x(n, t) \) is decreasing in \( t \). As long as some sectors have only CRS firms, there is tax evasion, and therefore, positive consumption when \( t = 1 \).

Each agency simultaneously chooses a tax rate \( t_j \) to maximize its own utility of

\[
U_j = \ln[t_j(n + (1 - n)\bar{\theta})Y(n, t_j + t_{-j})] + \ln \Omega(n, t_j + t_{-j})
\]  

(14)

where \( t_j(n + (1 - n)\bar{\theta})Y(n, t) \) is agency \( j \)'s tax revenue. For simplicity, we assume that the tax agencies have symmetric preferences and the same production functions for converting their collections into the public good. According to this specification, each agency always wants some positive level of social order since its utility becomes arbitrarily low when social order collapses and \( \Omega \rightarrow 0 \). Since social order collapses when the overall tax rate \( t \) approaches one, the tax agencies will refrain from such overzealous taxation in an equilibrium. Since social order as increases as private consumption increases and all collection agencies benefit from social order, private consumption \( x(n, t) \) is a public good for each tax collection agency. The

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Roland and Verdier (1994) argue that governments in transition economies often cannot commit to a privatization policy.
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 taxing agencies, \( J \), on economic performance, we first analyze the second stage game in which all \( J \) agencies take \( n \) as given and simultaneously choose \( t_j \) to maximize their utility. The second stage equilibrium is characterized by a set of first order conditions:

\[
\frac{1}{t_j} + \frac{1}{Y} \frac{\partial Y}{\partial t} = -\frac{1}{\Omega} \frac{\partial \Omega}{\partial t}
\]

for \( j = 1, \ldots, J \). The left hand side of (15) is agency \( j \)'s marginal utility of increased revenue as a result of the increase in its tax rate. This must then balance the marginal disutility arising from the deterioration of social order as a result of the tax increase, which is on the right hand side of (15).

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 establishes the existence and uniqueness of a symmetric Nash equilibrium in the second stage. The proof for this, and other results in this paper, can be found in the Appendix.

**Proposition 1.** Given assumptions (6) and (7), there exists a unique symmetric Nash equilibrium in the second stage. The equilibrium tax rate, \( t(n, J) = Jt_j(n, J) \), is bounded:

1. \( t(n, J) < t(0, J) = J/(1 + J) \), and
2. \( (J - 2)/(J - 1) < t(n, J) \) for \( J \geq 2 \).

The overall tax rate in the equilibrium is less than one, implying that the indicator of social order \( \Omega(n, t(n, J)) \) is positive.

The next Proposition analyzes the impact of an increase in the number of taxing agencies, \( J \), on the second stage symmetric Nash equilibrium.

**Proposition 2** In the second stage symmetric Nash equilibrium, as \( J \) increases,

1. the overall tax rate increases: \( \partial t/\partial J > 0 \);
2. aggregate income falls: \( \partial Y/\partial J < 0 \);
3. private consumption falls: \( \partial x/\partial J < 0 \);
4. social order deteriorates: \( \partial \Omega / \partial J < 0 \); and
5. industry profits decline: \( \partial \Pi / \partial J < 0 \).

Proposition 2 establishes that the assignment of tax rights is related to the tragedy of the commons. When many tax agencies simultaneously tax production in the economy, the tax base is a common pool or open access resource. An independent tax 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 their tax base and the social order. (See (15) and recall that \( \partial Y / \partial t < 0 \) and \( \partial x / \partial t < 0 \).) Each independent tax agency ignores the external costs in setting its own tax rate, which leads to over-taxation in a Nash equilibrium. The equilibrium tax rate is lowest when \( J = 1 \) and tax rights are sharply defined. As the number of independent tax agencies increases, the negative impact of the externality is exacerbated and the overall tax rate increases while aggregate income, consumption, profits and social order fall. Thus, as tax rights become fuzzier, a particular government's tax policy becomes part of a predatory system.

The next Proposition analyzes the reaction of the tax agencies to an increase in \( n \).

**Proposition 3** In the second stage symmetric Nash equilibrium, the tax rate \( t(n, J) \) is decreasing in \( n \): \( \partial t / \partial n < 0 \).

Since the IRS firms are more efficient and less evasive than CRS firms, the tax base expands as more IRS firms invest. Proposition 3 shows that this change will induce the tax agencies to lower their taxes, foregoing tax revenue for increased social order.

We now turn to the first stage of the game. Rationally anticipating the overall tax rate in stage two, an 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 this is unprofitable, i.e., \( \pi(n, t(n, J)) \leq 0 \). In this case, many CRS firms enter the sector. The IRS firm in a sector invests when \( \pi(n, t(n, J)) > 0 \). The firms' individual choices in the first stage determine, in a subgame-perfect equilibrium, the share of sectors with IRS firms. Thus, equilibrium outcomes are dependent on the profit function properties. A useful profit function property is stated in the following lemma.

**Lemma 1** If there exists an \( m \in [0, 1] \) such that \( \pi(m, t(m, J)) = 0 \), then \( \partial \pi / \partial m > 0 \) and \( m \) is unique.

According to lemma 1, if the profit function crosses its break-even point of zero, then profits are strictly increasing in the share of IRS firms in the neighborhood of the break-even
point. Therefore, if the profit function crosses the break-even point, it must cross at a unique \( m \in [0,1] \). This property has the following behavioral implications:

**Proposition 4** 1. If it is profitable for \( n \in (0,1) \) IRS firms to invest, then it is profitable for all IRS firms to invest.

2. If it is unprofitable for \( n \in (0,1) \) IRS firms to invest, then it is strictly unprofitable for any IRS firm to invest unilaterally.

These properties of the profit function imply that 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, then all IRS firms can invest and earn positive profits. In this case, all IRS firms expect that investing is profitable and Proposition 4 states that this expectation is self-fulfilling. Hence, a subgame perfect equilibrium exists in which 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 in which all sectors are comprised solely of CRS firms. The following proposition summarizes these results.

**Proposition 5** There exists a subgame perfect equilibrium in which either the IRS firm in each sector invests or there is no investment in each sector.

Thus, the model thus gives rise to potentially two types of equilibria. We call the equilibrium in which the IRS firm in each sector invests in the more productive growth-oriented activity the **high equilibrium**; the equilibrium in which there is no investment and each sector is comprised of many CRS firms which use the less productive informal profit-seeking activity is the **low equilibrium**.

For the high equilibrium to be sustainable, all IRS firms must make positive profits from their investments:

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

Solving for \( t(1, J) \) yields,

\[
t(1, J) < t_H \equiv \frac{1 - a - F_0/L}{1 - a\theta - s}
\]

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

If the low equilibrium is sustainable, then no IRS firm can profitably invest alone:

\[
\pi(0, t(0, J)) = L[1 - a - t(0, J)(1 - a\theta - s\theta)] - F_0 < 0
\]

Solving for \( t(0, J) \) yields,

\[
t(0, J) > t_L = \frac{1 - a - F_0/L}{1 - a\theta - s\theta}
\]

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, if the a low equilibrium exists, then \( t(0, J) > t_L \) necessarily holds in an economy with \( J \) tax agencies. The set \( J_L = \{ J \in J | t(0, J) > t_L \} \) thus represents the collection of all possible configurations of tax agencies such that the low equilibrium can be sustained. Since \( t(0, J) \) is increasing in \( J \), the set \( J_L \) must be bounded from below. Therefore, for the low equilibrium to be sustainable, the number of tax agencies must be sufficiently large.

By inspection, \( t_L < t_H \). Recalling Proposition 2, we know that \( t(n, J) \) falls as the number of sectors which invest increase, implying \( t(0, J) > t(1, J) \). It is thus possible that the intersection of \( J_H \) and \( J_L \) is non-empty and the economy can sustain both the high and low equilibria. Since the intersection of \( J_H \) and \( J_L \) are bounded from both above and below, multiple equilibria can be sustained when \( J \) is an intermediate range. The next proposition analyzes the relationship between equilibrium regimes and \( J \).

**Proposition 6** Given the number of tax agencies \( J \in J \) in the economy,

1. the high equilibrium is unique if \( J \) is sufficiently low: \( t(0, J) \leq t_L \) or \( J \in J \setminus J_L \);
2. the low equilibrium is unique if \( J \) is sufficiently high: \( J \in J \setminus J_H \);
3. the economy can sustain both the low and the high equilibria if \( J_H \cap J_L \neq \emptyset \) and \( J \in J_H \cap J_L \).

Figure 1 illustrates the results of Proposition 6. Tax rates are on the vertical axis and the number of tax agencies, \( J \), is on the horizontal axis. The parameters are \( a = .1, s = .3, F_0/L = .32 \) and \( \theta = .6 \). Consistent with Propositions 2 and 3, we have \( t(0, J) > t(1, J) \) and

\[^5J \setminus J_L \] denotes the complement of the set \( J_L \).
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 \( J_H = \{ J|1 \leq J \leq 11 \} \), and the set of the numbers of tax agencies under which the low equilibrium is sustainable is \( J_L = \{ J|J \geq 4 \} \). The high equilibrium is unique when \( J \in J \setminus J_L = \{1, 2, 3\} \) (marked by \( H \)). Both the high and the low equilibrium can be sustained when \( J \in J_H \cap J_L = \{ J|4 \leq J \leq 11 \} \) (marked by \( M \)). The low equilibrium is unique when \( J \in J \setminus J_H = \{ J|J \geq 12 \} \) (marked by \( L \)).

When there are multiple equilibria, then, *ceteris paribus*, the high equilibrium Pareto dominates the low equilibrium. Aggregate income is higher in the high equilibrium since consumers receive profits in addition to the wage income, which is their sole source of remuneration in the low equilibrium. Since the tax rate is lower and there is no evasion in the high equilibrium, consumer prices of \( 1/(1 - tO) \) 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 more significant 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. As a result, tax collections and the provision of social infrastructure is stronger in the high equilibrium. Therefore even at a lower equilibrium tax rate, each of the \( J \) tax agencies is strictly better off in the high equilibrium. These results are summarized below.

**Proposition 7** 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.

Propositions 4 and 6 imply 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 \( J \in J_H \cap J_L \) such that when \( n > m(J) \) we have \( \pi(n, t(n, J)) > 0 \). 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 of \( \pi(m, t(m, J)) = 0 \). The existence of the critical mass shows the importance of investment coordination in selecting the high equilibrium. 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. Policies and actions which elevate investor optimism and confidence about future profits can push the economy towards the high equilibrium.
The size of the critical mass reveals how difficult it is to coordinate on the high equilibrium. A small critical mass, say \( m(J) = 0.1 \), means that one 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 8** The critical mass, \( m(J) \), is increasing in \( J \), for all \( J \in J_H \cap J_L \).

We have argued that government tax rights are more sharply defined in China: \( J^C < J^R \), where superscripts \( ^C \) and \( ^R \) denote a typical Chinese and Russian local economy. Abstracting from differences in demand and technology, 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 the Russian subnational economy, while investment, overall tax collections and, thus, the provision of social infrastructure will be higher in the Chinese local economy. In the concluding section, some empirical support for these predictions is provided.

### 5 Capital Mobility

In China and Russia, the liberalization of financial markets, the easing of trade restrictions and the breakdown of planning has allowed investment capital to become more mobile. Some local and regional governments have imposed border controls and other barriers to restrict capital flows (see Bylov (1997) for Russia and Young (1997) for China). This section shows that an increase in capital mobility can increase the likelihood that a low equilibrium is selected. Since mobility can reduce investment, which reduces local welfare; a local government has an incentive to take measures to erect barriers which limit investment outflow as capital becomes more mobile.

To see this more explicitly: suppose that any mobile IRS firm can earn a profit of \( \pi^* > 0 \) net of moving costs in another region. Thus, \( \pi^* \) 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. Allowing only a fraction of the IRS firms to be mobile would have no substantial impact on
our results. Once a mobile IRS firm invests in the region, its fixed costs are sunk. The next Proposition characterizes the impact mobility on the second stage equilibrium.

**Proposition 9** In the second stage symmetric Nash equilibrium, the tax rate is independent of the profit hurdle.

We now illustrate the impact of mobility on equilibrium selection with a parametric example represented in Figure 2. The parameters are $a = .1$, $s = .3$, $F_0/L = .32$ and $\theta = .6$. The fraction of IRS firms investing in the local economy, $n$, is depicted on the horizontal axis and the IRS firm’s profit as a function of $n$ is on the vertical axis. Figure 2 includes three profit schedules: the highest schedule is realized when there are only three tax agencies ($J = 3$); the middle one is realized when $J = 5$; the bottom holds when $J = 14$. When capital is immobile, the profit hurdle is zero. The high equilibrium is unique when $J = 3$; both the high and low equilibrium can be sustained when $J = 5$; the low equilibrium is unique when $J = 14$.

Suppose that, with mobility, each IRS firm can earn a profit of 4 labor units ($\pi^* = 4$) by investing in other regions. The IRS firms will therefore only invest in the home region if they can earn a profit of more than 4 labor units. If the local economy has only three tax agencies, adding capital mobility may alter the equilibrium outcome. As is shown in the figure, the profit hurdle line intersects with the top profit curve, indicating that multiple equilibria now emerge. Therefore, if a unique high equilibrium emerges when capital is immobile, then there exist multiple equilibria when capital is mobile and the return on investment outside the region is sufficiently high. In addition, as can be seen in the figure, if the profit hurdle is raised above 11; then, with capital mobility, the local economy will slip into the unique low equilibrium.

Consider next the case where both the high and low equilibrium can be sustained when capital is immobile and $J = 5$. All IRS firms will invest in the home region when the fraction of IRS sectors exceeds the critical mass, which is approximately .41. However, when capital is mobile, IRS firms that stay in the region must clear the profit hurdle $\pi^* = 4$. In this example, the hurdle cannot be cleared even when all IRS firms coordinate their investments in the home region, so the economy falls into the unique low equilibrium when capital becomes mobile. If the profit hurdle is lower (say $\pi^* = 3$), which is not shown in the figure, mobility raises the critical mass and makes it harder for the IRS firms to coordinate on the high equilibrium.

Finally, suppose that, when capital is immobile, the low equilibrium is unique due to the existence of fourteen tax agencies ($J = 14$). In this case, there is no investment in the
home region since the internal profit hurdle of zero cannot be cleared. Since capital mobility introduces a higher hurdle, it has no impact on the equilibrium.

This model clearly predicts that mobility can depress local welfare but makes no predictions about its impact on national welfare. This result can be understood using the theory of the second-best. Since the economy has many distortions, including imperfect competition and uncoordinated tax agencies, removing the distortion of capital immobility alone can depress welfare in a general equilibrium framework. Thus, capital mobility can significantly decrease the incentive for the IRS firms to invest at home and, therefore, increases the likelihood that a low equilibrium is selected. However, since we have no a priori knowledge about the difference in mobility between Russia and China, we cannot ascertain the degree to which the difference in mobility between the two countries alters our basic forecast that, because of differences in tax rights, the overall tax rate for investors tends to be higher in Russia, while local collections and provision of public infrastructure tend to be higher in China. However, in principle, the effects of mobility can be empirically determined.

6 Conclusions

The evolution of government tax rights has been very different in China and Russia. The number of independent tax agencies in China has decreased and local government tax rights have gradually 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 increased and local government tax rights tend to be ill-defined. This paper has analyzed the implications of differences in government tax rights using a model of a local economy. Abstracting from differences in technology, consumer preferences and capital mobility, one clear prediction of the model is that investment is higher in economies in which government tax rights are better defined. This forecast is consistent with the observation that there has been much more investment in China than Russia.

The theoretical model also predicts that local tax collections and local provision of public goods and infrastructure are higher when government tax rights are more clearly defined, while tax evasion and an investor’s tax burden are higher when these rights are fuzzier.

6Theoretical papers by Gordon (1983) and Wildasin (1989) show that factor mobility within fiscal federations restrains tax rates set by subnational governments. However, Keen and Kotsogiannis (1996) show where capital mobility is combined with many governments taxing the same enterprises, the equilibrium tax rate is still excessive from the standpoint of either social welfare or tax revenue maximization. Thus, our results are complementary to Keen and Kotsogiannis (1996). However, our model assumes that each regional economy is small while the previously cited papers incorporate strategic interactions between governments in different regions.
There is a great deal of anecdotal, survey and fragmentary empirical evidence suggesting that these forecasts capture key differences in the Chinese and Russian economies.

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, foreign investors, and joint ventures. 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 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 to official under-reporting of tax revenues, tax evasion of the ordinary type in China is about as pervasive as in other developing countries. For example, according to analysis conducted by the World Bank (1996a), the compliance of value-added tax in China is about 70 percent, which “is comparable to that in other developing countries, but falls short of the 90-95 percent compliance rates achieved by top tax performers.” (p. 42) 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 (World Bank (1995)).

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, transportation and communications.8

In the case of Russia, taxation of enterprises is typically burdensome and non-transparent. Enterprise managers complain about the complexities involved in paying taxes to many different government budgets. 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

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8According to World Bank (1996a), “China’s social indicators are higher than in most low-income countries and approach those in middle-income countries.”

8For 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).
payments to criminal protection organizations (krisha). 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 is also costly.

This highly complex and opaque system has 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, is a convenient way to evade tax obligations (pp.19-23).

High tax rates in Russia encourage evasion and discourage investment. Thus, local tax collections consistently are lower than targets and local governments have been forced to slash expenditures on public goods such as education, police protection, public health, transport infrastructure and legal operations. As a result, 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 and is in need of an explanation. Our comparative analysis of local public finances suggests that the definition of government tax rights is an important reason for the performance difference.

References


where \( A = 1 - s - a \theta + (1 - n)s(1 - \theta) > 0 \). Substituting (A.21) into the second order derivative, we obtain

\[
\frac{\partial^2 U_j}{\partial t_j^2} \bigg|_{t_j = t_j^*} = -\frac{[2 - 2n(1 - \alpha - A) + n(1 - t_j - A)]^2}{2[(1 - t_j - A)(1 - n\tau(n, 1)(1 - n\tau(n, t_j)))^2}
\]

It can be verified that for all \( n \geq 0 \) and \( t_j < 1, 2 - 2n(1 - \alpha - A) + n(1 - t_j - A) > 0 \). So \( \frac{\partial^2 U_j}{\partial t_j^2} < 0 \) along j's reaction curve.

A Appendix

A.1 Quasi-Concavity of \( U_j \)

We prove that the tax collector's utility function

\[
U_j = \ln[t_j(n + (1 - n)\theta)Y(n, t_j + t_j - A)] + \ln \Omega(n, t_j + t_j - A)
\]

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 \( \partial U_j / \partial t_j = 0 \):

\[
t_j^* := \frac{(1 - t_j - A)(1 - n - n\alpha + nt_j - A)}{2 - 2n(1 - \alpha - A) + n(1 - t_j - A)}
\]

where \( A = 1 - s - a \theta + (1 - n)s(1 - \theta) > 0 \). Substituting (A.21) into the second order derivative, we obtain

\[
\frac{\partial^2 U_j}{\partial t_j^2} \bigg|_{t_j = t_j^*} = -\frac{[2 - 2n(1 - \alpha - A) + n(1 - t_j - A)]^2}{2[(1 - t_j - A)(1 - n\tau(n, 1)(1 - n\tau(n, t_j)))^2}
\]

It can be verified that for all \( n \geq 0 \) and \( t_j < 1, 2 - 2n(1 - \alpha - A) + n(1 - t_j - A) > 0 \). So \( \partial^2 U_j / \partial t_j^2 < 0 \) along j's reaction curve.
A.2 Proof of Proposition 1

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

\[
\frac{f(n, J, t)}{B(n, t)} = \frac{\alpha t^2 + \beta t + \delta}{B(n, t)} = 0
\]  

(A.23)

where

\[
\alpha(n, J) = -n[1-a\theta - s + s(1-\theta)(1-n)][(J-1)] \leq 0
\]

\[
\beta(n, J) = (J-2)[ns(1-n)(1-\theta) + n(1-a\theta - s)] - (J+1)(1-n+na)
\]

\[
\delta(n, J) = J(1-n+na) > 0
\]

\[
B(n, t) = (1-t)[(1-n+na) + nt(1-a\theta - s) + s(1-n)(1-\theta)] > 0
\]

for all \(n \in [0, 1]\), \(J \geq 1\) and \(t \in (0, 1)\). The sign of \(\beta\) is ambiguous. However, it can be verified that

\[
f(n, J, 1) \equiv \alpha(n, J) + \beta(n, J) + \delta(n, J)
\]

\[= -(1-n+na) - n^2s(1-\theta) - n(1-a\theta - s\theta) < 0 \]  

(A.24)

We 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

\[
t(n, 1) = \frac{1-n+na}{2(1-n+na) + n(1-a\theta - s) + ns(1-n)(1-\theta)}
\]  

(A.25)

It can be verified that \(t(n, 1) \in (0, 1/2]\) 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

\[
t(0, J) = \frac{J}{J+1}
\]  

(A.26)

Clearly, \(t(0, J) \in (0, 1)\).

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:

$$t(n, J) = -\frac{\beta - \sqrt{\beta^2 - 4\alpha\delta}}{2\alpha}$$  \hspace{1cm} (A.27)

Given that $f(n, J, 1) = \alpha + \beta + \delta < 0$ from inequality (A.24), one can verify that $t(n, J) < 1$.

We now prove that the equilibrium is unique. Suppose to the contrary that there exists a different equilibrium tax rate $t^* \neq t \equiv t(n, J)$. By definition, $f(n, J, t^*) = 0$, $f(n, J, t) = 0$ and $t^* \in (0, 1)$ and $t \in (0, 1)$. So

$$f(n, t^*, J) - f(n, t, J) = \alpha(t^* - t^3) + \beta(t^* - t) = 0$$  \hspace{1cm} (A.28)

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

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

To show that the equilibrium tax rate is bounded, we first establish that $f(n, J, t)$ is a decreasing function in $t$ under certain conditions. This is done by differentiating $f(n, J, t)$ with respect to $t$:

$$\frac{df}{dt} = 2\alpha t + \beta$$

$$= -2n[1 - a\theta - s + s(1 - \theta)(1 - n)](J - 1) \left(t - \frac{J - 2}{2(J - 1)}\right)$$

$$-(J + 1)(1 - n + na)$$

$$< 0$$  \hspace{1cm} (A.29)

if $J \leq 2$ or if $\frac{J - 2}{2(J - 1)} \leq t < 1$ for all $J > 2$.

To show that $J/(J + 1)$ is an upper bound of $t(n, J)$, we substitute $t = J/(J + 1)$ into $f(n, J, t)$ to get:

$$f \left(n, J, \frac{J}{J + 1}\right) = -\frac{2Jn}{(1 + J)^2}[(1 - a\theta - s) + s(1 - n)(1 - \theta)] \leq 0$$  \hspace{1cm} (A.30)

where the strict inequality holds only when $n > 0$. Since $J/(J + 1) > (J - 2)/(2(J - 1))$, $f(n, J, t)$ is strictly decreasing in $t$ at $t = J/(J + 1)$. Therefore, $t(n, J) \leq J/(J + 1)$ and the strict inequality holds only when $n > 0$.

To show that $(J - 2)/(J - 1)$ is a lower bound of $t(n, J)$ for $J \geq 2$, we substitute $t = (J - 2)/(J - 1)$ into $f(n, J, t)$ to get

$$f \left(n, J, \frac{J - 2}{J - 1}\right) = \frac{2(1 - n + na)}{J - 1} > 0$$  \hspace{1cm} (A.31)

Since $f(n, J, t)$ is strictly decreasing in $t$, it must be that $t > (J - 2)/(J - 1)$ for $J \geq 2$.  

27
A.3 Proof of Proposition 2

We first show that $\frac{\partial t(n, J)}{\partial J} > 0$. By the implicit function theorem, we have

$$\frac{\partial t(n, J)}{\partial J} = \frac{\partial f(n, J, t)}{\partial J} / \frac{\partial f(n, J, t)}{\partial t}$$

(A.32)

By (A.29), $\partial f/\partial t < 0$ for at the equilibrium tax rate $t(n, J)$. Therefore, it remains to be established that $\partial f/\partial J > 0$. But this is apparent since:

$$\frac{\partial f(n, J, t)}{\partial J} = \frac{B(n, t)}{t} > 0$$

(A.33)

The remaining claims in Proposition 2 follow immediately.

A.4 Proof of Proposition 3

We first show that $\frac{\partial t(n, J)}{\partial n} < 0$. Consider first the case where $J = 1$. Differentiating the equilibrium tax rate given by (A.25), then

$$\frac{\partial t(n, 1)}{\partial n} = \frac{\partial f(n, 1, t)}{\partial n} / \frac{\partial f(n, 1, t)}{\partial t}$$

(A.34)

For $J > 2$, we use the implicit function theorem to obtain

$$\frac{\partial t(n, J)}{\partial n} = \frac{\partial f(n, J, t)}{\partial n} / \frac{\partial f(n, J, t)}{\partial t}$$

(A.35)

Since $\partial f/\partial t < 0$, it remains to be established that $\partial f/\partial n < 0$. To do so, we partially differentiate $f(n, J, t)$ with respect to $n$ and obtain

$$\frac{\partial f}{\partial n} = \frac{\partial \alpha}{\partial n} t^2 + \frac{\partial \beta}{\partial n} t + \frac{\partial \delta}{\partial n}$$

(A.36)

Since $f(n, J, t) = 0$ occurs at the second stage equilibrium, then multiplying (A.36) by $n$ and substracting $f$, we obtain

$$n \frac{\partial f}{\partial n} - f = -n^2 s(1 - \theta)[(J - 2) - (J - 1)t] + (1 + J)t - J < 0$$

(A.37)

The lower and upper bounds on the equilibrium tax rate established in Proposition 1 imply that the above equation is strictly negative. It follows that $\partial f/\partial n < 0$ for $J \geq 2$. 

28
A.5  Proof of Lemma 1

We prove the two claims in turn. Given that \( \pi(m, t(m, J)) = 0 \), a total differentiation of \( \pi(m, t(m, J)) \) with respect to \( m \) gives:

\[
\frac{\partial \pi}{\partial m} = \frac{\partial \pi}{\partial m_1} \bigg|_{t(m, J)} + \frac{\partial \pi}{\partial t} \frac{\partial t}{\partial m} = \frac{L_s(1-\theta)}{1-n\pi(m, t)} - \frac{L[1-s-a\theta + s(1-m)(1-\theta)]}{1-n\pi(m, t)} \frac{\partial t}{\partial m} > 0
\]

since \( \partial t/\partial m < 0 \).

Since \( \pi(m, t(m, J)) \) is continuously differentiable and since it crosses the zero line at a positive slope, it can cross the zero line only once. Therefore, \( \pi(m, t(m, J)) \) can have at most one root.

A.6  Proof of Proposition 4

The two statements can be restated formally as:

1. If \( \pi(n, t(n, J)) > 0 \) for some \( n \in (0, 1) \), then \( \pi(1, t(1, J)) > 0 \);
2. If \( \pi(n, t(n, J)) \leq 0 \) for some \( n \in (0, 1) \), then \( \pi(0, t(0, J)) < 0 \).

We give a proof for the first statement only since the second follows by analogy.

Suppose that, to the contrary, we have \( \pi(1, t(1, J)) \leq 0 \) when \( \pi(n, t(n, J)) > 0 \) for some \( n \in (0, 1) \). Fix this \( n \). Consider first the case \( \pi(n, t(n, J)) < 0 \). By Lemma 1, \( \partial \pi/\partial n_1 > 0 \) and \( n_1 \) is unique. Take an arbitrarily small \( \epsilon > 0 \) such that \( \pi(n_1 - \epsilon, t(n_1 - \epsilon, J)) < 0 \) and \( n_1 - \epsilon > n \). Then, by continuity, there again exists a \( n_2 \in (n, n_1 - \epsilon) \) such that \( \pi(n_2, t(n_2, J)) = 0 \). But this contradicts with the fact the \( \pi \) has a unique root.

Consider the case \( \pi(1, t(1, J)) = 0 \). By continuity, there exists a small enough \( \delta > 0 \) such that \( \pi(1 - \delta, t(1 - \delta, J)) < 0 \) and \( 1 - \delta > n \). The arguments made above can be easily applied here.

A.7  Proof of Proposition 5

The result follows directly from Proposition 4.

A.8  Proof of Proposition 6

The results in the proposition follow directly from the discussion in the text.

A.9  Proof of Proposition 7

Since \( t(0, J) > t(1, J) \), 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
\[
\frac{T_H}{T_L} = \frac{t(1, J)Y(1, t(1, J))}{t(0, J)Y(0, t(0, J))}
\] (A.38)

Substituting in (9) and (10), we have
\[
\frac{T_H}{T_L} = \frac{t(1, J)}{t(0, J)} \frac{1 - F_0/L}{a + t(1, J)(1 - a\theta - s)}
\] (A.39)

Since at the high equilibrium \(t(1, J) < \frac{1 - a - F_0/L}{1 - a\theta - s}\) (eq (17)) must hold and at the low equilibrium \(t(0, J) > \frac{1 - a - F_0/L}{1 - a\theta - s}\) (eq (19)) must hold, we have
\[
\frac{T_H}{T_L} > \frac{1 - a\theta - s\theta}{1 - a\theta - s} > 1
\] (A.40)

A.10 Proof of Proposition 8

Totally differentiating \(\pi(m(J), t(m(J), J)) = 0\) with respect to \(J\) yields,
\[
\frac{\partial \pi}{\partial m} \frac{\partial m}{\partial J} + \frac{\partial \pi}{\partial t} \frac{\partial t}{\partial J} = 0
\] (A.41)

Since \(\partial \pi/\partial m > 0\) (Proposition 1), \(\partial t/\partial J > 0\) (Proposition 2) and \(\partial \pi/\partial t < 0\), it is apparent that \(\partial m/\partial J > 0\).
Figure 1: The Relationship Between $J$ and Equilibrium Regimes
Figure 2: The Impact of Capital Mobility