THE ORGANIZATION OF PUBLIC SERVICE PROVISION

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Abstract

This paper addresses the question of how the responsibility for the delivery of social services, including health, education, and welfare programs, should be divided between state and central governments. We combine a random voting model and the incomplete contracts paradigm to formalize the trade-off between central and state responsibility for service delivery, and find that authority should rest with the party for whom the marginal impact of the service on re-election chances is greater. This in turn means that, other things equal, states with lower than average health, education, or welfare status should be given responsibility for service delivery, while authority in states with above average indicators should reside with the central government. Also, we show that there is no presumption that states that are given authority for service delivery should necessarily be granted expanded tax authority.

1. Introduction

This paper addresses the question of how the responsibility for the delivery of social services, including health, education, and welfare programs, should be divided between state and central governments. For example, should central governments have the authority and responsibility to intervene and take over the operations of state hospitals and schools, or should these residual control rights rest with states? We examine these and related issues in the context of a political economy model in which residents respond to the quality of services provided, and to the tax cost imposed on them.[1]

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[1]In some cases it might be more realistic to interpret the model in terms of the allocation of responsibility for service delivery between state and county governments.

Traditional approaches to the decentralization of government (e.g., Oates 1972, 1999) identify local information advantages and interjurisdictional spillovers as reasons to prefer local or central control over certain allocative decisions. In the social sectors, the scope for interjurisdictional spillovers seems limited (except for policy-induced migrations and a potential "race to the bottom"—see e.g., Brueckner 2000), and while local preferences doubtless differ, it is not always clear why central government policy cannot be tailored to those preferences.[2]

There is a growing literature on the relative merits of public versus private provision of publicly funded services. In the health sector, questions of "corporatization" of public hospitals have been addressed by Harding and Preker (2001). In the education literature, the merits of private provision or management of schooling, sometimes implemented through voucher schemes, has received widespread attention (e.g., Hoxby 2002).[3] Similarly, the contracting out of employment placement and other welfare services was implemented, for example, in Australia as part of that country's public sector reforms of the late 1990s.

At the theoretical level, Hart, Shliefer, and Vishny (1997) examined the issue of public provision versus contracting out, and Besley and Ghatak (2001) investigated whether public goods should be publicly or privately owned. These models employ the techniques of the incomplete contracts literature, developed by Grossman and Hart (1986), Hart and Moore (1990), and Hart (1995).

This paper employs similar theoretical techniques, making extensive use of the incomplete contracts model, to address the related issue of decentralization of government. However, we enrich the incomplete contracts model in order to realistically model political determinants of central and local decisions, by adapting a random voting model (following, for example, Perrson and Tabellini 2000) that allows explicit derivation of decision-makers' objectives. In the model, central and state governments make investments in complementary assets that together are used to produce public services. The probability of re-election depends on the quality of the service produced, and the cost imposed on taxpayers.

When the two parties cooperate, the assets are used efficiently, and service quality is high (conditional on the level of ex ante investments). Cooperation is interpreted as the result of a Nash bargain, with associated

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[2]Oates' (1972) "decentralization theorem" states that in the absence of interjurisdictional spillovers, decentralized decisions are preferred because central policy is assumed to be uniform across states. Besley and Coate (1999) assume heterogeneous public good provision across states, and develop a model of political choice that yields a trade-off between central and local provision.

[3]In April 2002, the Philadelphia School District's School Reform Commission voted to transfer control of 42 failing schools to seven for profit and nonprofit firms (National School Boards Association 2002).

intergovernmental transfers.[4] These transfers do not serve any externality-correction function as in traditional models of fiscal federalism, but just allocate the surplus from cooperation between the central and local governments. When the parties do not cooperate, one on them—perhaps as identified in the constitution—provides the service, the quality of which falls below the level achieved under cooperation. The specification of the party with responsibility for service delivery in the event of noncooperation affects incentives to make ex ante investments.

One of the central results of the paper, reminiscent of Besley and Ghatak's (2001) analysis, is that responsibility for service delivery should be allocated to that level of government for which the marginal benefit of quality is greater. This result is robust in the sense that it does not depend on the relative productivity of state and central investments. Due to the public good nature of each party's investment (improved service quality increases both parties' chances of re-election), ownership improves the investment incentives of the party with the higher marginal valuation of quality, but it reduces the investment incentives of the party with the lower marginal valuation. Thus assigning ownership to the party with the higher marginal valuation unambiguously improves *both* parties' investment incentives.

Our analysis differs from Besley and Ghatak's however in the sense that these marginal benefits are endogenized in an explicit voting model. We therefore do not have to rely on arbitrary differences in the preferences of state and central governments,[5] but derive these from underlying heterogeneity across states. Another difference is that we allow multiple states, and show that the allocation of responsibility should differ systematically across states. In particular, it will never be optimal to allocate responsibility uniformly (either to the center or to the states) across all states. That is, responsibility for service delivery in some states should rest with the central government, while responsibility in other states should reside with the state government.

Our other contribution is to examine the issue of financing authority in the context of decentralization. It is natural to argue that decentralization of responsibility for the provision of public services must be coupled with adequate financial resources. In terms of the feasibility of meeting goals for the level of services provided (e.g., maintaining or exceeding the level reached under a centralized system), such advice seems indisputable (correcting for any possible technologically determined efficiency differentials between central and local provision).

We address a slightly more subtle financing issue in this paper however, namely, how should the marginal cost of public funds be set for state governments? Under an optimal tax system, the marginal cost of funds will be as low

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[4]A series of papers (e.g., De Meza and Lockwood 1998, Rajan and Zingales 1998) examined the effects of alternative bargaining protocols on optimal ownership rules in the context of the theory of the firm.

[5]In Besley and Ghatak's model, the two parties are the government and an NGO.

as possible (subject to revenue, administrative, and information constraints). However, by intentionally narrowing the tax base accessible to state governments, the marginal cost of funds, which affects re-election prospects, can be increased. We provide indicative evidence that when state governments are optimally allocated responsibility for service delivery, it becomes more likely that an increase in the marginal cost of public funds, achieved through a narrowing of their tax base, could have a net positive effect on incentives for ex ante investments. That is, there should be no presumption that state tax authority should be increased in tandem with an increase in responsibility for service delivery.

The next section of the paper sets up the model of service delivery and how it affects re-election prospects. Section 3 examines the determination of intergovernmental grants as side payments in a bargaining game over the use of ex ante investments. Section 4 derives optimal and noncooperative levels of ex ante investments, and Section 5 states the conditions under which state or central ownership/authority is preferred. Section 6 incorporates the choice of state tax base in the analysis, and Section 7 briefly concludes.

2. Service Quality and Political Outcomes

There is a central government (c) and S state governments ($s = 1, \ldots, S$). The central government makes a capital investment K_c and each state government s invests K_s. K_c should be thought of as an investment in knowledge and information, such as is undertaken by the National Institutes of Health in the United States. On the other hand, K_s can be thought of as investment in facilities such as hospitals. Similar models of education provision (where K_c is educational research and K_s is schools, etc.) fit this framework.

When the two capital goods are used jointly and cooperatively by the two governments, the quality of medical care in state s is $Q_s = Q(K_c, K_s)$. In this section, it is assumed such cooperation obtains. However, if the central government and state s do not use the capital goods cooperatively, the quality of care in state s is lower, $q_s = q(K_c, K_s)$.

Each government cares about being re-elected, which we describe using a random voting model (see e.g., Perrson and Tabellini 2000). In state s there are N_s residents, and $\sum_{s=1}^{n} N_s = N$. The underlying health status of individual i in state s is denoted h_i, which is distributed uniformly on an interval $[\bar{h}_s - \frac{1}{2}, \bar{h}_s + \frac{1}{2}] \in \mathbb{R}^+$. All residents of all states have the same income endowment, m. Publicly supplied health care services of quality Q_s uniformly increase the health status of all residents in state s by an amount Q_s, so the health status of individual i in the presence of such services is $x_i = h_i + Q_s$. All residents have identical quasi-linear preferences over health status x, and net money income m',

$$u(x, m) = v(x) + m',$$

where $v(\cdot)$ is increasing and concave.

Taxes can be levied by each government to finance capital investment and operating costs. We assume that residents of state s accurately attribute liability for taxes to the relevant government, that is, they do not "blame" one government for taxes levied by the other. On the other hand, since the quality of health service depends on capital investments of both governments, they do not separately or differentially attribute the quality of care delivered to the central or state bodies.

Thus, let t_s be the (uniform across residents) tax levied by state s on its residents, and let t_c be the (uniform across all residents of all states) tax levied by the central government. $T_s = t_s + t_c$ is the total tax levied on each resident of state s.

In the absence of a public health system, individual i's utility is simply $u(h_i, m)$. When health services in state s are of quality Q_s, and state and central taxes are T_s, individual i's utility is $u(h_i + Q_s, m - T_s)$. There is a state-level random effect η_s distributed uniformly on $[\bar{\eta}_s - \frac{1}{2}, \bar{\eta}_s + \frac{1}{2}]$, that measures (uniformly across residents of state s) a bias against the state government being re-elected. Finally, there is an independent random effect η_c distributed uniformly on $[\bar{\eta}_c - \frac{1}{2}, \bar{\eta}_c + \frac{1}{2}]$, measuring the (uniform across all residents in all states) bias against central government re-election.

Individual i resident in state s will vote for the re-election of the state government if and only if

$$u(h_i + Q_s, m - T_s) - u(h_i, m - t_c) \geq \eta_s.$$

We assume for expositional convenience that the subutility of health takes the form

$$v(x) = \ln x.$$

Individual i in state s will thus vote for re-election of the state government if and only if

$$\ln\left(\frac{h_i + Q_s}{h_i}\right) - t_s \geq \eta_s,$$

or

$$h_i \leq \frac{Q_s}{[\exp(\eta_s + t_s) - 1]} \equiv \phi(Q_s, t_s, \eta_s).$$

The proportion of residents in state s who vote for re-election of the state government is thus $\phi(Q_s, t_s, \eta_s) - (\bar{h}_s - \frac{1}{2})$, and the state government is re-elected if this represents a majority, i.e., if

$$\phi(Q_s, t_s, \eta_s) > \bar{h}_s.$$

Thus the probability that the state government is re-elected, p_s, is equal to the probability that the realized state shock η_s is less than $\ln(1 + Q_s/\bar{h}_s) - t_s$, or

$$p_s = \ln\left(1 + \frac{Q_s}{\bar{h}_s}\right) - t_s - \left(\bar{\eta}_s - \frac{1}{2}\right).$$

We assume that in a neighborhood of the equilibrium of the game we describe below, the probability of re-election is strictly between 0 and 1.[6]

Similarly, individual i in state s will vote for the re-election of the central government if and only if

$$\ln\left(\frac{h_i + Q_s}{h_i}\right) - t_c \geq \eta_c,$$

that is, if and only if

$$h_i \leq \phi(Q_s, t_c, \eta_c) \equiv \phi_s^c.$$

The number of votes the central government receives from state s is $N_s \times [\phi_s^c - (\bar{h}_s - \frac{1}{2})]$. The central government thus wins re-election if and only if

$$\sum_{s=1}^{S} N_s\left[\phi_s^c - \left(\bar{h}_s - \frac{1}{2}\right)\right] \geq \frac{1}{2}\sum_{s=1}^{S} N_s,$$

or

$$\eta_c \leq \ln\left(1 + \frac{\bar{Q}}{\bar{h}}\right) - t_c,$$

where $\bar{Q} = \sum_{s=1}^{S} N_s Q_s / N$ is the national weighted average quality of health services and $\bar{h} = \sum_{s=1}^{S} N_s \bar{h}_s / N$ is the national average health status in the absence of health services. The probability that the central government is re-elected is therefore

$$p_c = \ln\left(1 + \frac{\bar{Q}}{\bar{h}}\right) - t_c - \left(\bar{\eta}_c - \frac{1}{2}\right).$$

Again, we assume than in a neighborhood of the equilibrium, this probability is between 0 and 1.

3. Ex Post Bargaining

Each level of government chooses and finances its capital investment. State and central governments can also make transfers between each other, financed by taxes on their constituents. Thus the total per capita tax levied by

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[6]The variable $\bar{\eta}_s$ could be interpreted as a measure of political accountability at the state level, a higher value making it less easy on average, for an incumbent government to be re-elected. However, note that the *marginal* impact of the quality of public services *vis-à-vis* health status on the probability of re-election does not vary across states. This assumption is nontrivial, as it is likely that poorer status, in which political participation is more limited, may have weaker accountability mechanisms.

state government s, is $t_s = K_s/N_s - \tau_s/N_s$, where K_s is the capital investment made by the state, and τ_s is the transfer (possibly negative) the state receives from the central government. The total per capita tax levied by the central government is $t_c = K_c/N + \tau/N$, where $\tau = \sum_{s=1}^{S} \tau_s$ is the aggregate central government transfer to states.

Thus, if the central government and the state governments cooperatively utilize the capital goods in place, the probabilities of re-election of the central government, and each of the state governments, are

$$p_c = \ln\left(1 + \frac{\bar{Q}}{\bar{h}}\right) - \left(\frac{K_c}{N} + \frac{\tau}{N}\right) - \left(\bar{\eta}_c - \frac{1}{2}\right) \qquad (1)$$

and

$$p_s = \ln\left(1 + \frac{Q_s}{\bar{h}_s}\right) - \left(\frac{K_s}{N_s} - \frac{\tau_s}{N_s}\right) - \left(\bar{\eta}_s - \frac{1}{2}\right), \qquad (2)$$

respectively.

We search for Nash bargaining outcomes between the central government and each state government. To this end, define $\bar{Q}_{-s} = (\sum_{s' \neq s} N_{s'} Q_{s'})/(\sum_{\text{all } s'} N_{s'})$, and $\tau_{-s} = (\sum_{s' \neq s} \tau_{s'})$. If the center cooperates with all states but state s, the probability of central government re-election is

$$p_c^s = \ln\left(1 + \frac{\tilde{Q}_{-s}}{\bar{h}}\right) - \left(\frac{K_c}{N} + \frac{\tau_{-s}}{N}\right) - \left(\bar{\eta}_c - \frac{1}{2}\right),$$

where $\tilde{Q}_{-s} = \bar{Q}_{-s} + n_s q_s$ and $n_s = N_s/N$. The probability of the government in state s being re-elected is

$$p_s^s = \ln\left(1 + \frac{q_s}{\bar{h}_s}\right) - \frac{K_s}{N_s} - \left(\bar{\eta}_s - \frac{1}{2}\right).$$

That is, when the parties do not cooperate, the quality of health care in state s falls from Q_s to q_s. At the same time, there is no intergovernmental transfer, τ_s, between the center and state s.

Cooperation thus increases the probability of re-election of the central government by

$$\Delta p_c = p_c - p_c^s$$

$$= \left[\ln\left(1 + \frac{\bar{Q}}{\bar{h}}\right) - \left(\frac{K_c}{N} + \frac{\tau}{N}\right)\right] - \left[\ln\left(1 + \frac{\tilde{Q}_{-s}}{\bar{h}}\right) - \left(\frac{K_c}{N} + \frac{\tau_{-s}}{N}\right)\right]$$

$$= \ln\left(\frac{\bar{h} + \bar{Q}}{\bar{h} + \tilde{Q}_{-s}}\right) - \frac{\tau_s}{N},$$

and of the government of state s by

$$\Delta p_s = p_s - p_s^s$$
$$= \ln\left(\frac{\bar{h}_s + Q_s}{\bar{h}_s + q_s}\right) + \frac{\tau_s}{N_s}.$$

Assuming the central government and the governments of states $s' \neq s$ cooperate, under the Nash bargaining solution, the central government and the government of state s set τ_s so as to

$$\max \Delta p_c \times \Delta p_s.$$

The maximand in this problem is quadratic in τ_s, and the equilibrium transfer is simply

$$\tau_s^* = \frac{1}{2}\left(N \ln\left(\frac{\bar{h} + \bar{Q}}{\bar{h} + \bar{Q}_{-s}}\right) - N_s \ln\left(\frac{\bar{h}_s + Q_s}{\bar{h}_s + q_s}\right)\right). \qquad (3)$$

Negotiations with all states yield total equilibrium central transfers to states of $\tau^* = \sum_{s=1}^{n} \tau_s^*$.

Taking the capital investment of the central government as sunk, and the agreements with and transfers to the other state governments $s' \neq s$ as fixed, the transfers to state s in Equation (3) can be interpreted more easily by writing it as

$$\frac{\tau_s^*}{N} = \frac{1}{2}\left\{\left[\ln\left(\frac{\bar{h} + \bar{Q}}{\bar{h}}\right) - \ln\left(\frac{\bar{h} + \bar{Q}_{-s}}{\bar{h}}\right)\right]\right.$$
$$\left. - n_s\left[\ln\left(\frac{\bar{h}_s + Q_s}{\bar{h}_s}\right) - \ln\left(\frac{\bar{h}_s + q_s}{\bar{h}_s}\right)\right]\right\} \qquad (4)$$
$$\equiv \frac{1}{2}\left\{G_c - n_s G_s\right\},$$

where G_c and G_s are the direct gains from cooperation (in terms of increased probabilities of re-election) that accrue to the central and state governments, respectively. The central government thus gives up half of its direct gains by making a gross transfer of $NG_c/2$ dollars to state s. The cost of this transfer, in terms of reduced probability of election, is $G_c/2$. State s in turn gives up half of *its* direct gains ($G_s/2$), making a reciprocal gross dollar transfer equal to $N_s G_s/2$, the benefit of which (to the central government) is $N_s G_s/2N$.

Our implicit assumption is that each central–state bargain is negotiated under the expectation that all other negotiations are successful. (Since payoffs are linear is transfers, all that matters is that each state assumes that other states will negate to an efficient use of resources with the central government.) This counterfactual determines the anticipated outside options in each bargaining relationship, and hence the bargaining power of the parties. We therefore

interpret the set of S bargains as constituting a Nash equilibrium among states.

4. Ex Ante Investments

4.1. Efficient Capital Investments

The Pareto efficient investments by the central and state governments satisfy

$$\max_{K_c, \mathbf{K}} p_c(K_c, \mathbf{K}) \quad \text{s.t.} \quad p_s(K_c, K_s) \geq p_s^0$$

for some constants p_s^0, $s = 1, \ldots, S$, where $\mathbf{K}$ is the vector of states' investments. It is straightforward to show that the efficient investment for state s satisfies

$$\left(\frac{1}{(\bar{Q} + \bar{h})} + \frac{1}{(Q_s + \bar{h}_s)} \right) \frac{\partial Q_s}{\partial K_s} = \frac{1}{N_s}, \tag{5}$$

and that for the central government satisfies

$$\sum_{s=1}^{S} n_s \left(\frac{1}{(\bar{Q} + \bar{h})} + \frac{1}{(Q_s + \bar{h}_s)} \right) \frac{\partial Q_s}{\partial K_c} = \frac{1}{N}. \tag{6}$$

Defining

$$\mu_s \equiv \frac{1}{Q_s + \bar{h}_s} \quad \text{and} \quad \mu_c \equiv \frac{1}{\bar{Q} + \bar{h}}$$

conditions (5) and (6) can be written simply as

$$(\mu_c + \mu_s) \frac{\partial Q_s}{\partial K_s} = \frac{1}{N_s} \tag{7}$$

and

$$\sum_{s=1}^{S} n_s (\mu_c + \mu_s) \frac{\partial Q_s}{\partial K_c} = \frac{1}{N}, \tag{8}$$

where μ_s is the marginal impact of quality (evaluated at that level of quality achieved when the assets are used cooperatively) on state s's probability of re-election. Similarly, μ_c is the marginal impact of quality on the central government's electoral chances.[7] Equation (7) simply requires that the total

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[7] A reduced form model similar to Besley and Ghatak's (2001) could be written down using these marginal valuation parameters. For example, if there is just one state government, the payoff to government x (central or state) might be specified as

$$\pi_x = \mu_x Q(K_c, K_s) - t_x,$$

where t_x is the net tax revenue raised by x to finance capital investment K_x and intergovernmental transfers.

marginal benefit of state s's capital investment (to both the state and central governments) equals its marginal cost (measured in terms of the reduced probability of re-election for state s). State s's investment therefore represents a public good (*vis-a-vis* itself and the central government), and (7) is just the Samuelson condition for its optimal provision. Similarly, (8) says that the marginal benefits of central government investment, that accrue to all states and the center, should equal the marginal cost (measured in terms of the reduced probability of re-election for the center). Denote the efficient investment levels by K_s^{eff} and K_c^{eff}.

4.2. Noncooperative Capital Investments

The central government and each state government choose levels of investment noncooperatively, anticipating the bargains they will enter into ex post. Thus the central government takes the vector of state investment choices, **K**, as given, and solves

$$\max_{K_c} \ln \left(1 + \frac{\bar{Q}(K_c, \mathbf{K})}{\bar{h}} \right) - \left(\frac{K_c}{N} + \frac{\tau^*(K_c, \mathbf{K})}{N} \right).$$

Each state s takes the investment of the central government K_c, and the vector of other states' investments $\mathbf{K}_{-s}$, as given, and solves

$$\max_{K_s} \ln \left(1 + \frac{Q_s(K_c, K_s)}{\bar{h}_s} \right) - \left(\frac{K_s}{N_s} - \frac{\tau_s^*(K_c, \mathbf{K}_{-s}, K_s)}{N_s} \right),$$

where $\tau_s^*(K_c, \mathbf{K}_{-s}, K_s) \equiv \tau_s^*(K_c, \mathbf{K})$.

State s's optimal investment thus satisfies

$$\frac{1}{(Q_s + \bar{h}_s)} \frac{\partial Q_s}{\partial K_s} - \frac{1}{N_s} \left(1 - \frac{\partial \tau_s^*}{\partial K_s} \right) = 0, \tag{9}$$

and that of the central government satisfies

$$\frac{1}{(\bar{Q} + \bar{h})} \frac{\partial \bar{Q}}{\partial K_c} - \frac{1}{N} \left(1 + \frac{\partial \tau^*}{\partial K_c} \right) = 0. \tag{10}$$

From (3), it is straightforward to calculate that

$$\frac{\partial \tau_s^*}{\partial K_s} = \frac{N_s}{2} \left[\left(\frac{1}{\bar{Q} + \bar{h}} - \frac{1}{Q_s + \bar{h}_s} \right) \frac{\partial Q_s}{\partial K_s} \right.$$
$$\left. - \left(\frac{1}{\bar{Q}_{-s} + \bar{h}} - \frac{1}{q_s + \bar{h}_s} \right) \frac{\partial q_s}{\partial K_s} \right]$$

and

$$\frac{\partial \tau_s^*}{\partial K_c} = \frac{N_s}{2} \left[\left(\frac{1}{\bar{Q} + \bar{h}} - \frac{1}{Q_s + \bar{h}_s} \right) \frac{\partial Q_s}{\partial K_c} \right.$$
$$- \left(\frac{1}{\tilde{Q}_{-s} + \bar{h}} - \frac{1}{q_s + \bar{h}_s} \right) \frac{\partial q_s}{\partial K_c}$$
$$\left. + \frac{1}{n_s} \left(\frac{1}{\bar{Q} + \bar{h}} - \frac{1}{\tilde{Q}_{-s} + \bar{h}} \right) \frac{\partial \bar{Q}_{-s}}{\partial K_c} \right].$$

Substituting these expressions into (9) and (10) and simplifying we arrive at the first-order conditions for equilibrium investments by the state and central governments:

$$\frac{\partial p_s}{\partial K_s} = \frac{1}{2} \left[\frac{1}{\bar{Q} + \bar{h}} + \frac{1}{Q_s + \bar{h}_s} \right] \frac{\partial Q_s}{\partial K_s}$$
$$- \frac{1}{2} \left[\frac{1}{\tilde{Q}_{-s} + \bar{h}} - \frac{1}{q_s + \bar{h}_s} \right] \frac{\partial q_s}{\partial K_s} - \frac{1}{N_s} \tag{11}$$

$$\frac{\partial p_c}{\partial K_c} = \sum_{s=1}^{S} \left\{ \frac{1}{2} n_s \left[\frac{1}{\bar{Q} + \bar{h}} + \frac{1}{Q_s + \bar{h}_s} \right] \frac{\partial Q_s}{\partial K_c} \right.$$
$$+ \frac{1}{2} n_s \left[\frac{1}{\tilde{Q}_{-s} + \bar{h}} - \frac{1}{q_s + \bar{h}_s} \right] \frac{\partial q_s}{\partial K_c}$$
$$\left. - \frac{1}{2} \left[\frac{1}{\bar{Q} + \bar{h}} - \frac{1}{\tilde{Q}_{-s} + \bar{h}} \right] \frac{\partial \bar{Q}_{-s}}{\partial K_c} \right\} - \frac{1}{N}. \tag{12}$$

Conditions (11) and (12) define Nash equilibrium investments, which we denote by K_s^*, for $s = 1, \ldots, S$, and K_c^*.

4.3. Interpretation

In order to interpret these conditions, let us suppose that q_s and Q_s are sufficiently close that we have

$$\mu_s \equiv \frac{1}{Q_s + \bar{h}_s} \approx \frac{1}{q_s + \bar{h}_s} \tag{13}$$

and

$$\mu_c \equiv \frac{1}{\bar{Q} + \bar{h}} \approx \frac{1}{\tilde{Q}_{-s} + \bar{h}}. \tag{14}$$

Under the approximations suggested in (13) and (14), we can write (11) as

$$\frac{1}{2}\left[\mu_c + \mu_s\right]\frac{\partial Q_s}{\partial K_s} - \frac{1}{2}\left[\mu_c - \mu_s\right]\frac{\partial q_s}{\partial K_s} = \frac{1}{N_s} \tag{15}$$

and (12) as

$$\sum_{s=1}^{S}\left\{\frac{1}{2}n_s\left[\mu_c + \mu_s\right]\frac{\partial Q_s}{\partial K_c} + \frac{1}{2}n_s\left[\mu_c - \mu_s\right]\frac{\partial q_s}{\partial K_c}\right\} = \frac{1}{N}. \tag{16}$$

Under the assumption that the productivity of investment is lower when the parties do not cooperate (i.e., $\partial q_s/\partial K_x < \partial Q_s/\partial K_x$ for $x = s, c$) a comparison of conditions (15) and (16) with (7) and (8) indicates that the Nash equilibrium investment by each party will be below its first-best level, that is $K_s^* < K_s^{\text{eff}}$ for $s = 1, \ldots, S$ and $K_c^* < K_c^{\text{eff}}$.

The extent of underinvestment by each party depends, inter alia, on the relative sizes of μ_c and μ_s.[8] From (13) and (14), we see that states where average health status (including the effects of health services) is higher than the national average have a lower marginal value of quality than the central government. This conforms with intuition—other things held equal, the value of better health care (to politicians hoping for re-election) is likely to be lower in places that are on average healthier. State s's underinvestment is lower (i.e., its investment is higher) when $\mu_s > \mu_c$ than when $\mu_s < \mu_c$.

5. Ownership

The model developed in the previous sections allows us to study the effects of alternative allocations of the ownership of public facilities in the context of intergovernmental relations. Following the standard literature on incomplete contracts and the theory of the firm (e.g., Hart 1995), we assume that formal ownership affects outside options in the bargaining games that the parties might enter into. This in turn effects incentives to make ex ante investments.

There is a fundamental asymmetry between the capital investments made by central and state governments, deriving from the fact that the centrally produced capital good has the features of a public good vis-a-vis all the state governments. On the other hand, each state-produced capital good confers no external benefits on other states.[9] In this context, we think of ownership as authority to take over the operation of the state-produced asset in the event that the state and central government do not agree on how it is to be used.[10] Thus,

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[8]Of course, the μ_s's and μ_c are related, and it cannot be the case that $\mu_s < \mu_c$ (or $\mu_s > \mu_c$) for all s.

[9]We do not allow for external effects associated with cross-border flows of patients, etc.

[10]Because of the public good nature of the center's capital investment, it is difficult to imagine a state government being granted ownership of the center's asset.

state government ownership might be identified with institutional arrangements wherein hospital managers are state employees, that is, answerable to state government officials, while under central ownership the managers are employees of the central government.

When the parties do not agree on the use of the assets, the owner of the state asset delivers health services unilaterally. If the center delivers services without the cooperation of the state, it has access to the state-produced asset, but may not be able to use it efficiently. On the other hand, if the state delivers the services unilaterally, it does so with only partially effective access to the centrally produced asset. One way to model these inefficiencies, following Hart, Shleifer, and Vishny (1997), is to assume that some of the value of the asset produced by a given party is embodied in the human capital of managers employed by that party, so that when the manager is replaced the effective capital stock is reduced.[11]

Here it is sufficient to let q_s^s and q_s^c denote the quality of services delivered in state s under state and central operation, respectively (the superscript denotes the owner of the facility), and to assume that the marginal productivity of capital varies across cooperative and unilateral provision. To this end, we assume

$$\frac{\partial Q_s}{\partial K_c} > \frac{\partial q_s^c}{\partial K_c} > \frac{\partial q_s^s}{\partial K_c} \tag{17}$$

and

$$\frac{\partial Q_s}{\partial K_s} > \frac{\partial q_s^s}{\partial K_s} > \frac{\partial q_s^c}{\partial K_s}. \tag{18}$$

Condition (17) says that the marginal product of central government investment is higher when services are delivered cooperatively than when the center delivers them unilaterally, and that the marginal product of central investment is even smaller when the state unilaterally operates the system. Equation (18) is the corresponding condition of state-produced capital.[12]

Inspection of Equations (15) and (16) indicates, as long as the approximations are valid, that in order to induce higher investment by both state and central governments, facilities in state s should be owned by the party for which the marginal value of quality (in terms of increased probability of re-election) is higher. This result mirrors that independently derived by Besley and Ghattak (2001), which states that ownership should reside with the party that cares relatively more about quality. In particular, to strengthen

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[11]An extreme assumption is that the center's asset is unavailable to a state government employee in the event of noncooperation. It is reasonable to assume, however, that some of the benefits of the center's asset spillover to the state, even when it does not formally have access to the asset, e.g., if the asset is R&D research.

[12]These conditions correspond to Assumption 1 in Besley and Ghattak's (2001) model of government versus private ownership of public goods.

incentives for investment in complementary assets, health facilities should be owned locally in states where average health status is lower than the national average, and they should be owned by the central government in states with relatively healthy populations. Such ownership allocations will be optimal because they maximize capital investments at levels that are nonetheless below the first-best levels defined by conditions (7) and (8).[13]

Some intuition for this result can be found by integrating the left-hand side of (15) to obtain a linearized expression for state s's probability of re-election net of capital costs:[14]

$$p_s^{\text{ex post}} \approx \frac{1}{2}(\mu_c + \mu_s)Q_s - \frac{1}{2}(\mu_c - \mu_s)q_s.$$

If $\mu_c > \mu_s$, state s has an incentive to make q_s as low as possible, since this increases the ex post surplus from cooperation. As the central government values cooperation more than the state, it is willing to pay more to avoid a breakdown of cooperation ex post, that is, state s holds up the center. When s is the owner, withholding investment reduces q_s significantly, but when c is the owner s can do less damage by withholding its investment. Thus when $\mu_c > \mu_s$, the state's investment incentives are stronger (that is, s's incentives to underinvest are weaker) when c is the owner.

On the other hand, the center's ex post utility, associated with the bargain with state s, is approximately

$$p_c^{s,\text{ex post}} \approx \frac{n_s}{2}(\mu_c + \mu_s)Q_s + \frac{n_s}{2}(\mu_c - \mu_s)q_s.$$

When $\mu_c > \mu_s$, the center has an incentive to make q_s as large as possible. This incentive is reinforced by making it the owner. Thus, allocation of ownership to the party with the higher marginal valuation of quality improves the investment incentives of *both* parties.

6. Financing Authority

We modify the model now to incorporate the distortionary costs of tax collection. Setting the distortionary cost of public funds, by choosing the tax base accordingly, allows the parties to alter implicit investment incentives in a nontrivial way. Let us then assume that in raising a dollar of revenue from an individual, the central government reduces that individual's income by $(1 + \lambda_c)$ dollars. Similarly, state government s reduces the income of a resident by $(1 + \lambda_s)$ dollars when it raises a dollar. By narrowing the tax base, λ

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[13]That is, there is no ownership allocation that would induce *too much* investment.

[14]This would be called s's ex post utility in a more standard model.

increases. The probabilities of re-election, Equations (1) and (2), are then modified to read

$$p_c = \ln\left(1 + \frac{\bar{Q}}{\bar{h}}\right) - \left(\frac{K_c}{N} + \frac{\tau}{N}\right)(1 + \lambda_c) - \left(\bar{\eta}_c - \frac{1}{2}\right) \tag{19}$$

and

$$p_s = \ln\left(1 + \frac{Q_s}{\bar{h}_s}\right) - \left(\frac{K_s}{N_s} - \frac{\tau_s}{N_s}\right)(1 + \lambda_s) - \left(\bar{\eta}_s - \frac{1}{2}\right), \tag{20}$$

respectively. After some algebra, it can be shown that the noncooperative investments chosen by the parties satisfy the following modified versions of Equations (15) and (16):

$$\frac{1}{2}\left[\hat{\mu}_c + \hat{\mu}_s\phi(\lambda_s)\right]\frac{\partial Q_s}{\partial K_s} - \frac{1}{2}\left[\hat{\mu}_c - \hat{\mu}_s\right]\frac{\partial q_s}{\partial K_s} = \frac{1}{N_s} \tag{21}$$

and

$$\sum_{s=1}^{S}\left\{\frac{1}{2}n_s\left[\hat{\mu}_c\phi(\lambda_c) + \hat{\mu}_s\right]\frac{\partial Q_s}{\partial K_c} + \frac{1}{2}n_s\left[\hat{\mu}_c - \hat{\mu}_s\right]\frac{\partial q_s}{\partial K_c}\right\} = \frac{1}{N}, \tag{22}$$

where $\hat{\mu}_c = \mu_c(1 + \lambda_c)$, $\hat{\mu}_s = \mu_s(1 + \lambda_s)$, and $\phi(\lambda) = 2/(1 + \lambda)^2 - 1$.

In the previous section, we assumed that ownership of the state's asset could be allocated to the central or state government, but that ownership of the centrally produced asset could not easily be granted to the state. Here we make a similar assumption with respect to tax bases, that is, that the tax base of the central government is fixed, but that of the state is potentially variable.[15] Thus, denote the left-hand side of (21) by $z^s(\lambda_s)$, and that of (22) by $z^c(\lambda_s)$. It follows that

$$\begin{aligned}z^{s'}(\lambda_s) &= \frac{\mu_s}{2}\left([\phi(\lambda_s) + (1 + \lambda_s)\phi'(\lambda_s)]\frac{\partial Q_s}{\partial K_s} + \frac{\partial q_s}{\partial K_s}\right)\\ &= \frac{\mu_s}{2}\left(-\left[\frac{2}{(1 + \lambda_s)^2} + 1\right]\frac{\partial Q_s}{\partial K_s} + \frac{\partial q_s}{\partial K_s}\right) < 0.\end{aligned}$$

Thus, restricting the taxing authority of a state government (increasing λ_s) necessarily reduces the equilibrium level of state investment for two reasons. First, a higher λ_s makes K_s more expensive. Second, for a given pair of investments (K_s, K_c), the center makes a smaller transfer τ_s^* to s because a dollar is worth more to the state. Therefore, the share of the surplus from cooperation enjoyed by s falls.

However, this second effect operates to the center's advantage, and

$$z^{c'}(\lambda_s) = \frac{n_s}{2}\mu_s\left(\frac{\partial Q_s}{\partial K_c} - \frac{\partial q_s}{\partial K_c}\right) > 0,$$

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[15]The idea is that the central government must use a single tax base for all revenue it collects, and cannot make commitments with different states to use different tax bases.

so restricting a state's tax base improves the investment incentives of the central government. There is thus some ambiguity surrounding the net effect of a restriction in the taxing authority of state governments on the equilibrium quality of services, and the probabilities of re-election.

A weak result that we can derive is that in those cases in which a state government is optimally allocated ownership of the state-produced asset (i.e., when $\mu_s > \mu_c$), $z^{s'}(\lambda_s)$ is less negative and $z^{c'}(\lambda_s)$ is more positive (from conditions (17) and (18)). Qualitatively, in these cases it is more likely that an increase in λ_s will be optimal, compared with situations in which central ownership is optimal.

A more forceful statement of the preceding analysis is that, within the current context, there should be no presumption that ownership and financing authority should necessarily coincide. Indeed, on balance state governments should be afforded greater tax authority (lower distortionary costs of raising revenues) only when they do not have formal authority to operate facilities in the event that intergovernmental bargaining breaks down.

Although this result is rather weak, the intuition for it follows directly from the intuition for the ownership allocation, elaborated on at the end of the previous section. Suppose $\mu_s > \mu_c$, so the state government should optimally be the owner. Increasing the marginal cost of public funds the state faces increases the value of a dollar transferred by the center. Other things being equal then, at a Nash bargain the size of the central transfer will be smaller. This increases the incentive of the center to invest, as it retains more of the returns to its investment. Since it is the underinvestment of the center that needs to be mitigated, the value of the improvement in central incentives outweighs the value of the reduction in state incentives.

7. Conclusion

This paper has addressed the question of the decentralization of public service delivery by asking which level of government should have responsibility for providing services out of equilibrium. The focus has been not on performance incentives in the day-to-day operation of hospitals, schools, and welfare programs, but on the incentives of central and state governments to invest in capital assets that improve the quality of services. One interpretation of our model is that it assumes that operational incentives, e.g., for managers etc., can be provided through explicit labor contracts, but that investment incentives are less easily specified.

In our model, authority to intervene in the operation of facilities should rest with states with below average health, education, or welfare status. In these states, the marginal impact of quality on re-election prospects is higher for the state government than for the central government, so the state effectively cares more about quality than the center. In other states, the marginal impact of the state's investment is smaller than that of the center's.

Finally, increasing the cost of taxation at the state level can effect the division of ex post surpluses, because it alters the relative price of tax revenues

between the two parties. Since investment incentives are generated in part by the expectation of sharing in ex post surpluses, increasing the state-level cost of funds tends to reduce state investment levels but increase central investment. The net effect on quality is ambiguous, but there is no presumption that authority for service delivery should be matched with expanded tax authority.

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