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Intragovernment Procurement of Local Public Good: A Theory of Decentralization in Nondemocratic Government

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Abstract: Local governments (LGs) are seen as producers of the local public good ("the good"). An authoritarian country is one in which the government decides if the good should be produced and how much to tax to finance it, as versus a democracy in which voters decide. This paper identifies conditions under which it is more efficient for a nondemocratic government to delegate to the LGs the authority to 1) decide whether or not to produce the good and 2) collect tax to finance it if the good is produced. Two conditions are identified. First, when the net benefit of producing the good is sufficiently small so that, compared with the benefit, inducing LGs' effort under the centralized system is too costly (a moral hazard problem). Second, when the net benefit of the good is higher in a locale with a higher production cost parameter, making it difficult for the center to induce the LGs to truthfully reveal the cost parameter (a adverse selection problem). These results are consistent with the experience of China in the past several decades, where "too small to be worth bothering" and "too diversified and complicated local conditions for the center to know" have been the two most prominent official arguments made by the communist government itself for decentralization.

1. Introduction

In democratic countries, decentralization in government is institutionalized with a constitutionally defined relationship between the central and local governments (center and LGs). Decentralization is also common in nondemocratic governments - more often than not, the center would delegate some tax and other nontrivial economic decision making power to the LGs. Recently, several people have discussed the effect of decentralization in a nondemocratic government to an economy.[1] In this paper, we raise and discuss the theoretical question: When and why would the authoritarian center want to decentralize economic power to the LGs? We identify conditions under which a decentralized government is more efficient.

We use a model that builds on Laffont and Tirole (1993) to discuss the rationale for decentralization in the nondemocratic government. In the model, the LGs are producers of the local public good (the good) and the center is to make sure the good is provided in an efficient way.[2] Asymmetric information (AI) exists between the center and the LGs on the cost parameter and social value of the good (an adverse selection problem) and the LG's effort to reduce cost (a moral hazard problem). In our model, like in the standard procurement model, the welfare maximizing center's problem is to design a mechanism to induce the LGs to truthfully report their private information and, based on the information, make the production and transfer payment decisions.

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[1]Much of this interest is based on China's experience during both the central planning and transition periods. Qian and Xu (1994) and Maskin, Qian and Xu (1997), for example, observe the divisional structure in the Chinese economy and study its impact on transition. Weingast (1994) discusses the importance of federalism in preserving market. Qian and Roland (1994) and Qian and Weingast (1995) apply the idea to study de facto federalism in China. There is considerable agreement that de facto federalism contributed much to the high growth rates of the Chinese economy during the transition period.

[2]The problem is thus one of government procurement. Major contributions to the economics of government procurement and regulation are also made by, among others, Baron and Myerson (1982), Sappington (1982, 1983), Baron and Besanko (1984), Riordan (1984), Laffont and Tirole (1986), Lewis and Sappington (1988a, 1988b), Picard and Rey (1990), McAfee and McMillan (1987), Dewatripont and Tirole (1992).

Our model is different from the standard procurement model in two main respects. First, in standard procurement model, firms producing public goods can only obtain revenue from the government, whereas in our model the LG can be a tax authority and, therefore, use tax revenue to compensate itself. The tax power of the LG enables decentralization as a possibility. Second, in the standard procurement model, goods produced by different firms would have the same social value and their differ only in production cost. In our model, the goods produced in different locales have different social values because of their local nature. These two features are essential for the consequent findings of our model.

Under the assumption that the LGs' tax power is restricted by local resource and the principle that no one can be made worse off if the good is produced, the decentralized system is found more efficient in two situations. First, the decentralized system is more efficient if the net social value of the good is sufficiently small. This is so because when the value of the good is small, it may not be enough to offset the cost of inducing the LG to reveal its private information under the centralized system. Second, the decentralized system is more efficient when the net social value of the good increases with the cost parameter and there is enough locales where the good should not be produced. The reason for this result is that, when the net social value of the good increases with the cost parameter, design and implement a truth-telling mechanism becomes difficult because of two conflicting principles: For truth-telling, a low cost producers must receive higher benefit, but for efficient production decisions, the low cost producers must not be allowed to produce the good. Thus, under the centralized system, the center would have to either let the good be produced in all locales or in no locales. When there is enough locales where the good should not be produced because of the negative social value, the center will choose the latter. In such a case, it is more efficient to decentralize and let each LG to decide for itself whether or not to produce the good and let those who produced the good to collect tax

revenue for compensation. This way, the good is produced in locales where the good has a positive net social value, but not where it does not.

The findings of the model are consistent with the experience of China in the past several decades, where "too small to be worth bothering" and "too diversified and complicated local conditions for the center to know" have been the two most prominent official arguments made by the communist government itself for decentralization. In practice, "grab (hold-on to) the big (projects) and let go the small" or "decentralize power (authority) on small things but monopolize that on big things" have been a primary rule by which the Chinese government decides what power to decentralize and what not.[3] Decentralization is also more often introduced regarding matters of greater complication where "one-cut" ("same policy to everybody" in standard Chinese official language) brings severe efficiency losses.

Other authors have discussed the welfare implications of decentralization in different contexts. Tiebout (1956) argues that decentralization promotes economic efficiency through voter mobility. The eventual "grouping" of consumers of the same type that mobility leads to enables efficient consumption of local public goods.[4] It is easy to see that Tiebout's theory does not directly apply to the decentralization problem in countries of authoritarian government where a direct voters' role is minimum by definition and consumer "grouping" through mobility often does not happen. Furthermore, it is not clear why the center of an authoritarian government cannot order consumer grouping exactly as it would occur in a Tiebout economy and also order the same level of production and consumption of local public goods in each and every locale as the voters would themselves choose so there is no welfare loss at all.

Qian and Roland (1994) argue that decentralization improves economic efficiency by forcing LGs to compete with each other for productive factors, e.g., investment funds. Their theory is applicable to countries of both

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[3]The former quotation is the policy of the current reform government and the latter a famous principle taught by late Party Chairman Mao Zedong.

[4]The idea is further discussed in Oats (1972) and others.

authoritarian and democratic governments, as long as factors in the economy are largely free to move as in Tiebout (1956). The condition of free factor mobility, however, may or may not be satisfied when an authoritarian government decentralizes. For example, in China, while factor mobility has greatly improved since 1979, satisfying the assumption of Qian and Roland (1994), it had been quite limited in the preceding decades. Meanwhile, decentralization of economic power in the Chinese government occurred in both pre- and post-1979 periods. Compared with these theories, a feature of our model is that it studies the welfare implications of decentralization strictly from the relationship between the center and the LGs.

The rest of the paper is organized as follows. Section 2 introduces the model and describes the optimization problems under first the centralized and then the decentralized system. Section 3 characterizes the solutions to the problems. Sections 4 and 5 discuss conditions under which decentralization is more efficient. Section 6 briefly reviews the decentralization experience of the Chinese government to highlight the empirical relevance of the results of the model.

2. The model

There are infinitely many locales continuously distributed in the range of $[\underline{I}, \bar{I}]$ with $\underline{I}<\bar{I}$ and indexed by $I\in[\underline{I}, \bar{I}]$. I has the cumulative distribution function $F(I)$ with a strictly positive density function $f(I)>0$. The distribution of I is common knowledge. Each locale is governed by a LG who is also the producer of a local public good (hereon referred to as "the good"). The production of the good has the technological parameter β with the properties that

A1: $\beta(I) = bI$ for all $I\in[\underline{I}, \bar{I}]$, $b>0$ being a constant.

A1 implies $\beta'(I)=b>0$ and $\beta''(I)=0$. Note that $\beta'(I)>0$ can be true by choice, i.e., the locales can always be indexed by the value of β such that $\beta'(I)$ is true. $\beta''(I)=0$ is a simplifying assumption to keep the model tractable.

The cost of producing the good is

$$C(I) = \beta(I) - e(I) = bI - e(I) \qquad (1)$$

where $e(I)$ the cost reducing effort of the LG. The disutility of effort is $\psi(e)$, which has the properties $\psi(0)=0$, $\psi'(e)>0$, $\psi''(e)>0$ and $\psi''(e)>0$. The cost of producing the good, C, is observable to the center, but $\beta=bI$ and $e(I)$ are not.

The gross social value of the good is $S(I)$ with $S'(I)\neq 0$. While the standard procurement model assumes $S'(I)=0$, assuming $S'(I)\neq 0$ is more reasonable here because of the local nature of the good. For example, the value of a local highway is probably higher in economically more prosperous locales of busy traffic than in locales of not much traffic. The value of a park as either a public leisure place or place for the homeless is also likely to vary across locales of different income levels.

A2: $S'(I)\neq 0$, $S''(I) = 0$, for all $I\in[\underline{I}, \bar{I}]$

Assuming $S''(I) = 0$ is again intended to keep the model tractable.

Note that A1 and A2 imply a monotonic relationship between the cost parameter $\beta(I)$ and the gross social value of the good $S(I)$. It is easy to imagine situations in which his condition does not hold. It is possible, for example that, as $\beta(I)$ increases in I, $S(I)$ increase at some but decrease at other values of I. However, it is also reasonable to believe there are many situations in which the kind of relationship between $\beta(I)$ and $S(I)$ as specified by A1 and A2 does exist. A compelling reason is that the benefit of the good and the technological efficiency in its production can be both correlated with some broad economic conditions, e.g. income or development level. For example, the monotonic relationship between $\beta(I)$ and $S(I)$ will

hold if in some ranges both the technological efficiency and the value of the good change monotonically with income.[5]

The center's objective is to maximize the total social welfare, which is the aggregate of welfare in all locales. The LG maximizes the utility of the functional form

$$U(I) = T(I) - C(I) - \psi(e(I)).$$

T(I) is the LG's gross revenue from producing the good. It is a transfer from the center under the centralized system (CS), revenue from local tax under the decentralized system (DS). (The CS and DS will be defined shortly.) Regardless of the system, i.e., CS or DS, a dollar of revenue T(I) has a social cost of $1+\lambda$ because of the distortional effect of taxation.[6] The normalized individual rationality (IR) constraint is

$$\text{IR: } U(I) \geq 0$$

If the LG receives a transfer from the center, its revenue is constrained by the center's transfer policy (CTP).

The center can also allow the LGs to tax the local economy to support the production of the good. An LG's tax power, however, is assumed constrained by total resources available in the economy. Assume that before the good is produced existing taxes have exhausted all tax potentials in the local economy. Assume also that it is politically unacceptable that local people is made worse off with the production of the good and tax levied to support the production, i.e., the production of the good has to lead to

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[5]The cost parameter of constructing a highway may be higher in economically more prosperous locales (higher β) because of higher labor and land costs. But the value of the highway S is likely also higher, giving a positive correlation between $\beta(I)$ and $S(I)$. A negative correlation between $\beta(I)$ and $S(I)$ can be found in the highway example if higher efficiency in economically prosperous locales can more than offset the higher land and labor costs to lead to a lower β.

[6]It is assumed that the center's transfer payment to a LG is covered by its own tax revenue. See Stern (19??) for a discussion of the cost of taxation λ.

Pareto improvement in the local economy.[7] Thus by producing the good, the LG can increase tax by no more than the gross social value of the good discounted by the social cost of taxation. Formally, the resource constraint (RC) to an LG's new tax is given by

$$RC: \quad T \leq S(I)/(1+\lambda).$$

Define the CS as a system in which the center decides i) if the good should be produced at a locale, and ii) if the good is produced, the amount of transfer T(I) to the LG as compensation. The DS is a system in which the center i) allows each LG to decide for itself if to produce the good, and ii) let the LG collect a local tax to compensate for producing the good, subject to the RC.

Let I^* denote the set of all locales where the good is produced under the CS. The center makes the production and transfer decisions to

$$\text{(2)} \quad \text{Maximizes} \quad W^c = \int_{I \in I^*} (S(I) - (1+\lambda)T(I) + U(bI, I))dF(I)$$

s.t., Equation (1), IR, and the LG's incentive constraint.

The LG's incentive constraint will be discussed in the next section.

If the center adopts the DS, it does nothing further. The LG at I makes the production decision and collects local tax to

$$\text{(3)} \quad \text{maximize} \quad U = T - C - \psi(e(I)) = S(I)/(1+\lambda) - [bI - e(I)] - \psi(e(I))$$

$$e, T$$

s.t., (1), RC and IR.

[7]The institutional contents of this assumption may include, first, people does not tolerate being made worse off with the production of the local public good. Second, the center is strong enough to punish a LG that violates this constraint and causes political trouble for it. Third, the punishment makes the LG worse off than not violating the rule.

Before finishing this section, it is worth pointing out that our assumption of the center as a welfare maximizer need not be based on the belief of a benevolent center. Instead, one may see political power as the center's primary concern, but welfare level dependent on government policies is a determinant of a government's security in power. When this is true, decentralization must bring about higher welfare for a power-greedy center to adopt it. To know if decentralization can lead to higher welfare, we need to know what the maximum welfare is that the center can achieve without decentralization. In light of this discussion, we can view a welfare-maximizing center assumed in the model as a working assumption to study a necessary condition for decentralization in a nondemocratic government.

Alternatively, one can think of the center as a utility maximizer with its utility determined by its own tax revenue (note that the center does not incur any direct cost in producing the good). Under the Pareto-improving principle of taxation and the production of the good described in (RC) above, the center's tax potential is given by the amount of welfare generated by the production of the good. To maximize its tax potential, it is in the center's own best interest to maximize social welfare.

3. Welfare under the centralized and the decentralized system.

The solution to the LG's optimization problem under the DS described by Equation (3) is straightforward. The LG will choose $T=S(I)/(1+\lambda)$. It makes the first best effort e^n given by $\psi'(e^n)=1$ to reduce production cost because every dollar saved accrues to the LG itself. The production decision is also first best. The good is produced at a locale if

$$U(I) = S(I)/(1 + \lambda) - [bI - e^n(I) + \psi(e^n(I))] \geq 0. \quad (4)$$

The first term on the left-hand side of the inequality is the maximum amount of tax that the LG can (and will) collect, the second term total production cost incurred by the LG, which is the aggregate of the direct monetary cost and disutility of effort. At locales where the inequality sign is reversed,

the good is not produced because the LG after producing the good cannot collect enough tax to compensate the cost.

With e^{fb} given by $\psi'(e^{fb})=1$, we can define the first best social cost of production as

$$FBSCOP \equiv bI - e^{fb}(I) + \psi(e^{fb}(I)),$$

as shown in Figure 1, lying parallel below $\beta(I)=bI$.

[Figure 1: β and FBSCOP as a function of I]

At the same time, the difference

$$S(I) - (1 + \lambda)[bI - e^{fb}(I) + \psi(e^{fb}(I))]$$

gives the maximum possible net social benefit of the good to the local. A variation of this difference is

$$\omega(I) \equiv S(I)/(1 + \lambda) - [\beta(I) - e^{fb} + \psi(e^{fb})]. \qquad (5)$$

Since under the DS the amount of tax is $S(I)/(1 + \lambda)$, we immediately have

Proposition 1: The CS leads to higher social welfare than the DS if $\omega(I)$ is sufficiently large for all $I\epsilon[\underline{I}, \bar{I}]$.

Proof: When $\beta(I)$ is given and $S(I)/(1+\lambda)$ is sufficiently large for all $I\epsilon[\underline{I}, \bar{I}]$ (refer to Figure 2), the center can order the good be produced at all I's. The upper limit of production cost is $C(I)=bI$ obtained at $e=0$. When $C(I)=bI$, the transfer the center needs to make to the LG is $T(I)=bI$. The welfare loss associated with it is λbI. Since the upper limit of the production cost bI and the cost of tax λbI are both finite, their aggregate is smaller than the net loss of welfare caused by the LG's tax, $\lambda[S(I)/(1+\lambda)]$, when $S(I)$ is sufficiently large.

The result obvious also holds when $S(I)$ is given and $\beta(I)$ is sufficiently small for all $I\epsilon[\underline{I}, \bar{I}]$. Q.E.D.

[Figure 2: High Social value of the good at all locales]

So for the DS to be more efficient than the CS in terms of social welfare, it is necessary that the net social value of the good is not too large in all I. To identify conditions when the DS is socially more beneficial than the CS, we assume

A3: There exists $I^{fb} \in [\underline{I}, \bar{I}]$ at which $\omega(I^{fb}) = 0$.

The assumption gives the necessary and sufficient condition under which it is socially undesirable to produce the good at all locales. It does not cause much loss of generality, for the results obtained under the assumption apply when $\omega(I) > 0$ for all I but is sufficiently small for some I. Note that under A1 and A2, A3 must have one of the two forms below, but not both.

A3a: $\omega(I) \geq 0$, for $I \in [\underline{I}, I^{fb}]$, and $\omega(I) < 0$, for $I \in (I^{fb}, \bar{I}]$.

A3b: $\omega(I) < 0$, for $I \in [\underline{I}, I^{fb})$, and $\omega(I) \geq 0$, for $I \in [I^{fb}, \bar{I}]$.

The two cases are depicted in Figures 3a and 3b, respectively.

[Figure 3: $\omega(I)$ under A3a and A3b, respectively.]

Under A3a, the total social welfare under the DS is

$$W^{d*} = \int_{\underline{I}}^{I^{fb}} [S(I)/(1+\lambda) - [bI - e^{fb} + \psi(e^{fb})]dF(I) \qquad (6)$$

whereas under A3b it is

$$W^{d*} = \int_{I^{fb}}^{\bar{I}} [S(I)/(1+\lambda) - [bI - e^{fb} + \psi(e^{fb})]dF(I)$$

Under the CS, the center designs a transfer policy T(I) to induce the LGs to truthfully reveal their types. It can be noted that, given the one-to-one relationship between β and I, inducing the LGs to reveal I and to reveal β are equivalent. Laffont and Tirole (1993, p.63-4) discussed and gave the properties of the mechanism.

Let

$$t(I) \equiv T(I) - C(I)$$

be the net revenue of the LG if the good is produced. Let

$$\phi(I,I) \equiv t(I) - \psi(bI - C(I)) \qquad (7)$$

be the LG's utility as a function of the true type I and the announced oneI . Assuming that utility is single valued in announced typeI and transfer t(I), truth-telling requires that for any pair of values of I and I' in $[\underline{I},\bar{I}]$,

$$t(I) - \psi(bI - C(I)) > t(I') - \psi(bI - C(I')),$$

and

$$t(I') - \psi(\beta(I') - C(I')) > t(I) - \psi(bI' - C(I)).$$

Adding up the two sides and cancelling terms lead to the condition

$$\psi(bI' - C(I)) - \psi(bI - C(I))$$

$$> \psi(bI' - C(I')) - \psi(bI - C(I'))$$

or

$$\int_{I}^{I'} \int_{C(I)}^{C(I')} \psi''(x - y)dxdy > 0 \qquad (8)$$

Therefore, a revelation mechanism requires that, if I'>I, then C(I')>C(I), or, supposing that C(I) is differentiable everywhere with respect to I,C (I)>0. Note thatC (I)>0 impliese (I)<0.

Truth telling requires thatI =I maximize $\phi(I,I)$. The first-order condition is $\phi_2(I,I)=0$, or equivalently,

$$t (I) = - \psi'(bI - C(I))C, \qquad (9)$$

i.e., the net transfer t(I) decreases in I.

Let U(I) denote the rent of LG I. From the envelope theorem applied to the maximization of Equation (7) with respect toI , we have

Proposition 2 (Laffont and Tirole): If I∈[I̲,Ī], a pair of functions U(.) and C(.) is incentive compatible if

IC: $\dot{U}(I) = -\psi'(bI - C(I))$, and

C $(I) > 0$ (ore $(I) < 0$), for all I.

Proof: See Laffont and Tirole (1993, p.63-64).

Note that the IC condition in Proposition 2 is derived from the relationship among C, β, e and ψ(e). It is independent of A2 and A3.

4. "Thin" benefit of the good and decentralization.

Under A3a, the optimization problem described by Equation (2), after substituting β-e for C and some simplifying and rearranging, is

$$\text{Maximize } W^e = \int_{\underline{\beta}}^{\beta^*} (S(\beta/b) - (1+\lambda)[\beta - e(\beta) + \psi(e(\beta))] - \lambda U(\beta))dG(\beta)$$

s.t., IR and IC, (10)

where G(β) is the cumulative function of the distribution of β with the density $g(\beta)>0$.[*]

Proposition 3 (Laffont and Tirole): Under A1, the solution to problem described by Equation (10) is found at

$$\psi'(e^*(\beta)) = 1 - \lambda G(\beta)\psi''(e^*(\beta))/(1+\lambda)g(\beta)$$

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[*]The production decision is rewritten as made over β instead of I. The one-to-one mapping between F(I) and G(β) is obvious. Under the IC condition, the effort level in Equation (1) is a function of $\beta(I)=bI$, i.e., $e(I)=e(\beta(I))=e(bI)$, for under any mechanism for truth-telling, a LG reporting a particular I is required to demonstrate a particular C. This requires the LG to make the effort e consistent with the given β. It follows that from Equation (9), IR, and the fact T=t+C that the net transfer, utility and gross revenue all depend on I through β(I), i.e., $t(I)=t(\beta(I))$, $U(I)=U(\beta(I))$ and $T(I)=T(\beta(I))$.

$$C^*(\beta) = \beta - e^*(\beta)$$

$$U^*(\beta) = \int_{\beta}^{\beta^*} \psi'(e^*(\beta))dI \qquad (11)$$

$$t^*(\beta) = \psi(e^*(\beta)) + U^*(\beta)$$

The optimal truncation of production is at β^* where

$$(S(\beta^*/b)/(1+\lambda) - [\beta^* - e(\beta^*) + \psi(e(\beta^*))]) \qquad (12)$$
$$- \lambda G(\beta^*)\psi'(e(\beta^*))/(1+\lambda)g(\beta^*)$$
$$= 0.$$

It is easy to check that the second order conditions for e^* and β^* are satisfied.

Proof: See Laffont and Tirole (1993, p.67-8).

The solution has the features that the LG with $\underline{\beta}=b\underline{I}$ (at $\underline{I}$) will insert the first best effort, i.e., $e^*(\underline{\beta})=e^{fb}$, but $e^*(\beta)<e^{fb}$ for all $\beta>\underline{\beta}$ (all $I>\underline{I}$). Effort decreases with β (hence also with I), and so does rent. The LG with β^* (at I^*) inserts the lowest effort, and derives no rent from the transfer ($t=\psi(e^*(\beta^*))$ and $U(\beta^*)=0$). The truncation of production has the feature that $\beta^*<\beta^{fb}$ ($I^*<I^{fb}$). The essential tradeoff in this solution is to induce a lower efforts from any LG at $I>\underline{I}$ and have a suboptimal production truncation in order to reduce the rent and hence also the distortion associated with it.

Substituting the results of Proposition 4 back to Equation (10) gives the maximized social welfare under the CS, W^*.

Figure 4 summarizes the result. In the graph, the line above FBSCOP is the second best (and actual) social cost of production (SBSCOP) under the CS defined by

$$SBSCOP \equiv \beta(I) - e^*(\beta) + \psi(e^*(\beta)).$$

The SBSCOP is above FBSCOP because, except for $I=\underline{I}$, effort under the CS is suboptimal. The distances between SBSCOP and FBSCOP increases in I because the higher the I, the further effort falls below e^{fb}. Above SBSCOP is the

curve of CTP (the center's transfer $T(\beta)$ for producing the good. The difference between CTP and SBSCOP is the rent obtained by the LG. It is the largest at $I=\underline{I}$, declines in I to zero at I^*.

[Figure 4: Optimal truncation, transfer and cost of production under the CS.]

It can be shown that, given I^{fb}, the DS leads to higher welfare than the CS when the net social value of the public good is sufficiently small.

We use $\omega(I)$ to measure the net social value of the good. Recall the fact that $\omega(I)$ is defined by the difference between $S(I)/(1+\lambda)$ and FBSCOP. This means that $\omega(I)$ can be small for different reasons. For example, under A3a and given $\beta(I)$ and thus FBSCOP, $\omega(I)$ can be small because $S(I)$ is small, $I<I^{fb}$. Or, under A3a and given $S(I)$, $\omega(I)$ can be small because $\beta(I)$ is large, $I<I^{fb}$. The economic meaning of both cases are easy to see. The net social value of the good is small in the former case because, with the cost parameter β given, the gross social value of the good is low, whereas in the latter case because, with the gross social value of the good given, the cost of producing the good is high.

We first show that under A3a and with I^{fb} and $\beta(I)$ given, $W^c<W^d$ if $\omega(I)$ is small because $S(I)$ is small for $I<I^{fb}$.

Since $\beta(I)$ and $S(I)$ are linear in I, with I^{fb} given, the value of $\omega(I)$ for all I can be found if we know the value of $\omega(\underline{I})=\underline{\omega}$. It is easy to see that, when $\underline{\omega}$ vanishes, both W^c and W^d vanish. It turns out, however, that as $S(\underline{I})$ approaches FBSCOP and thus $\underline{\omega}$ vanishes, W^c vanishes faster than W^d, giving the desired result that $W^c<W^d$ if $S(I)$ is sufficiently small.

Lemma 1: Under A3a and with I^{fb} given, the optimal production truncation under the CS, I^*, approaches $\underline{I}$ as $\underline{\omega}$ vanishes.

Proof: First consider the case where $\underline{\omega}$ vanishes because $S/(1+\lambda)$ approaches the FBSCOP. In Equation (12) the term in {.} has the value $v(I^*)<\omega(I^*)<\underline{\omega}$. When $\underline{\omega}$ approaches zero, $v\leq 0$ for any $I^*>\underline{I}$. Also, without a change in $\beta(I)$, the optimal effort $e^*(\beta(I))$ under the CS does not change. The only way the equal sign in Equation (12) can hold is for I^* to approach $\underline{I}$ so that the first and the second term in Equation (12) can both approach zero. The second term approaches zero because $G(I^*)$ vanishes as I^* approaches $\underline{I}$.

Then consider the case where the FBSCOP approaches the (given) $S(I)/(1+\lambda)$ so at, again, $\omega(I)$ vanishes. Note that for $\omega(I)$ to vanish as FBSCOP increases at $\underline{I}$, $S'(I)>0$ must be true in order not to violate A1. This implies that b does not approach zero with $\omega(I)$. Then the difference between SBSCOP and FBSCOP does not vanish. So as FBSCOP approaches $S(I)/(1+\lambda)$ and $\omega(I)$ vanishes, I^* again has to approach $\underline{I}$ for $G(I^*)$ to vanish.[*] Thus Lemma 1 holds. Q.E.D.

Based on Lemma 1, we have

Proposition 4: Under A3a and with I^m given, the CS leads to a lower welfare than the DS, i.e., $W^c<W^d$, if $\underline{\omega}$ is sufficiently small.

Proof: Note first that both I^* and ω are functions of $\underline{\omega}$, i.e., $I^* = I^*(\underline{\omega})$ and $\omega=\omega(\underline{\omega},I)$. Since $\underline{\omega}>\omega(I)$ for all $I>\underline{I}$, we have

$$
\begin{aligned}
W^c &= \int_{\underline{I}}^{I^*(\underline{\omega})} \{S(I) - (1+\lambda)[\beta(I) - e(I) + \psi(e(I))] - \lambda U(I)\}dF(I) \\
&< \int_{\underline{I}}^{I^*(\underline{\omega})} \{S(\underline{I}) - (1+\lambda)[\underline{\beta} - e^m + \psi(e^m)]\}dF(I) \\
&= (1+\lambda)\underline{\omega}F(I^*(\underline{\omega})) \\
&= W^{c*}.
\end{aligned}
$$

[*] When $S'(I)=0$ the difference between SBSCOP and FBSCOP vanishes as $\omega(I)$ vanishes due to higher $\beta(I)$. This means that I^* need not vanish to maintain Equation 12. This, however, is a case of not particular interest to us, for $S'(I)=0$ means that the center has perfect information about $S(I)$. As $\omega(I)$ vanishes, the center's information about the types of all LGs is almost perfect in the sense that the differences among locales become negligible.

So,

$$W^f - W^d < W^{f'} - W^d = (1 + \lambda)\underline{\omega}F(I^*(\underline{\omega})) - \int_{\underline{I}}^{I^{fb}} \omega(\underline{\omega}, I)dF(I)$$

But,

$$\lim_{\underline{\omega}\to 0} W^{f'}(\underline{\omega})/W^{d'}(\underline{\omega})$$

$$= \lim_{\underline{\omega}\to 0} W^{f''}(\underline{\omega})/W^{d''}(\underline{\omega})$$

$$= \frac{(1 + \lambda)[F(I^*(\underline{\omega})) + \underline{\omega}f(I^*)I^{*'}(\underline{\omega})]}{\int_{\underline{I}}^{I^{fb}} [\partial(\omega(\underline{\omega},I))/\partial(\underline{\omega})]dF(I)}$$

$$= 0$$

The last equal sign holds because the numerator vanishes with $\underline{\omega}\to 0$, while the denominator remains a constant.[19] So the right-hand side of the inequality is smaller than zero. This proves $W^{f'}(\underline{\omega})<W^{d'}(\underline{\omega})$ and also $W^f<W^d$. Q.E.D.

The above discussion suggests that under A3a the CS leads to lower total social welfare than the DS when the net welfare of the good is sufficiently small in locales $I<I^{fb}$.

Next, we show that the result of Proposition 4 holds when A3a is replaced by A3b. Without loss of generality and for the reason that will become clear after Proposition 6, in this discussion let us assume

A4: $S(\underline{I})/(1+\lambda)=\beta(\underline{I})-e^{fb}+\psi(e^{fb})$, i.e., $I^{fb}=\underline{I}$. (See Figure 5.)

[Figure 5: I^{fb} at $\underline{I}$]

Proposition 5: Under A3b and A4, the CS leads to a lower welfare than the DS, i.e., $W^f<W^d$, if $\underline{\omega}$ is sufficiently small.

Proof: When $S(I)/(1+\lambda)$ falls for all I, local tax under the DS $T=S(I)/(1+\lambda)$ also becomes smaller because of RC. When $S(I)/(1+\lambda)$ and FBSCOP are

[19] The value of $\partial(\omega(\underline{\omega},I))/\partial(\underline{\omega})$ is constant in $\underline{\omega}$ and between [0, 1].

arbitrarily close, local tax $T = S(I)/(1+\lambda)$ is also arbitrarily close to FBSCOP, giving the result

$$T(I) = S(I)/(1+\lambda)$$
$$< \beta(I) - e^{\cdot} + \psi(e^{\cdot}) \qquad \text{for all } I\epsilon(\underline{I}, \bar{I}]$$
$$< T^{\cdot}(I) \qquad \text{for all } I\epsilon[\underline{I}, \bar{I}).^{11}$$

It follows that $W^{f}<W^{d}$ when $\omega(I)$ is sufficiently small because the DS leads to both higher effort and lower tax. Q.E.D.

Propositions 4 and 5 together suggest that the result is quite general that, when the net social benefit of the good is small, the DS can lead to higher welfare than the CS.

5. Indistinguishability of local condition and decentralization.

The mechanism to induce the LGs to report their true types as discussed in Section 3 works at the balance of two opposing forces. Reporting a lower I, the LG needs to work harder to achieve a lower C corresponding to it because $C=\beta-e$. Reporting a higher I, the LG receives a smaller amount of net transfer t(I) becauset $(I)<0$. Both reduces the LG's utility. The properly structured mechanism is such that telling the truth gives the LG the most beneficial tradeoff between the two sources of disutility, effort and a lower net transfer.

Under A3b, $\omega(I)$ increases in I, making it desirable for the DS to truncate the production from below, i.e., truncating at an $I=I' \geq I^{fb}$ such that the good is not produced at $I<I'$. Such a production truncation decision, however, is in conflict with any mechanism to induce all LGs to truthfully reveal their types because of the discontinuity of rent U(I) at I'.

---

[11] At $\underline{I}$, $S(I)/(1+\lambda)$ = FBSCOP = SBSCOP. At $\bar{I}$, $T^{\cdot}(I)$ = SBSCOP.

Lemma 2: Under A1, A2 and A3b, IC to induce truth-telling and a production truncation at $I'>\underline{I}$ such that the good is not produced in locales $I<I'$ are not consistent with each other.

Proof: Note that the IC conditionU $(I)<0$ holds under both A3a and A3b. Suppose that a revelation mechanism and a truncation at $I'>0$ such that the good is not produced at $I<I'$ are found. This means $t(I)=0$ and $U(I)=0$ for all $I<I'$, but $t(I')>0$ and $U(I')>0$. The question is if the LG at $I^*<I'$ can be better off by reporting I'? Because $\beta(I^*)<\beta(I')$ by A1, there always exists an effort level, $e(I^*)<e^*(I')$, that the LG can make to produce the desired and observable cost required for I', $C(I')=\beta(I')-e^*(I')$ (supposing $\beta(I^*)$ and $C(I')$ are such that this is achieved at $e(I^*)>0$). Receiving the same net transfer as LG I' at a lower effort level means by reporting I' LG at I^* can achieve $U(I^*)>U(I')>0$, which contradicts the ICU $(I)<0$ for truth-telling. Q.E.D.

So, when A3b is satisfied, the center cannot induce truth-telling by the LGs through proper transfer without producing the good in locales $I\in[\underline{I},I^{fb})$ where it is socially undesirable to do so. So, if the good is produced at any $I'\in(\underline{I},\bar{I}]$, it must also be produced in all $I<I'$. This indistinguisability of local conditions by the center under the CS gives us

Proposition 6: Under A1, A2 and A3b, $W^f<W^d$ if I^{fb} is sufficiently close to but not equal to $\bar{I}$.

Proof: Under A3b, the center cannot truncate the production of the good from below I^{fb}. But only the production of the good at $I>I^{fb}$ can lead to a gain in social welfare; Production at $I<I^{fb}$ leads to a net social loss. W^f is given by the difference between the gain from producing the good in $I\in(I^{fb},\bar{I}]$ and the loss from producing the good in $I\in[\underline{I},I^{fb})$. When I^{fb} is sufficiently close to but not equal to $\bar{I}$, the production of the good leads to $W^f\leq 0$ under

the CS. The center is better off by ordering no production of the good, leading $W^c=0$, while $W^s>0$. Q.E.D.

Proposition 6 explains why A4 was assumed to derive Proposition 5: Under A3b, the CS can be better than the DS only when I^m is sufficiently small. The smallest I^m possible is, of course, $\underline{I}$. Obviously, the result of Proposition 5 holds when I^m is greater than $\underline{I}$.

6. The decentralization experience of China

[To be added.]

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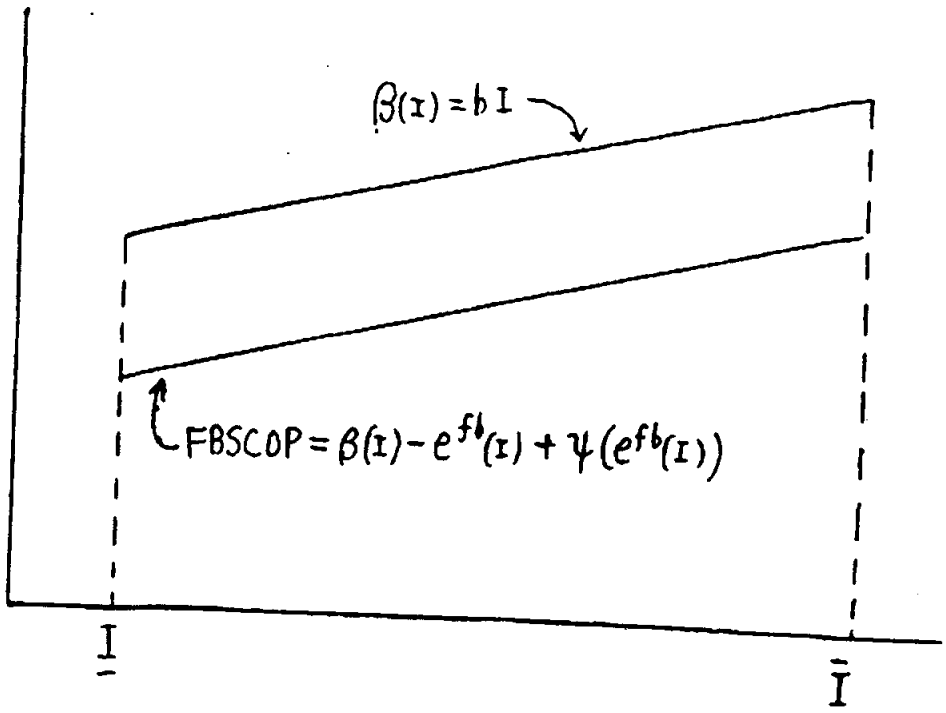


Figure 1: β and FBSCOP as functions of I

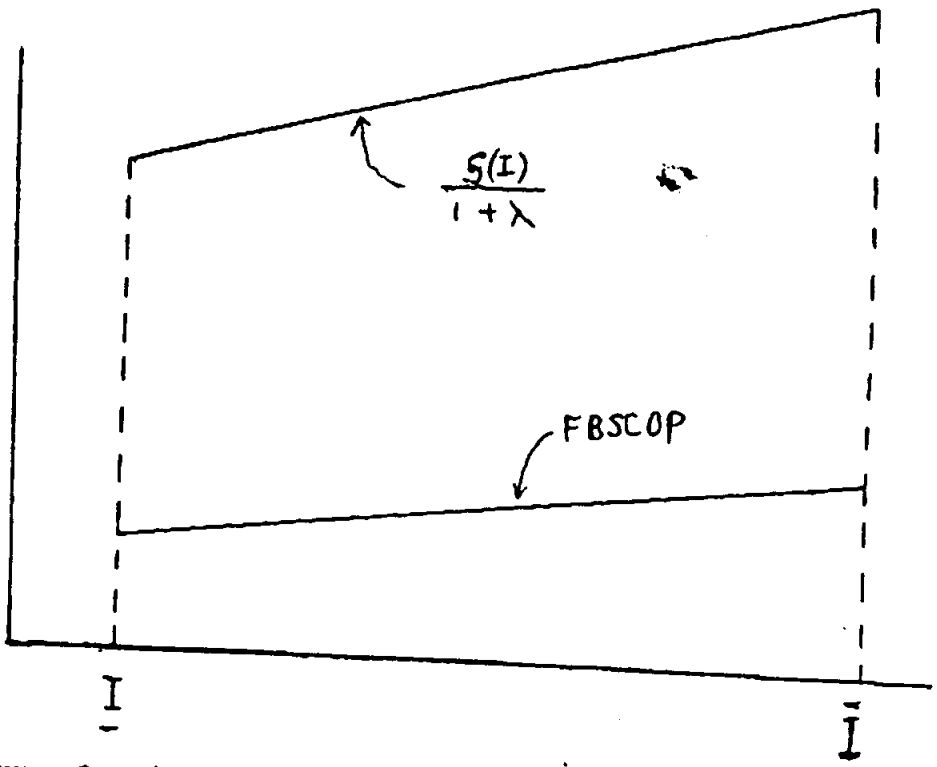
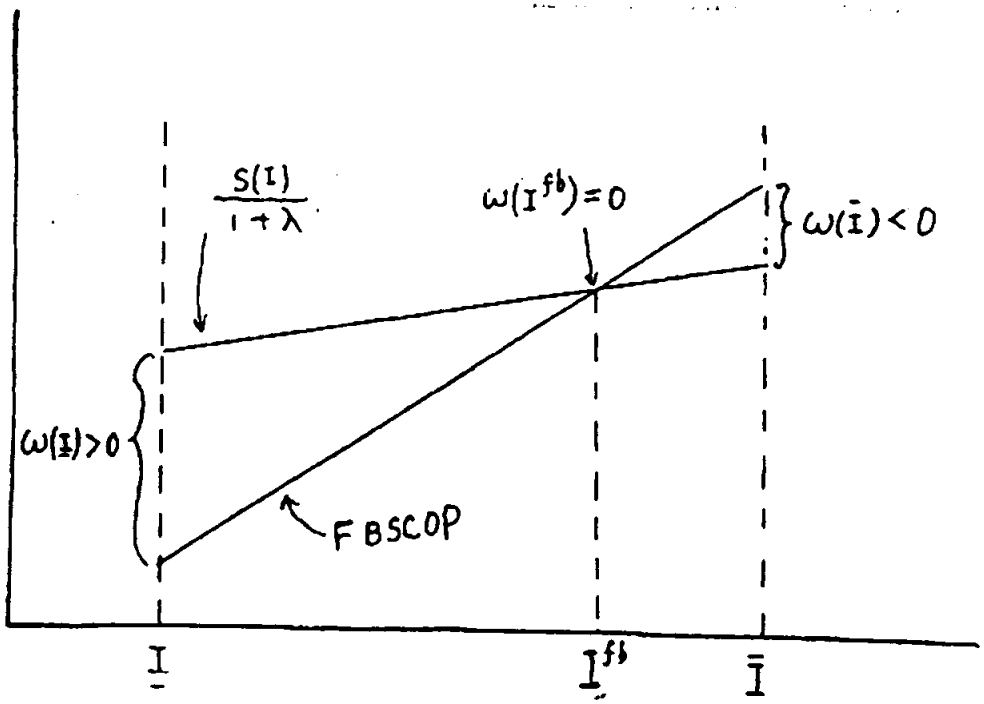
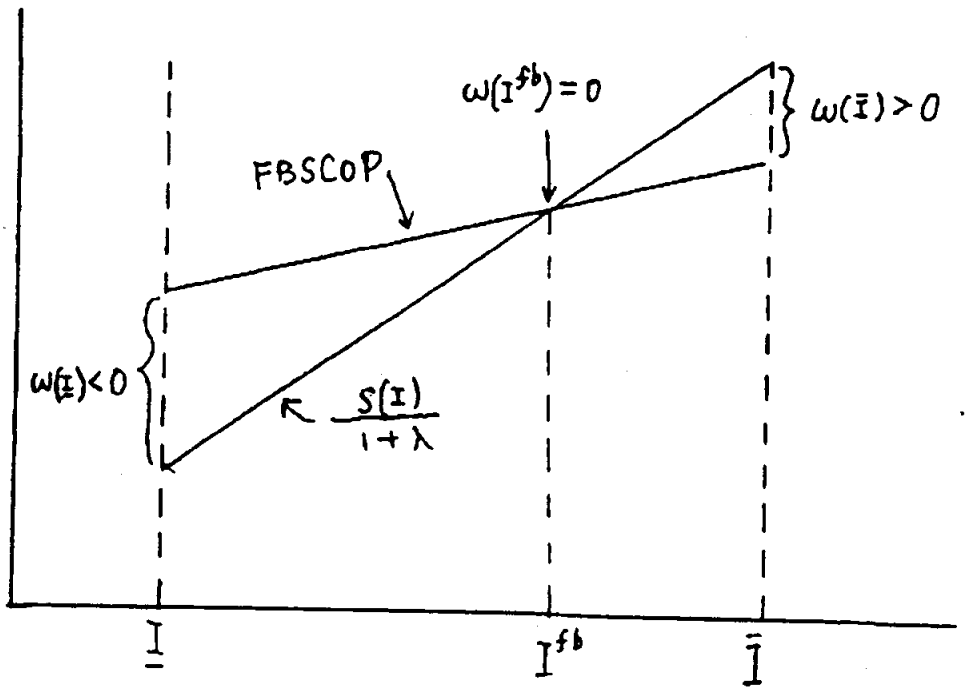


Figure 2: High Social Value of the good at all locales



a



b

Figure 3: ω(I) under A3a and A3b, respectively

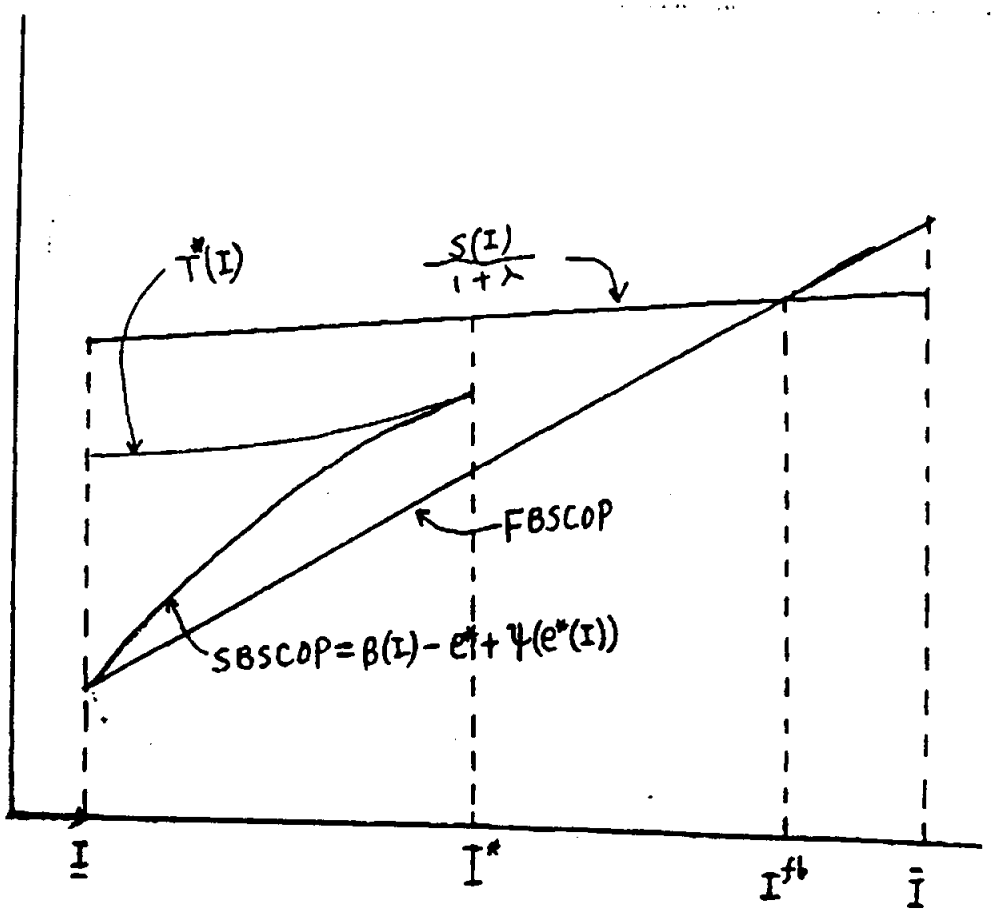


Figure 4: Optimal truncation, transfer and cost of production under the centralized system