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Public procurement in times of crisis: The bundling decision reconsidered☆

Patrick W. Schmitz*

University of Cologne, Germany
CEPR, London, UK

HIGHLIGHTS

- The government wants two tasks to be performed.
- In each task, unobservable effort can be exerted by a wealth-constrained private contractor.
- If the government faces no binding budget constraints, it is optimal to bundle the tasks.
- If the government has only a limited budget, it may be optimal to separate the tasks.
- High efforts in both tasks can then be implemented with smaller bonus payments.

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ABSTRACT

The government wants two tasks to be performed. In each task, unobservable effort can be exerted by a wealth-constrained private contractor. If the government faces no binding budget constraints, it is optimal to bundle the tasks. The contractor in charge of both tasks then gets a bonus payment if and only if both tasks are successful. Yet, if the government has only a limited budget, it may be optimal to separate the tasks, so that there are two contractors each in charge of one task. In this case, high efforts in both tasks can be implemented with smaller bonus payments.

1. Introduction

An important question in public procurement is whether the government should bundle different tasks together and let one private contractor be responsible for these tasks, or whether the government should contract with different private parties each in charge of only one task.[1] The present paper reconsiders the bundling decision in a model where the principal (i.e., the government) has only a limited budget. In an influential paper, Hart (2003) has argued that financing issues may be secondary in the context of public–private partnerships, since the government has "enormous powers of taxation" (Hart, 2003, p. C75). Yet, in times of financial crises, governments may well face binding budget constraints. The purpose of the present study is to explore

* Correspondence to: Department of Economics, University of Cologne, Albertus-Magnus-Platz, 50923 Köln, Germany. Tel.: +49 221 4705609; fax: +49 221 4705077.
E-mail address: patrick.schmitz@uni-koeln.de.

[1] For discussions of bundling in public procurement, see e.g. Hart (2003), Bennett and Iossa (2006), Chen and Chiu (2010), Iossa and Martimort (2012), and De Brux and Desrieux (forthcoming).

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the implications of such constraints on the optimal bundling decision.[2]

In the principal–agent literature, many authors have studied moral hazard problems in which the agent is risk neutral but wealth constrained, such that a "limited liability rent" must be paid to motivate an agent to exert high effort (see Laffont and Martimort, 2002). In most papers, only the agent is wealth constrained, while the principal faces no (binding) wealth constraints.[3] When in such a framework two technologically independent tasks have to be performed, bundling these tasks may reduce the limited liability rent that the principal has to pay in order to induce high efforts. If one agent is in charge of both tasks, the principal must pay a bonus only if both tasks are successful. In contrast, if two different agents are each in charge of one task, then the principal must also pay a bonus if only one agent is successful.[4]

Yet, if the principal has only a limited budget which she can use for making payments to the agent(s), then she may be better off when she does *not* bundle the tasks. The intuition for this novel finding is as follows. If one agent is in charge of both tasks, the payment that the principal has to make if both tasks are successful may be so large that the principal cannot afford to induce the agent to exert high efforts in both tasks. In contrast, if there are two agents each in charge of one task, the principal can induce both agents to exert high efforts, since now the payments can be smaller, as they are also paid when only one task is successful.

2. The model

Consider a principal (a government agency) who wants two tasks to be performed in order to improve the provision of public goods. In each task $i \in \{1, 2\}$, unobservable effort $e_i \in \{e_l, e_h\}$ can be exerted, where $0 < e_l < \frac{1}{2} < e_h < 1$. Effort in task i leads to a success ($y_i = 1$) with probability e_i and to a failure ($y_i = 0$) otherwise. A success in task i yields a non-monetary benefit b to the principal, capturing the improved quality of public good provision. A failure yields no benefit to the principal. The outcome y_i of each task is verifiable.

The principal can either decide to have one agent in charge of both tasks (*bundling*), or to have two different agents in charge of the two different tasks (*separation*). An agent's effort costs in a task i are given by $\psi > 0$ if high effort is chosen and by 0 if low effort is chosen. Note that the two tasks are technologically unrelated. All parties are risk neutral and the reservation utilities are given by zero. Moreover, we assume that the agents have no wealth and are protected by limited liability; i.e., payments to the agents must be non-negative.

If the principal decides to bundle the tasks, then a contract is given by $(w_{11}, w_{10}, w_{01}, w_{00})$, where $w_{y_1y_2}$ denotes the payment from the principal to the agent given the outcomes y_1 of task 1 and y_2 of task 2. Analogously, if the principal hires agent A to perform task 1 and agent B to perform task 2, the contracts are given by $(w^A_{11}, w^A_{10}, w^A_{01}, w^A_{00})$ for agent A and $(w^B_{11}, w^B_{10}, w^B_{01}, w^B_{00})$ for agent B.

Finally, our key assumption is that also the principal has limited resources. This assumption distinguishes the present paper from previous studies on public procurement contracting with limited liability.[5] Specifically, the payment to the agent in the case of bundling and the sum of the payments that the principal makes to the agents in the case of separation must not be larger than the principal's budget W.

Throughout, we suppose that the principal's benefit b is sufficiently large to make high effort attractive for the principal to implement even in a second-best world in which effort is unobservable.[6]

Assumption 1. $b > e_h\psi/(e_h - e_l)^2$.

3. Bundling

Let us first suppose the principal contracts with only one agent to perform both tasks. The agent's expected payoff when he exerts high effort in both tasks is given by

$$u_{hh} = e_h^2 w_{11} + e_h(1 - e_h)(w_{10} + w_{01}) + (1 - e_h)^2 w_{00} - 2\psi.$$

When the agent exerts high effort in task 1 and low effort in task 2, his expected payoff is

$$u_{hl} = e_h e_l w_{11} + e_h(1 - e_l)w_{10} + (1 - e_h)e_l w_{01} + (1 - e_h)(1 - e_l)w_{00} - \psi.$$

Analogously, when the agent chooses low effort in task 1 and high effort in task 2, his expected payoff is

$$u_{lh} = e_l e_h w_{11} + (1 - e_l)e_h w_{01} + e_l(1 - e_h)w_{10} + (1 - e_l)(1 - e_h)w_{00} - \psi.$$

Finally, when the agent chooses low effort in both tasks, his expected payoff is given by

$$u_{ll} = e_l^2 w_{11} + e_l(1 - e_l)(w_{10} + w_{01}) + (1 - e_l)^2 w_{00}.$$

High effort in both tasks can be implemented if it is possible to simultaneously satisfy the incentive compatibility constraints $u_{hh} \geq u_{hl}, u_{hh} \geq u_{lh}, u_{hh} \geq u_{ll}$ and the constraints that the payments must be non-negative and smaller than the budget W.[7] The principal's expected payoff when high effort in both tasks is implemented is given by

$$2e_h b - e_h^2 w_{11} - e_h(1 - e_h)(w_{10} + w_{01}) - (1 - e_h)^2 w_{00}.$$

It is straightforward to see that it is optimal for the principal to set $w_{00} = 0$ and $w_{10} = w_{01} =: w_1$. The incentive compatibility constraints $u_{hh} \geq u_{hl}$ and $u_{hh} \geq u_{lh}$ can thus be written as

$$w_{11} \geq C_l(w_1) := \frac{\psi}{e_h(e_h - e_l)} + \frac{2e_h - 1}{e_h} w_1$$

and the incentive compatibility constraint $u_{hh} \geq u_{ll}$ can be written as

$$w_{11} \geq C_{ll}(w_1) := \frac{2\psi}{e_h^2 - e_l^2} - 2\frac{1 - e_h - e_l}{e_h + e_l} w_1.$$

Lemma 1. *Suppose that the two tasks are bundled and the principal wants to implement high effort in both tasks.*

[2] In a model encompassing agency problems and property rights, Martimort and Pouyet (2008) find that the question of whether tasks are bundled may be more important than the ownership structure. For discussions of public versus private ownership in incomplete contracting frameworks, see Hart et al. (1997) and Hoppe and Schmitz (2010).

[3] See Innes (1990) for an exception. Yet, Innes (1990) does not analyze bundling of tasks.

[4] See e.g. Bolton and Dewatripont (2005, Section 6.2.2), when their parameter γ is zero. For experimental evidence, see the "no conflict" treatments in Hoppe and Kusterer (2011).

[5] See e.g. Martimort and Straub (2012) and Hoppe and Schmitz (2013).

[6] The expected total surplus is $2(e_h b - \psi)$ if high effort is exerted in both tasks, $(e_h + e_l)b - \psi$ if high effort is exerted in only one task, and $2e_l b$ if low effort is exerted in both tasks. Thus, in a first-best world, high effort in both tasks would be chosen whenever $b \geq \psi/(e_h - e_l)$, while low effort in both tasks would be chosen otherwise. Yet, it will become clear in Section 4 that in the second-best world under separation the principal would never implement high effort if $b < e_h\psi/(e_h - e_l)^2$. Hence, if Assumption 1 is violated, separation cannot be strictly better than bundling.

[7] Throughout, participation constraints are redundant, as they are implied by incentive compatibility and non-negativity of the payments.