Public–private partnerships: Task interdependence and contractibility

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ABSTRACT

We examine the proper scope of public–private partnerships in the context of a project consisting of two tasks, building and operation of a facility. We investigate the optimal arrangement regarding bundling versus unbundling and private ownership versus public ownership. Like Bennett and Iossa (2006), we assume that the innovative activity in the building stage has impacts on, among other things, the subsequent operational cost. We relax the nature of task interdependence and study different contractual frameworks. The general insight is that given limitations in contractibility, contrary to common sense, complementarity between tasks favors unbundling over bundling.

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1. Introduction

Nowadays, it is common across countries that governmental agencies collaborate with the private sector to deliver public services; in some cases, even the whole project is contracted out to a single firm that takes responsibilities for all involved tasks, such as both building and maintaining the facility. In the literature of public–private partnerships (PPPs), as this practice is usually referred to, two issues have received much attention: multitasking and investment contractibility. Given multiple tasks – such as building and subsequent maintenance of a facility – an important question is whether the tasks should be handled by a single consortium (in case of bundling) or by two separate firms (in case of unbundling). This question of course depends on the contractibility of and the relationship between tasks, as is shown in the literature. In this paper, we further examine this question, extending the existing work.

Our paper is closely related to the piece by Bennett and Iossa (2006), in which two non-contractible innovation activities (or investments in short), one in the building stage and the other in the operating stage, are supposed to reduce cost and enhance quality. Assuming a sort of task externality so that the investment in the building stage may increase or decrease the cost in the operating stage, the paper shows that, with positive externality, it is more efficient for the tasks to be bundled; with negative externality, it is

more efficient for the tasks to be separated. In another paper where both operational costs and service quality are contractible, Martimort and Pouyet (2008) also show similar results.

However, the relationship between tasks can be richer. They may be interdependent, being substitutes, such that making more of one investment will decrease the returns of making more of another investment. For example, a hospital may be built in a more specified manner so that, while the subsequent operational cost is generally lower (i.e., positive externality), further enhancement of quality or alternation of usage would be more difficult to achieve. The two tasks may be interdependent, sharing complementaries, such that making more of one investment will increase the returns of making more of another investment. For instance, a school may be built with better-quality and more-expensive-glass windows so that, whereas the subsequent operational cost is generally lower (i.e., positive externality), an increase in guard services during the operating stage may be more valuable as it prevents a greater loss from pupils' vandalism. In this paper, we examine the implications of task interdependence that allows for substitutability and complementarity; another novelty is the way we model investment contractibility, which will be clear in a moment.

To briefly illustrate how task interdependence matters, let us revisit the contractual framework in Bennett and Iossa (2006). Consider the case of task complementarity. In case of unbundling, the builder could bargain with the manager or the government. After the bargaining, the builder could share the benefits generated by the manager's investment, while not bearing any cost incurred by such investment. Because of complementarity, a higher building

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investment leads to a higher operating investment, yielding a greater net surplus to be split. Anticipating more rents to be extracted from the manager's investment, the builder has a greater incentive to invest. As a result, investment complementarity helps mitigate the underinvestment problem of the builder under unbundling. In the case of bundling, on the contrary, when investing in the building stage, the consortium will internalize not only the benefits but also the costs of subsequent investment, resulting in a dampened investment incentive on his part.[1] Thus, at the margin, task complementarity favors unbundling, relative to bundling. Notice that because task complementarity can be viewed as a special kind of positive externality, this result sheds new, somewhat counter-intuitive, light to the issue on PPPs.

In the main body of this paper, we focus on a contractual framework somewhat different from Bennett and Iossa (2006); we assume that the operation task becomes contractible subsequent to the building stage. Examples from construction sectors show that the contract on service provision is usually finalized until the infrastructure is in place. Moreover, even though a contract specifies the operating task in advance of the project, it may still be subject to adaptation and renegotiation after the construction is carried out. These observations are consistent with the idea that the requirements regarding the successive operation task become revealing as time goes by.[2] We think that the framework of "interim contractibility" is worthwhile studying (see Iossa and Martimort (2008) for discussions). To check the robustness of our results, we also examine the role of task interdependence in the incomplete contracting framework as in Bennett and Iossa (2006) and in complete contracting frameworks as in Martimort and Pouyet (2008) and Schmitz (2005).

In the framework of interim contractibility, our findings suggest that under private ownership, task externality, as well as task interdependence, still plays an important role in shaping the trade-offs between integration and separation. In particular, task complementarity favors the builder's ownership, but disfavors the consortium's ownership. The intuition is much similar to what we have discussed with respect to Bennett and Iossa's model, but the difference is that, given the interim contractibility, the negotiation on the ex post adoption of the operating investment is replaced by the negotiation on the ex ante approval prior to its choice. Through such bargaining, either the builder or the consortium shares the benefits (generated by the operating investment), and the gains are in turn dependent on his own investment in the building stage. On the other hand, we find that under public ownership, the difference between integration and separation vanishes. The reasons trace to the interim contractibility of the operating investment as well as the veto power of the government on the ex post adoption of the building investment.

Besides the bundling versus unbundling problem, this paper also reexamines, in different contractual frameworks, whether the project should be privately owned or publicly owned. In general, our main results are consistent with those in Bennett and Iossa (2006), where a larger residual value effect and a smaller social value effect favor private ownership, and public ownership is favored when the opposite is true.

The present paper belongs to the strand of literature that investigates either desirable contracting schemes in the public–private partnership (e.g., Hart, 2003; Martimort and Pouyet, 2008; Bentz et al., 2001; Iossa and Martimort, 2008; Hoppe and Schmitz, 2008) or optimal ownership structures in the public–private partnership (e.g., Hart et al., 1997; Francesconi and Muthoo, 2006;

Besley and Ghatak, 2001; Bennett and Iossa, 2006). But none of these papers has addressed exactly the same questions as we do here.

Our research is also related to the papers that study the holdup problem of sequential specific investments. Like what we assume here, Smirnov and Wait (2004) assume that, if an initial investment is made, contracting on the subsequent investment becomes possible. But they address a different question about whether the parties should make investments simultaneously or sequentially. Another relevant paper is De Fraja (1999), who find that if specific investments are made sequentially, ex ante contracting can solve the holdup problem even though there exist two-sided direct externalities across investments.[3] Here, we study the interrelationship among three parties (namely, two investors and one principal), instead of between two, leading to different results.

The remainder of this paper is organized as follows. Section 2 presents the main model. Section 3 examines the optimal regime when the operation task becomes contractible subsequent to the building stage. Section 4 briefly discusses the issue in the framework used by Bennett and Iossa (2006), in which all tasks are non-contractible. Section 5 addresses the issue from a complete contract perspective. Section 6 concludes.

2. Model

A governmental agency (hereafter, the government) is contemplating a project that, upon its completion, will enhance social benefit. The project consists of two sequential tasks, namely, "building" and "operating" a facility. The facility of a minimum standard can be built at a certain cost, and the completed facility can be operated at a certain cost as well. However, prior to the actual building, the builder can undertake an innovative activity that increases both the social benefit and the residual value of the facility, affecting the costs and efficacy of the following operation task (the residual value refers to the value of the facility to the owner upon the expiration of the project). Likewise, subsequent to the completion of building but prior to the actual operation, the manager can undertake an innovative activity that reduces the operational cost and increases the social benefit. We use a and e to denote the level (also the cost) of innovative activity in the building stage and in the operating stage, respectively. The government can either engage with the builder and the manager who are separately in charge of these two tasks, or with a consortium who takes care of both tasks.[4] In either case, these agents are risk-neutral, so is the government.

Let $C(a,e)$ be the operational cost of the facility borne by the manager (or operator) in the operating stage. We assume that

$$C(a,e) = C_0 - d(a,e),$$

where C_0 is the positive default cost, and $d(a,e)$ is the reduction of operational cost caused by the investments of a and e. The function $d(a,e)$ is three-order differentiable, satisfying the following properties:

(i) $d(0,0) = 0$.
(ii) $d_2(a,e) > 0$, $d_2(a,0) = \infty$, $d_2(a,\infty) = 0$, $d_{22}(a,e) < 0$.

[1] Without loss of generality, we use the pronoun "she" to represent the government, and use the pronoun "he" to represent the firms (or agents).

[2] One fact, which is pointed out by Neher (1999), is that as the project matures, more human capital is converted into physical assets, making the alienable (contractible) elements of the project manifested.

[3] Disagreeing with De Fraja (1999), Che (2000) argues that the contract suggested by De Fraja (1999) provides almost no incentive for specific investments when they exhibit sufficiently large direct externalities. Che (2000) proposes an alternative contract. For other papers on the sequential specific investments, please see Lulfesmann (2004), etc.

[4] We assume that when the builder and the manager form a consortium, they act as one person. This assumption is also used in Bennett and Iossa (2006), as well as in the main part of Martimort and Pouyet (2008) that we will contrast with in Section 5. This view of integration, however, is different from Grossman and Hart (1986). In general, integration and non-integration are different ownership structures, and there should still be incentive problems within an integrated firm. An alternative interpretation of our case is that we are indeed asking whether the two tasks should be assigned to one agent or to two separate agents.