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Public Input Competition and Public Service Providers

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Public-Private Partnerships (PPP) has become popular in many countries. At the same time, the capital flow across countries and regions has increased, which gave rise to the fiscal competition for capital among governments. An early study that investigated these two trends together argued that competition in public-input investment hardens the budget constraints of local governments. Another study, however, showed that poorly endowed regions give up competition and hence competition does not discipline local governments. In the present paper we assume that private firms, as well as local governments, can provide public services and show that poorly endowed regions invest more in the production of these services than well-endowed ones.

Keywords: Public-Private Partnerships; asymmetric regions; fiscal competition

I. Introduction

After the privatizations and deregulations in the 1980's, both developed and developing countries worked on further restructuring of the public service provisions. They often cooperated with private firms to provide public services more efficiently. Those approaches are collectively referred to as the Public-Private Partnerships (PPP). The measures of PPP include the Private Finance Initiative (PFI) developed in the United Kingdom, Concessions, and other types of cooperation between public and private sectors. In a broader sense, certain kinds of privatization and public enterprises may be included.

PFI was introduced in public services such as roads, prisons, hospitals and others, and has generally been successful in reducing public spendings. Other types of PPP were introduced in various public services such as waterworks, libraries, railroads and others. PPP has been investigated with contract theories and other approaches. Examples of those studies are Schmidt (1996a,b), Hart et al. (1997), Hart (2003) and Bennett and Iossa (2006). A typical approach has been, as in Hart (2003), to investigate when the government chooses "bundling" in which

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building and managing facilities are contracted in a bundle (PPP), or "unbundling" in which they are contracted separately (traditional public-works projects).

During the same period, according to the globalization of the economy, the capital began to flow across countries and regions more rapidly and in a larger scale. The governments began to compete with each other to attract the capital, which is called the fiscal competition among countries and regions.

Fiscal competition among governments has been studied intensively for more than two decades. Following the formal analyses by Zodrow and Mieszkowski (1986) and Wilson (1986), the models of tax competition have been extended in various areas such as competition between countries (or regions) of different sizes, and that for different tax bases (i.e. the preferential tax regimes).[1)] Zodrow and Mieszkowski (1986) also analyzed the competition between countries using public input, or the investment in infrastructure, and argued that the level of public input is inefficiently low under the fiscal competition. This encouraged further studies such as Noiset (1995), Keen and Marchand (1997), Matsumoto (1998) and Bucovetsky (2005).

While the literatures of fiscal competition and PPP have mostly been studied separately, they are becoming more related with each other because the competition among governments can affect the performance of the PPP projects. An early example which studied such a situation is Qian and Roland (1997) who argued that the fiscal competition hardens the budget constraints of local governments competing each other, which would otherwise bail out failed public enterprises. On the contrary, Cai and Treisman (2005) assumed asymmetric regions which differ in exogenous endowments and showed that competition does not necessarily discipline local governments; some governments give up competition and spend money on wasteful purposes. Although public enterprises do not appear in their model, their results are quite a contrast to those of Qian and Roland (1997).

We sometimes find similar cases to Cai and Treisman (2005) in the sense that some local governments give up competition. While PPP is considered to reduce public spendings, local governments in some regions provide public services themselves rather than contracting with private companies. This suggests that PPP may be difficult in those regions. Figure 1 shows the relation between per-capita income and the rate of introducing the Designated Manager System (one form of PPP) in public services of 47 Japanese prefectures.[2)] One can see that wealthier regions (supposedly better-endowed in geography or others) tend to be more willing to cooperate

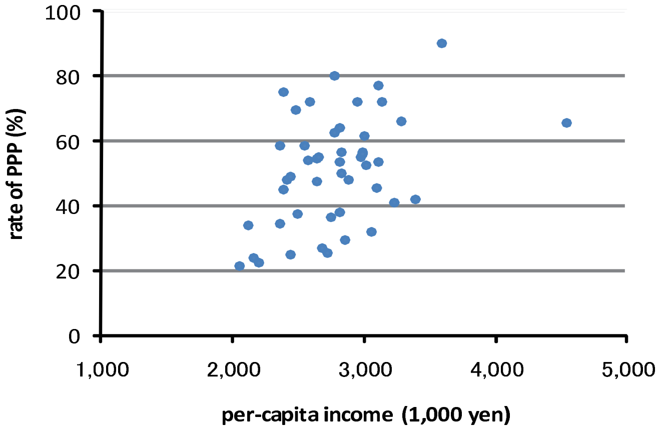

Figure 1: Regional income and the rate of introducing PPP

with outside organizations such as private firms. If PPP helps reduce public spendings, this seems contradictory because poorly endowed regions should be more eager to introduce PPP.[3)]

In this paper we assume that private firms, as well as local governments, can provide public services by investing (private or public) capital and show that governments in poorly endowed regions invest more in those services and less in infrastructure than governments in well-endowed ones. This is in line with the cases where local governments in rural areas give up competing with other regions to attract private capital, and produce public services themselves rather than contracting with private companies.

The rest of the paper is organized as follows. Section II sets up a model and analyze the two cases when capital is immobile and when it is mobile across regions. Section III provides numerical examples. Section IV concludes.

II. The Model

We consider an economy that consists of $N + M$ regions indexed by i. Of these regions, N are well endowed (type-n) in some geographic characteristics and their productivity is higher than M poorly endowed (type-m) regions given other conditions. Regions of the same type are equally endowed. We mainly focus on the public side of the economy and production in each region is that of public services such as constructing and managing waterworks, libraries, prisons, and others. Both the government and private firms can produce those services.

Private investors own a total amount of capital K_P, invest in different regions and establish public service providers. Let k_P^i denote the private capital invested in region i. We assume that there exists a capital market where governments pay the return to these investors. Private investors invest their capital so that the returns from different regions are equalized. Governments can also produce public services by investing capital, denoted by k_G^i. At the same time, governments choose the level of infrastructure investment I^i. Infrastructure includes transportation, telecommunications, legal protection and others which increase the productivity of capital k_P and k_G.

Suppose that the aggregate production function of region i, $F(A^i, k_P^i, k_G^i, I^i)$, takes the form of Cobb-Douglas type as in Cai and Treisman (2005) except that we have two types of capital:

$$F^i = A^i(k_P^i + k_G^i)^\alpha (I^i)^\beta \tag{1}$$

where $\alpha > 0$, $\beta > 0$, $\alpha + \beta < 1$ (which implicitly assumes other immobile factors such as labor), and $A^i > 0$. The parameter A^i denotes the level (or effect) of regional endowment. We assume that $A^i = A^n$ for the well-endowed regions, $A^i = A^m$ for the poorly endowed regions, and $A^n > A^m$. While k_P^i and k_G^i (in other words, private and public enterprises) are substitutable, endowment, infrastructure, and capital are complementary.

Residents of each region owns the equal amount of capital $\bar{k}_P$, where $\bar{k}_P = \sum_i^{N+M} k_P^i/(N + M)$. The government of region i (hereafter government i) maximizes the regional welfare u^i, which consists of the values of public services net of payment to the capital, $x^i \equiv F^i - r(k_P^i + k_G^i)$, and capital income of the region $r(\bar{k}_P + k_G^i)$, where r denotes the return from capital and therefore $r = \partial F^i/\partial k_P^i$. From (1), x^i is expressed as follows:

$$x^i = (1 - \alpha)A^i(k_P^i + k_G^i)^\alpha (I^i)^\beta. \tag{2}$$

We assume that the regional welfare u^i takes the following form:

$$u^i = u\big(x^i, r(\bar{k}_P + k_G^i)\big) = x^i + r(\bar{k}_P + k_G^i)$$

which means that the net values of public services and capital income are equally evaluated. Unlike Cai and Treisman (2005), we do not assume wasteful government expenditure. Each government is endowed with revenue $S > 0$ and invests k_G^i and I^i. The budget constraint of the government i is as follows:

$$I^i + k_G^i = S. \tag{3}$$

The identical revenue S represents some national mechanism of fiscal redistribution across regions.[4)] The assumption of identical revenues is just for simplification and the results are basically unchanged if we introduce the tax on capital, as shown in the Appendix.

Consider a game in which all governments decide the level of infrastructure I^i and capital investment k_G^i, then private investors decide the level of capital investment k_P^i. We compare two cases, where private capital is immobile (or the amount of capital invested in each region is fixed) and where it is mobile across regions.

1. Immobile Capital

First we consider the case where private capital is immobile and allocated equally across regions, that is, $k_P^i = \bar{k}_P$. This can be interpreted that the amount of capital is historically determined. The problem for government i is to maximize $x^i + r(\bar{k}_P + k_G^i)$ subject to (3). Therefore the Lagrangian is as follows:

$$L = x^i(k_G^i, I^i; \bar{k}_P) + r(\bar{k}_P + k_G^i) + \mu(S - I^i - k_G^i). \tag{4}$$

Solving this we have,

$$\frac{\partial x^i}{\partial I^i} = \frac{\partial x^i}{\partial k_G^i} + r. \tag{5}$$

Given (2), rearranging (5) yields the following condition:

$$I^i = \frac{(1-\alpha)\beta}{\alpha(2-\alpha)}(\bar{k}_P + k_G^i). \tag{6}$$

From (3) and (6) we can solve k_G^i and I^i as follows:

$$k_G^i = \frac{\alpha(2-\alpha)}{B}S - \frac{(1-\alpha)\beta}{B}\bar{k}_P \tag{7}$$

$$I^i = \frac{(1-\alpha)\beta}{B}S + \frac{(1-\alpha)\beta}{B}\bar{k}_P \tag{8}$$

where $B \equiv (1-\alpha)\beta + \alpha(2-\alpha) > 0$. Because $(1-\alpha)\beta/B$ is positive, (7) and (8) show that k_G^i decreases and I^i increases as $\bar{k}_P$ increases. Therefore, if larger amount of private capital is available, the government reduces its investment of public capital and increases the infrastructure. On the other hand, k_G^i and I^i increase in the revenue S because $\alpha(2-\alpha)/B$ is also positive. The productivity parameter A^i has no effect on k_G^i and I^i. This is different from Cai and Treisman (2005) who assume a public consumption good (or wasteful public spending) other than the investment in infrastructure, in which larger productivity causes more investment in infrastructure.

2. Mobile Capital

Next we assume that private capital is mobile across regions costlessly. Then the capital flows from regions with lower return rates to those with higher rates and the rates are equalized in all regions. Let r denote the economy-wide rate of return to capital. From (1), the condition $\partial F^i/\partial k_P^i = r$ can be rewritten as follows:

$$k_P^i + k_G^i = \left(\frac{\alpha A^i}{r}(I^i)^\beta\right)^{\frac{1}{1-\alpha}}. \tag{9}$$

Because k_P is mobile, increasing I^i attracts more private capital. Differentiating (9) yields,

$$\frac{\partial k_P^i}{\partial I^i} = \frac{\beta}{1-\alpha}\left(\frac{\alpha A^i}{r}\right)^{\frac{1}{1-\alpha}}(I^i)^{\frac{\alpha+\beta-1}{1-\alpha}} = \frac{\beta}{1-\alpha}(k_P^i + k_G^i)(I^i)^{-1}. \tag{10}$$

Government i maximizes $x^i + r(\bar{k}_P + k_G^i)$ subject to (3). Therefore, from the Lagrangian

$$L = x^i(k_P^i, k_G^i, I^i) + r(\bar{k}_P + k_G^i) + \mu(S - I^i - k_G^i), \tag{11}$$

we have the following condition:

$$\frac{\partial x^i}{\partial I^i} + \frac{\partial x^i}{\partial k_P^i}\frac{\partial k_P^i}{\partial I^i} = \frac{\partial x^i}{\partial k_G^i} + r. \tag{12}$$

Given that $r = \partial F^i/\partial k_P^i$ and using (2), we obtain the following equation:

$$I^i = \frac{\beta}{\alpha(2-\alpha)}(k_P^i + k_G^i). \tag{13}$$

Comparing (6) and (13) we can see that given the level of the capital, governments invest more in infrastructure if the private capital is mobile. $1/(1-\alpha) > 1$ is so called "competition effect" on the infrastructure investment. From (9) and (13) we can solve I^i and $k_P^i + k_G^i$ as below:

$$I^i = C^{1-\alpha}\left(\frac{\alpha A^i}{r}\right)^{\frac{1}{1-\alpha-\beta}} \tag{14}$$

$$k_P^i + k_G^i = C^\beta\left(\frac{\alpha A^i}{r}\right)^{\frac{1}{1-\alpha-\beta}}. \tag{15}$$

where $C \equiv \{\beta/[\alpha(2-\alpha)]\}^{1/(1-\alpha-\beta)}$. Substituting (14) and (15) into (3) and rearranging we have,

$$k_P^i = (C^\beta + C^{1-\alpha})\left(\frac{\alpha A^i}{r}\right)^{\frac{1}{1-\alpha-\beta}} - S \tag{16}$$

$$k_G^i = S - C^{1-\alpha}\left(\frac{\alpha A^i}{r}\right)^{\frac{1}{1-\alpha-\beta}}. \tag{17}$$

The market-clearing condition for private capital $Nk_P^n(r) + Mk_P^m(r) = K_P$ along with $\partial F^i/\partial k_P^i = r$ determines the rate of return r, and hence k_P^i, k_G^i, and I^i. Therefore, although the revenue S does not appear in (14), the increase in S would lower r and hence raise I^i.

From (14) and (15) we have the following condition:

$$\frac{I^n}{I^m} = \frac{k_P^n + k_G^n}{k_P^m + k_G^m} = \left(\frac{A^n}{A^m}\right)^{\frac{1}{1-\alpha-\beta}}. \tag{18}$$

This shows that as A^n/A^m increases (i.e. the difference of endowments is larger), $(k_P^n+k_G^n)/(k_P^m+k_G^m)$ and I^n/I^m become larger. Unlike Cai and Treisman (2005), however, one cannot tell immediately whether I^n increases and I^m decreases (both may increase or decrease).[5)] This is because, even though k_P^n becomes larger and k_P^m becomes smaller, k_G^n and k_G^m may not increase or decrease accordingly. From (16) we have,

$$\frac{k_P^n + S}{k_P^m + S} = \left(\frac{A^n}{A^m}\right)^{\frac{1}{1-\alpha-\beta}}. \tag{19}$$

Because S is identical across regions and the market-clearing condition holds, k_P^n increases and k_P^m decreases as A^n/A^m increases. Besides, from (18) and (19) $I^n/I^m = (k_P^n+S)/(k_P^m+S)$, and hence we have $I^n/I^m < k_P^n/k_P^m$. That is, the private capital is invested in better-endowed regions more than proportionally to the infrastructure investments. On the other hand, comparing (18) and (19) and given that $k_G^i < S$, in order for (18) to hold, k_G^n must decrease and k_G^m must increase as A^n/A^m increases. Therefore, I^n increases and I^m decreases, which says that poorly endowed regions give up competition in infrastructure investment. See Figure 2 for an example. In addition, if A^n/A^m is large enough, the competition effect is overturned in poorly endowed regions; the investment in infrastructure is lower when capital is mobile than when it is immobile.

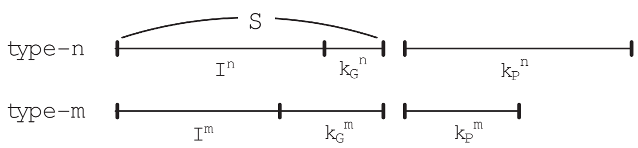

Figure 2: An example of capital allocation

The result above can be summarized as follows. While poorly-endowed regions may give up to compete with well-endowed regions with infrastructure investment, they invest larger amount of public capital and produce more public services themselves. This is how poorly-endowed regions rest on government production of public services rather than private production.

III. Numerical Examples

In this section we review the results in the previous section using numerical examples. We assume that $S = 10$, $\alpha = 0.25$, and $\beta = 0.2$ throughout.

1. Immobile Capital

First, suppose that capital is immobile as in Subsection II.1, $\bar{k}_P = 5$, $A^n = 1.5$, and $A^m = 1$. Then the equilibria are shown as in Table 1. One can see that there is no difference in the allocation of government budget between well-endowed and poorly endowed regions (although the production levels are different).

Table 1: Immobile capital

	I	k_G	$\bar{k}_P$
type-n region	3.83	6.17	5
type-m region	3.83	6.17	5

2. Mobile Capital

Suppose next that there are same number of type-n and type-m regions (say, j regions for each type) and total amount of private capital $K_P = 10j$ (i.e. the average amount of private capital per region is five). Table 2 shows a case where the difference between A^n and A^m is small ($A^n = 1.1$, $A^m = 1.0$). Infrastructure investments are larger than the case of immobile capital in both regions because of the competition effect. In Table 2, however, nearly two-thirds of the private capital is invested in type-n regions.

Table 2: A^n/A^m is small

	I	k_G	k_P
type-n region	5.11	4.89	6.30
type-m region	4.30	5.70	3.70

Table 3 shows a case where the difference between A^n and A^m is larger ($A^n = 1.4$, $A^m = 1.0$). One can see that with a forty percent difference of productivities ($A^n/A^m = 1.4$), more than ninety percent of the private capital is located in type-n regions. In addition, I^m is smaller than in Table 2, which can be interpreted that type-m regions gave up competition with type-n regions. If A^n/A^m becomes even larger, k_P^m will be zero, or we have corner solutions. Then type-m regions can no longer attract private capital and only public enterprises provide public services in those regions.

Table 3: A^n/A^m is large

	I	k_G	k_P
type-n region	6.10	3.90	9.45
type-m region	3.31	6.69	0.55

IV. Conclusions

In this paper we assumed government capital investments, in addition to private capital investments, to produce public services. While these two types of capital are substitutes, capital and infrastructure are complements. We have two types of regions, one with higher regional endowment (type-n) and the other with lower endowment (type-m). When they determine the allocation of capital and infrastructure investments to maximize regional welfares, it was shown that type-m governments invest less in infrastructure than type-n governments. That is, type-m governments give up the competition with type-n governments for private capital. Instead, they invest more public capital and produce public services themselves. The larger the difference in endowments, the more private capital is located in type-n regions and eventually type-m regions have to do without private capital.

While PPP is beneficial, it is possible that some regions cannot afford it. In that case, it is no use criticizing those regions for not contracting with private firms. One remedy might be for the central government to help local governments invest more in infrastructures to increase productivity, although actually it may not be efficient. Another one might be to increase A^m to attract private capital. That would be, for example, to improve bureaucratic procedures so that private companies can move in easily.

In the present paper public and private capital are perfect substitutes and there is no difference between public and private enterprises. In reality, however, they have their drawbacks and advantages respectively. Introducing those features is for future research.

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Appendix

We now introduce a unit tax on private capital and see whether the result in Section II holds. As in Cai and Treisman (2005) the tax rate t is given by the national government. Therefore local governments raise tax revenues from capital and are endowed with S. Then the budget constraint of government i is,

$$I^i + k_G^i = S + tk_P^i. \tag{3'}$$

If the private capital is immobile ($k_P^i = \bar{k}_P$), the Lagrangian is as follows:

$$L = x^i + r(\bar{k}_P + k_G^i) + \mu(S + t\bar{k}_P - I^i - k_G^i).$$

Solving this we have,

$$k_G^i = \frac{\alpha(2-\alpha)}{B}S - \frac{(1-\alpha)\beta - \alpha(2-\alpha)t}{B}\bar{k}_P \tag{7'}$$

$$I^i = \frac{(1-\alpha)\beta}{B}S + \frac{(1-\alpha)\beta(1+t)}{B}\bar{k}_P \tag{8'}$$

where $(1-\alpha)\beta - \alpha(2-\alpha)t$ in (7') is positive as long as the tax rate t is small enough (for example, $\alpha = 0.25$ and $\beta = 0.2$ as in Subsection III.1 and $t = 0.2$). Then the increase in $\bar{k}_P$ decreases k_G^i. If t is large enough (for example, $t = 0.5$), however, $(1-\alpha)\beta - \alpha(2-\alpha)t$ is negative and the increase in $\bar{k}_P$ may raise k_G^i. As in Subsection II.1 the increase in $\bar{k}_P$ raises I^i.

If the private capital is mobile, the condition for equal marginal productivity $\partial F^i/\partial k_P^i = r+t$ can be rewritten as,

$$k_P^i + k_G^i = \left(\frac{\alpha A^i}{r+t}(I^i)^\beta\right)^{\frac{1}{1-\alpha}}. \tag{9'}$$

Therefore we have

$$\frac{\partial k_P^i}{\partial I^i} = \frac{\beta}{1-\alpha}(k_P^i + k_G^i)(I^i)^{-1}. \tag{10'}$$

Solving the government's problem yields,

$$\frac{\partial x^i}{\partial I^i} + \frac{\partial x^i}{\partial k_P^i}\frac{\partial k_P^i}{\partial I^i} = \left(\frac{\partial x^i}{\partial k_G^i} + r\right)\left(1 - t\frac{\partial k_P^i}{\partial I^i}\right). \tag{12'}$$

Using (10') we have,

$$I^i = \frac{D}{E}(k_P^i + k_G^i) \tag{13'}$$

where $D \equiv (1-\alpha)\beta + \alpha(2-\alpha)\beta t > 0$ and $E \equiv \alpha(1-\alpha)(2-\alpha) > 0$. Using (9') and (3') yields,

$$I^i = \left(\frac{D}{E}\right)^{\frac{1-\alpha}{1-\alpha-\beta}}\left(\frac{\alpha A^i}{r+t}\right)^{\frac{1}{1-\alpha-\beta}} \tag{14'}$$

$$k_P^i = \frac{1}{1+t}\left\{\left(\frac{D}{E}\right)^{\frac{1-\alpha}{1-\alpha-\beta}} + \left(\frac{D}{E}\right)^{\frac{\beta}{1-\alpha-\beta}}\right\}\left(\frac{\alpha A^i}{r+t}\right)^{\frac{1}{1-\alpha-\beta}} - \frac{S}{1+t} \tag{16'}$$

$$k_G^i = \frac{1}{1+t}\left\{t\left(\frac{D}{E}\right)^{\frac{\beta}{1-\alpha-\beta}} - \left(\frac{D}{E}\right)^{\frac{1-\alpha}{1-\alpha-\beta}}\right\}\left(\frac{\alpha A^i}{r+t}\right)^{\frac{1}{1-\alpha-\beta}} + \frac{S}{1+t}. \tag{17'}$$

Therefore, similar discussions hold as in Subsection II.2 and one can say that poorly endowed regions give up competition while well-endowed regions attract private capital.

Notes

1) For tax competition between countries of different sizes see Bucovetsky (1991) and Wilson (1991). Studies of preferential tax regimes include, for example, Janeba and Peters (1999), Keen (2001), Janeba and Smart (2003) and Oshima (2010). For surveys, see Wilson (1999), Zodrow (2003) and Wilson (2006).

2) Public housings are excluded because their numbers are so large and vary greatly by prefecture. See Ministry of Internal Affairs and Communications (2009). The data of per-capita income of prefectures are from Cabinet Office, Government of Japan (2010).

3) Yamauchi et al. (2009) showed that while PPP is effective to reduce costs, Japanese cities facing financial difficulties tend to be negative toward PPP. They suggest that those cities may face the soft budget constraints, expecting the bailouts by the central government.

4) In Germany, for example, there exists the local equalization system across federal states and across municipalities. The local allocation tax in Japan is for fiscal redistribution across prefectures and municipalities. See Werner (2006) and Mochida (2006)

5) In Cai and Treisman (2005), there is no public capital k_G^i and the corresponding equation to (18) is $I^n/I^m = k^n/k^m = (A^n/A^m)^{1/(1-\alpha-\beta)}$. Because the total amount of capital is fixed, it follows that I^n increases and I^m decreases.

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