Contracting Out Public Service Provision to Non-for-profit Firms*

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Abstract

We analyze the contracting out of public service provision to private firms and compare the performance of for-profit and not-for-profit firms. We consider two alternative settings. In the first, the firm has control rights, as under the UK's Private Finance Initiative (PFI). In the second, the government retains control rights, as under traditional procurement.

The main insights of the paper can be summarized as follows. First, even when an NP cares more than an FP does about social benefits, it does not follows that provision by an NP yields the higher social benefits. This is because the non-distribution constraint in of an NP may work against its incentives to invest. Second, the new procurement strategy of PFI increases the desirability of NP provision, relative to traditional procurement. Third, a crucial role in determing the desirabiliy of NP provision is played by the correlation between the effect of investment on social benefit and profit and the nature of the firm's investment.

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1 Introduction

Recent years have witnessed a dramatic change in the way many public services are provided. In the UK, under the Private Finance Initiative (PFI), it has become common for the government to contract out the provision of public services to a consortium of private firms, that designs, finances, builds and manages the facilities concerned (HM Treasury, 2003). In Canada, such public-private partnerships have been used for major infrastructure projects, such as the 407 Express Toll Route to the north of Toronto and the redevelopment of Pearson International Airport (Daniels and Trebilcock, 2000), while in the US, in much of the European Union and in developing economies there has been increasing use of similar schemes (Linder and Rosenau, 2000).

This approach contrasts sharply with the way public services have traditionally been procured. Under traditional procurement (TP), the government specifies the inputs and retains control rights over the way the service ought to be delivered. Instead, under PFI, the government specifies the output -i.e., a basic service standard - but it is the firm that has control rights over how to deliver the service. Additionally, although not-for-profit firms (NPs) have long been established in health and education, their extension to other sectors has been debated extensively and has recently taken place in a number of well-publicized cases (see Bennett *et al.,* 2003; IPPR 2003, and Weisbrod 1997). An important recent example in the UK is the responsibility for rail track facilities that the government has given to the NP, Network Rail. Other examples are Glas Cymru, an NP created on a private initiative in April 2000 as holding company for the assets of Dwr Cymru, the Welsh water utility, and NAV Canada, an NP air traffic control.

In this paper we analyze the contracting out of service provision to private firms, and we compare the case when the contrcator is an NP to that in which

it is a for-profit firm (FP). We consider each of these cases under two different institutional arrangements. The first is PFI, under which the firm has control rights over the project; the second is TP, where the government retains control rights. We take an incomplete-contract approach (see, e.g., Hart, 1995), building on the seminal work on public service provision by Hart, Shleifer and Vishny (1997), and we assume that the firm in charge may make an observable but unverifiable investment, researching innovative approaches to perform its task in excess of the basic standard specified in the initial contract. In most of the paper we assume that the investment is non-monetary. Also, we assume that an innovation, if implemented, has an effect both on the social benefit that is generated by the production of the public service and on the firm's profit. Control rights (i.e., ownership of the project) give the power to veto the implementation of any given innovation.

In our model, an NP and an FP each have a utility function that is a linear combination of social benefit, profit and the disutility of effort in researching innovative approaches to provide the public service. However, the NP operates under a non-distribution constraint (NDC), which bans it from redistributing profit to its members. Hence, the value attached to profit is lower for an NP than for an FP; profits are valuable only insofar as they permit consumption of perquisites and the building up of precautionary financial reserves.[1] Furthermore, we allow for the possibility that, because of the participation of users and stakeholders on its Board of Trustees, an NP cares more than an FP does about the social benefits generated by the provision of the public service.

We compare the investment incentives of an FP and an NP under different institutional arrangements and apply our insights to real world examples. We consider three alternative scenarios. In the first one, labelled '*No conflict,*'

[1] A similar approach is followed by Glaeser and Shleifer (2001).

implementation of an investment increases both profit and social benefit. This is the case, for example, of investment in asset quality (e.g., of a hospital or a school building) that generates both lower maintenance costs and greater social benefit from the use of the asset for public service provision (e.g., fewer disruptions in the provision of educational services and a better healing environment in the provision of health services). In contrast, the second and the third scenarios are characterized by a conflict between social benefit and profit. In the second one, labelled '*Conflict of type 1*', this occurs because investments that increase social benefits are costly and unprofitable. An example is investment in safety by a single supplier when demand is rigid (e.g., air traffic control). In the third one, labelled '*Conflict of type 2*', it is because investments that increase profits have an adverse impact on social benefits. Examples are investments in cost-cutting activities that compromise safety and in the use of cheap building materials for nursing homes. We show that the appropriate instituional arrangement depends on which scenario obtains.

We start by comparing an NP and an FP under the assumption that they care equally about social benefits; the difference in their utility functions results simply from the presence of a NDC for the NP. Our results can be summarized as follows. Under TP, the government's approval is needed for implementation of an innovation, and this leads to bargaining between the firm and the government. The effects of the investments on social benefits and profits are then shared according to the bargaining power of the players, as well as the weights attached to social benefit and profit in the firms' utility functions. By not caring as much as an FP does about profits, and thus not caring so much about the monetary transfer to or from the government following negotiations over implementation, an NP does worse than an FP does in bargaining with the government. This results in an NP internalizing less than an FP does the effect

of its innovation on both social benefits and profit, and so always investing less than an FP. Thus, under TP, it is only if innovation reduces social benefits (i.e., there is Conflict of type 2) that NP provision may be preferable to provision by an FP.

Under PFI, however, there is more scope for NP-provision. Since the firm has control rights, the weights attached to social benefits and profit in the firm's utility function uniquely determine its incentives to invest (no bargaining with the government takes place) because the firm can implement any innovation without consultation. Due to the NDC, an NP internalizes less than an FP does the effect of its innovation on profits; and it invests more than an FP does if investment has a negative impact on profit (as under *Conflict of type 1*). Oherwise (as under *No conflict* or *Conflict of type 1*) an FP invests more.

The above considerations imply that when the only difference between an NP and an FP lies in the existence of an NDC for the NP (and not with differences in care for social benefits) the following occurs. Under *No conflict*, an FP invests more than an NP, and thus generates both higher profit and greater social benefits. In this case FP provision under PFI will lead to a higher investment than under TP if the effect of investment on profits is sufficiently higher than that on social benefits or if the bargaining power of the firm is small.

If instead there exists a conflict between social benefits and profit, NP provision may be desirable either because it yields the highest investment and/or because it helps to safeguard social benefits. An NP under PFI may invest more than an FP and yield greater social benefit when there is *Conflict of type 1.* However, in this scenario TP with an FP will be optimal if the bargaining power of the firm is sufficiently high. Instead, when there is *Conflict of type 2,* NP provision under TP will be always desirable because it safeguards social

benefits; in this case PFI with an FP leads to the highest level of investment and thus to the lowest level of social benefits.

We also discuss how the above results change when it is assumed that an NP cares more about social benefits than an FP does. In this case NP provision may also be desirable under *No conflict*. In particular, when investments increase both social and private benefits, but the social-benefit effect dominates, either TP with an FP, or NP under either PFI or TP, gives the greatest investment incentives. TP with an FP does this through bargaining with the government, whilst NP provision does it through the greater concern of an NP for social benefits.

Finally, we relax the assumption that investment in researching innovative approaches is non-monetary and discuss briefly how this affects the results. When an investment is monetary, whether an FP invests more than an NP depends only on whether innovation increases or decreases social benefits. Furthermore, social benefits are always greater with an NP than an FP.

The theoretical literature on the provision of public services is expanding rapidly. In particular, Hart, Shleifer and Vishny (1997), Schmitz (2000), and King and Pitchford (2001) compare public provision with contracting out to an FP. Also, for FPs, the optimality of bundling building and managing operations in PFI projects is discussed by Bennett and Iossa (2004) and Hart (2002) under incomplete contracts and by Bentz, Grout and Halonen (2001) under complete contracts.[2] All these papers restrict attention to public service provision by FPs.

There is also an extensive literature on NPs, though, for many years, its main focus was on the relationship between the firm and its donors (see Rose-Ackerman, 1996, and Weisbrod, 1998). However, a related branch of the litera-

[2] Bundling in incomplete-contract model is also analyzed by Bös and De Fraja (2002) for the case of health care, for which quality is unverifiable. Schmidtz (2000) extends the hart-Shleifer-Vishny framework to the case of joint ownership.

ture considers NPs that do not rely on donations, but maintain an NP aim (see Hansmann, 1980, 1996). A recent formulation by Glaeser and Shleifer (2001) examines why an entrepreneur setting up a firm might prefer to make it an NP. In their model, as in ours, an NP generates perquisites for an entrepreneur that are not as valuable as income, so that, relative to a FP, the NP has weaker profit incentives. Closer to our work is that of Besley and Ghatak (2001). In their model, as in ours, a critical role is played by the service provider's valuation of social benefit. They show that control rights should be left with the party that values services more highly, thus indicating a role for 'benevolent' NPs. However, contrary to us, they do not consider the effect of the NDC; nor do they discuss the role played by the correlation between the effects of investment on social benefits and profit.

The paper is organized as follows. Section 2 outlines the model, while Section 3 discusses and compares investment incentives under TP an PFI, when the only difference between FPs and NPs is due to the NDC. Section 4 extends our results to the case where an NP cares more than an FP about social benefits. Section 5 discusses briefly the case where investment in researching innovative approaches is monetary. Section 6 concludes.

2 The Model

We consider a setting where initially, the government and the firm agree a contract that specifies observable and verifiable basic standards for the provision of a public service. However, before operations begin, the firm may make an observable but unverifiable investment, researching innovative approaches to performing its task in excess of the basic standard. We denote by $x \geq 0$ the level and cost, in terms of disutility of effort, of the investment made. Innovation cannot be contracted upon *ex ante*, for it is not possible to specify in advance the

delivery of a specific innovation. We assume that an innovation, if implemented, affects both profit and the social benefit generated by the provision of the public service. When the implementation of an innovation requires the approval of the government, as under TP, we assume that there is generalized Nash bargaining between the firm (the NP or the FP) and the government, and we denote by γ the bargaining power of the firm. For simplicity we assume that γ does not depend on the firm's type; results can be easily be generalized.

In our solutions innovations $\{x\}$ is implemented, and so we economize on notation by writing social benefit and profit as functions of $\{x\}$.

The social benefit generated by the provision of the public service is

$$B_0 + B\left(x\right),$$

where B_0 is a positive constant. We consider two cases. In the first, x increases social benefits and we assume that $B_x > 0$; $B_{xx} \leq 0$; $B(0) = 0; B_x(0) = \infty$; and $B_x(\infty) = 0$. In the second, x decreases social benefits and we assume that $B_x < 0$; $B_{xx} \geq 0$; $B(0) = \infty; B_x(0) = 0$; and $B_x(\infty) = 0$.

The profit at generated by the provision of the public service is

$$\pi_0 + \pi\left(x\right),$$

where π_0 is a positive constant, and $\pi\left(x\right)$ is the net sum of the revenues and cost from implementing the innovation. We consider two extreme cases. In the first, x increases profits and we assume that $\pi_x > 0$; $\pi_{xx} \leq 0$; $\pi(0) = 0; \pi_x(0) = \infty$; and $\pi_x(\infty) = 0$. In the second, x decreases profits and we assume that $\pi_x < 0$; $\pi_{xx} \geq 0$; $\pi(0) = \infty; \pi_x(0) = 0$; and $\pi_x(\infty) = 0$. In practice it is likely that implementation of x would have an impact on profits that varies with the level of x. Introduction of this complication has limited impact on our qualitative results and so, for simplicity, we rule it out.

We assume that $B(x)$, $\pi(x)$ are observable but unverifiable, and we let x also denote the unverifiable cost, in terms of disutility of effort, of the investment made in researching innovative approaches.

Assumption 1. $B_x + \pi_x > 0$

Assumption 1 allows us to restrict our attention to cases where there are gains from implementing the innovation, and to focus on three different types of scenarios:[3]

- NO CONFLICT SCENARIO: *Benefit- and profit-enhancing innovations, where* $B_x, \pi_x > 0$.
- CONFLICT OF TYPE 1 SCENARIO: *Costly benefit-enhancing innovations, where* $B_x > 0 > \pi_x$.
- CONFLICT OF TYPE 2 SCENARIO: *Profitable benefit-reducing innovations, where* $\pi_x > 0 > B_x$.

We compare two institutional arrangements: TP and PFI. In the former, the government has control rights over the project. In the latter, the firm has control rights. In each of these two arrangements, the firm can be either a for-profit (FP) or a not-for profit (NP); we use subscript $j = F, N$ to denote the firm's type. We assume that both types of firm maximize a linear combination of social benefits, profit and disutility of effort, and consider both the case where the weight on social benefits is the same for each type of firm and the case where a higher weight is attached to social benefits by the NP than by the FP. Firms involved in public service provision may care about social benefits for reputational purposes; NP firms may also care about social benefits because of the presence of users on the Board of Trustees, making social benefits a

[3]Examples of these scenarios are discussed in Section 3.

part of their mission. Furthermore, we assume that the NP is affected by a non-distribution constraint (NDC), which bans redistribution of profits to the firm's members. As highlighted, for example, in Glaeser and Shleifer (2001), this results in an NP valuing \$1 of profits less than a FP does.

Formally, the utility function of firm j is given by

$$\Omega^j = \alpha^j B(x) + \delta^j [\pi(x) + z] - x, \quad 0 < \alpha^j < 1, \tag{1}$$
$$\alpha^N > \alpha^F; \delta^F = 1, \delta^N < 1$$

where z is the monetary transfer received from the government, with $z \gtreqless 0$, and where $\delta^N < 1$ captures the effect of the NDC. We refer to $1 - \delta^N$ as to the 'power' of the NDC.

The timing of the game is as follows. In period 0, the government chooses FP or NP and PFI or TP, and specifies the basic standards of service provision. In period 1, the firm in charge undertakes investment x researching improved methods for performing its task in excess of the basic standards. Then, if the government has control rights (TP), and there are gains from innovation, bargaining between the firm and the government takes place. If instead the firm has control rights (PFI), it implements the innovation straightaway if it wishes.

3 Investments under alternative regimes: the role of the NDC

In this section we focus our attention on the role played by the NDC. To this purpose we let $\alpha^N = \alpha^F > 0$.

3.1 Traditional procurement

Suppose that the government has control rights, as under TP. Then, innovations cannot be implemented without the government's approval. However,

whenever there are positive gains from implementation, it is reasonable to expect bargaining between the firm and the government to occur. We assume throughout that the firm and the government engage in Nash Bargaining; we let γ denote the bargaining power of the firm and s^j the monetary transfer from the government to the firm.[4] Then s^j solves

$$s^j \equiv \arg\max_{z_i} \left[\alpha B() + \delta^j \left(\pi() + z_i\right)\right]^{\gamma} \left[B() - z_i\right]^{1-\gamma},$$

yielding

$$\delta^j s^j = \gamma \delta^j B(.) - (1-\gamma)\left(\alpha B(.) + \delta^j \pi()\right), \tag{2}$$

that is,

$$s^j = \gamma B(.) - (1-\gamma)\left(\frac{\alpha}{\delta^j} B(.) + \pi()\right)$$

Substituting for s^j in (1), the firm's ex ante utility becomes

$$\gamma \alpha B(.) + \gamma \delta^j \left(B(.) + \pi(.)\right) - x$$

Therefore, the firm chooses the investment level given by

$$\gamma \alpha B_x(x^j_{TP}) + \gamma \delta^j \left(B_x(x^j_{TP}) + \pi_x(x^j_{TP})\right) = 1 \qquad j = F, N \tag{3}$$

Lemma 1 *Under TP, an FP always invests more than an NP. Furthermore, the higher the power of the NDC, the lower the investment level of an NP.*

Lemma 1 follows from the fact that the NDC makes an NP softer in the negotiation with the government, and the more so the higher the power of the NDC. Indeed, from (2), the 'value' to a firm, $\delta^j s^j$, of the monetary transfer s^j that the firm receives from government depends on δ^j. In bargaining with government, the firm appropriates a share $\delta^j \gamma$ of the benefits $B(.)$ that its

[4]We acknowledge that the bargaining power of an NP does not have to be the same as that of an FP. Our assumption of equal bargaining power is made for simplicity, and results can easily be extended to cover the more general case.

innovation brings to government, and gives up a share $1-\gamma$ of the total (private and social) benefits, $\alpha B(.)+\delta^j \pi()$, that the innovation brings to itself. There are two implications. First, an NP receives a lower compensation for any positive effects on social benefits that its innovation brings, and it compensates the government less for any reduction in social benefits following its innovative activities. Second, an NP obtains a greater (smaller) share of the profit and social-benefits gain (loss) that the innovation brings.

Consequently, compared to an FP, an NP internalizes less of the effect of its investment on both profits and social benefits, because it cares less about profits than an FP and because it bargains less strongly with the government than an FP does. In the light of (A1), this implies that an FP invests more than an NP.[5]

An immediate consequence of Lemma 1 relates to the effect of the type of firms on expected social benefits.

Corollary 1 *Under TP, in the presence of No conflict or of Conflict of type 1, social benefits are greater with an FP than with an NP. Instead, in the presence of Conflict of Type 2, social benefits are greater with an NP tha with a FP.*

Corollary 1 suggests that, under TP, FP yields the greater level of social benefits whenever $B_x(.) > 0$. Thus, somewhat counter-intuitively, in situations where an NP and an FP care equally for social benefits, an FP may provide higher social benefits than an NP, because of the effect that the NDC on the ability of an NPs to negotiate successfully with the government.

[5]If we relaxed (A1), it would be easy to show that under No Conflict or under Conflict of type 2, the result of Lemma 1 would still hold. However, under Conflict of Type 1, the lower concern for profits by an NP may compensate for the lower concern for social benefits that comes from a worse bargaining outcome with G, thereby resulting in higher incentives to invest compared to an FP. In this case, by differentiating (3), it is easy to show that x^j_{TP} is increasing in δ^I if $B(x^j_{TP}) + \pi(x^j_{TP}) > 0$.

3.2 PFI

Suppose, as under PFI, that the firm has control rights over the project. Given (1), it follows that, assuming an interior solution, the firm choices of investment solves

$$\alpha B_x(x^j_{PFI}) + \delta^j \pi_x(x^j_{PFI}) = 1 \quad j = N, F. \tag{4}$$

The following Lemma therefore obtains.

Lemma 2 *Under PFI, if investment increases profits ($\pi_x > 0$), an FP invests more than an NP, and the more so the higher the power of the NDC. Instead, if investment decreases profits ($\pi_x < 0$) an NP invests more than an FP, and the more so the higher the power of the NDC.*

The intuition behind Lemma 2 is straightforward. Under PFI, the firm is residual claimant for its investment since it has control rights, and no bargaining with the government occurs. Since, compared to an FP, an NP cares less about profits because of the NDC, it will invest more than an FP if the effect of its investment on profits is positive, and less otherwise.

The corollary below derives the implications of Lemma 2 on the effect that the type of firm has on expected social benefits.

Corollary 2 *Under PFI, social benefits are higher with an FP than with an NP only if there is No Conflict. In the presence of Conflict of type 1 or 2, social benefits are higher with an NP than with a FP.*

Corollary 2 suggests that social benefits are higher with an FP only if both social benefits and profit increase with investment. If, instead, social benefits and profit are in conflict, social benefits are higher with an NP. A comparison of Corollaries 1 and 2 suggests that the introduction of PFI has created additional scope for NP, provision as a means to enhance social benefits.

3.3 Comparisons

In this section we use the above results to compare investments under TP and PFI for each type of firm and across firms. From (3) and (4), we obtain our first proposition.

Proposition 1 *In the presence of No Conflict or of Conflict of Type 1, the j-the firm* $(j = F, N)$ *invests more under PFI than under TP if its bargaining power is sufficiently low and/or the effect of investment on social benefit is sufficiently low, and vice versa. In particular,* $x^j_{PFI} \gtreqless x^j_{TP}$ *for* $\gamma \lesseqgtr 1/\left[1 + \delta^j B_x(x^j_{PFI})\right]$. *In the presence of Conflict of Type 2, investments are higher under PFI.*

Under PFI, the weights attached to profit and social benefits in a firm's payoff function uniquely determine its incentives to invest. This is because, having control rights, the firm can implement any innovation without negotiation. Under TP, however, the government's approval is needed for implementation, which leads to bargaining between the firm and the government. As discussed in Section 3.1, in bargaining with the government the firm gives up a fraction $1-\gamma$ of its total gain$\big(\alpha B(.) + \delta^j \pi(.)\big)$, but obtains a fraction $\gamma\delta^j$ of the benefits $B(.)$ that innovation brings to the government. It follows that if the bargaining power of the firm is sufficiently low, or if the social-benefits effect is low, the firm invests more under PFI, and vice versa.

The next proposition compares all the different arrangements.

Proposition 2 *(i) In the presence of No Conflict, investment is higher with an FP than with an NP. Furthermore, for an FP, investment is higher under PFI than under TP according to the condition in Proposition 1 for* $x^F_{PFI} > x^F_{TP}$, *and vice versa.*

(ii) In the presence of Conflict of type 1 investment is highest under either TP-FP or PFI-NP; $x^F_{TP} \gtreqless x^N_{PFI}$ *as* $(\gamma(1+\alpha) - \alpha)\, B_x(x^N_{PFI}) + \gamma - \delta^N \gtreqless 0$; *thus,*

$x^F_{TP} > (<)\ x^N_{PFI}$ *if* γ *is high (low).*

(iii) In the presence of Conflict of type 2, investment is highest under PFI-FP.

Proposition 2 looks at investment levels across the different institutional arrangements. However, another important consideration for determining the desirability of one institutional arrangement over another is related to the effect each of them produce on the level of social benefit. This insight is easily derived from Proposition 2 and is stated in the corollary below.

Corollary 3 *(i) In the presence of No Conflict, social benefits are higher with an FP, and will be higher for an FP under PFI, rather than under TP, according to the condition in Proposition 1 for* $x^F_{PFI} > x^F_{TP}$.

(ii) In the presence of Conflict of type 1, social benefits are maximized under either TP-FP or PFI-NP. In particular, benefits will be higher under TP-FP if γ *is high, and vice versa if* γ *is low:* $B\left(x^F_{TP}\right) \gtreqless B\left(x^N_{PFI}\right)$ *as* $\left(\gamma(1+\alpha)-\alpha\right) B_x(x^N_{PFI}) + \gamma - \delta^N \gtreqless 0$.

(iii) In the presence of Conflict of type 2, social benefits are higher under TP with an NP than with an FP.

In the light of Propositions 1 and 2 and Corollary 3, we shall now discuss some examples, applying our results to highlight circumstances where one institutional arrangement is preferable to another.

Case 1 *NO CONFLICT:* $B_x(.), \pi_x(.) > 0$

Investment in building quality can raise both social benefits and reduce maintenance costs. For example, school buildings with less frequent need for repairs reduce disruptions and help to create a good learning environment; higher-quality hospital buildings also reduce disruptions and generate better healing environments. Another example of the *No conflict scenario* is given by

free-standing projects with elestic demand, such as leisure centres and nursing homes, where users are charged a fee and where higher quality of service can raise total revenues and profits.

In these cases, Lemmas 1 and 2 suggest that an FP will always invest more than an NP, under both PFI and TP. However, whether PFI-FP leads to a higher investment than TP-FP depends on the relative importance of this investment on social benefits and profits, as well as on the bargaining power of the firm. From Proposition 1, if the social-benefits effect is large enough or if the bargaining power of the firm is high enough, TP-PFI leads to the higher investment.

Case 2 *CONFLICT OF TYPE 1:* $B_x(.) > 0 > \pi_x(.)$

Investment in building quality that raises social benefits can also result in lower profits, because a better design may be expensive to implement. Furthermore, in conventional PFI projects the government is the purchaser of the service and lack of competition, together with rigid demand, make an increase in the quality of service unprofitable.

In these cases, from Proposition 2, the highest investment and level of social benefits will be achieved under PFI-NP if the social-benefits effect is low, the bargaining power of the firm is low and the power of the NDC is high. In the opposite case, the highest investment is achieved under TP-FP. In no case is PFI with an FP desirable, and it is interesting to note that the NHS Confederation in the UK recently reported that PFI hospitals designed and built by FPs often failed to create a good healing environment with less noise and more daylight.[6]

Case 3 *CONFLICT OF TYPE 2:* $\pi_x(.) > 0 > B_x(.)$

[6]See *PublicPrivateFinance*, 85, July/August 2004.

Investment that decrease costs, often come at the expense of lower benefits. Another case of *Conflict of Type 2* is investment in safety in the absence of competition (and therefore when higher safety standards do not translate into higher profits). Typical examples include railways maintenance and air traffic control. In these cases (from Lemma 1 and 2) an FP always invests more than an NP. Moreover the highest investment is achieved under FP-PFI (from Proposition 1) and it is also under FP-PFI that social benefits are at their lowest (Corollary 3). To safeguard social benefits public service provision by an NP under TP is most desirable.

4 Difference in care for social benefits

Until now we have assumed that firms care in exactly the same way about benefits. However, an NP is characterized by the presence of users on the Board of Trustees and so it is reasonable to think that they may show a greater concern than an FP does for the social benefits generated by the public service that is provided. Therefore, in this section we assume that $\alpha^N > \alpha^F$, and in order to focus on the effect of differences in the care for benefits, we assume away the presence of an NDC in NPs. Thus we let $\delta^N = 1$, throughout.

Equations (4) and (5) become, respectively,

$$\gamma\alpha^j B_x(x^j_{TP}) + \gamma\left(B_x(x^j_{TP}) + \pi_x(x^j_{TP})\right) = 1 \tag{5}$$

$$\alpha^j B_x(x^j_{PFI}) + \pi_x(x^j_{PFI}) = 1 \tag{6}$$

Under PFI, whether an NP invests more than an FP depends now on the social-benefits effect. In particular, the greater is $B_x(x)$, the greater the incentives to invest of an NP compared to an FP.

Proposition 3 *Let* $\widetilde{B} \equiv (1-\gamma)/\gamma$ *and* $\delta^N = 1$. *Then the institutional arrange-*

ment that leads to the highest investment is

$$TP - NP \text{ if } B_x(x^N_{PFI}) \geq \widetilde{B} \text{ or } \gamma \geq 1/[1 + B_x(x^N_{PFI})];$$
$$PFI - NP \text{ if } B_x(x^N_{PFI}) \in [0, \widetilde{B}) \text{ or } \gamma < 1/[1 + B_x(x^N_{PFI})];$$
$$PFI - FP \text{ if } B_x < 0.$$

The highest level of social benefits is always achieved with an NP, and in particular it is achieved under

$$TP - NP \text{ if } B_x(x^N_{PFI}) \geq \widetilde{B};$$
$$PFI - NP \text{ if } B_x(x^N_{PFI}) \in [0, \widetilde{B});$$
$$TP - NP \text{ if } B_x < 0.$$

Not surprisingly, once we assume away the effect of the NDC on investment, under both TP and PFI an NP always generates greater social benefits than an FP. NPs will also lead to the highest investment under *No conflict* and *Conflict of type 1* where investment has a positive effect on social benefits. Under *Conflict of type 2*, the greater concern for benefits by NPs induces them to restrict investments. FPs invest more and since bargaining with government under TP induces the firm to internalize further the negative effect of investment on social benefits, it is PFI-FP the institution that maximizes investments.

When we let $\delta^N < 1$, a full taxonomy of all possible cases leads to less clear-cut results. However, Propositions 2 and 3 suggest that which institutional arrangement will lead to the highest investments and social benefits depends on the distribution of the bargaining power between the firm (FP or NP) and the government, the weight attached by the a firm to social benefits (α^F, α^N), the power of the NDC $(1 - \delta^N)$, and the relative effects of the investments on marginal social and private benefits (e.g., $B_x()$ versus $\pi_x()$).

In particular, we have seen from Proposition 2 that, when there is no conflict between social benefits and profit, investments are highest with an FP. However, when a difference in care for social benefits is introduced, and if the social-benefits effect is high, Proposition 3 suggests that an NP may invest more

than an FP. Combining Propositions 2 and 3, we deduce that when the social-benefits effect dominates, either TP with an FP, or an NP with either PFI or TP, leads to the greatest investment incentives. TP with an FP does this through bargaining with the government, whilst NP provision does it through the greater concern for social benefits of NPs compared to FPs.

When there is Conflict of type 1, a greater difference in the care for social benefits will still favour an NP, although an FP under TP may still invest more than an NP if its bargaining skills are such that it appropriates a large proportion of the social-benefits effect.

In the case of Conflict of type 2, there is no ambiguity. From both Propositions 2 and 3 we observe that PFI-FP will lead to the highest investment, though to the lowest level of social benefits. Social benefits are best safeguarded by NP provision under TP.

5 Monetary investment

Until now we have assumed that the investment in researching innovations is non-monetary. Thus, x is primarily a human-capital type of investment. As we briefly show in this section, results change dramatically when this assumption is relaxed so as to consider the possibility that reseach instead requires a physical capital investment. In this case the payoff function of the firm becomes

$$\Omega^j = \alpha^j B(x) + \delta^j \left[\pi(x) + z - x\right], \quad 0 < \alpha^j < 1,$$
$$\alpha^N > \alpha^F; \delta^F = 1, \delta^N < 1.$$

Note, that the cost , x,of innovation has now a weight of δ^N in the NP's utility function. This is because, other things equal, incurring this cost reduces profits and for an NP, but, because of the NDC, a \$1 reduction in profits reduces its utility only by only $\$\delta^N$.

To emphasize the effect of the monetary nature of investment in innovative approaches, we return to the assumption that an NP and an FP care equally about social benefits; that is $\alpha^N = \alpha^F$. In this case the level of investments under TP and PFI solve, respectively,

$$\gamma\alpha B_x(x^j_{TP}) + \gamma\delta^j \left(B_x(x^j_{TP}) + \pi_x(x^j_{TP}) - 1\right) = 0, \qquad j = N, F; \tag{7}$$

$$\alpha B_x(x) + \delta^j \left(\pi_x(x) - 1\right) = 0 \quad j = N, F. \tag{8}$$

From these two expressions we obtain the following proposition.

Proposition 4 *When investment in researching innovations is monetary, the following occurs. (i) Under both TP and NP, investment is higher (lower) by an NP than by a FP if* $B_x > (<)\ 0$. *(ii) If* $B_x(x) > 0$, *investment is highest with an NP under TP. If* $B_x(x) < 0$, *investment is highest with an FP under PFI.*

Point (i) in Proposition 4 can be explained as follows. When the cost of investment is monetary the NDC no longer works against incentives to invest, for the NP gains from weighting this cost less than an FP does. In this case, the presence of the NDC only affects the incentives of the NP to invest insofar as it results in a greater relative weight attached to social benefits. This explains why an NP invest more than an FP if the effect of investment on social benefits is positive, and vice versa.

Point (ii) follows from the fact that under TP there is negotiation between the firm and the government that, as explained in Section 3.1, results in the firm internalizing part of the benefit effect that its innovation yields the government. It then follows that if $B_x > 0$ the firm's incentives to invest are increased by the bargaining with the government, and vice versa if $B_x < 0$.

The implications of Proposition 4 on the level of social benefits are stated in the following corollary.

Corollary 4 *NPs are always better at safeguarding social benefits. If $B_x > 0$, the highest social benefits are achieved under TP; but if $B_x(x) < 0$, the highest social benefits are achieved under PFI.*

Corollary 4 suggests that regardless of the scenario, NP provision always generates higher social benefits, compared to FP provision. The intuition follows the same line as Proposition 4(i) and thus it stems from the fact that when investment is non-monetary, the presence of the NDC results in a greater relative weight being attached to social benefits by an NP than by an FP.

6 Conclusions

In this paper we have analyzed contracting out to an NP and to FP under two alternative procurement arrangements. The first is PFI, where the firm has control rights over how to deliver the output; the second is TP, where the government retains control rights.

The main insights of the paper can be summarized as follows. First, even when an NP cares more than an FP does about social benefits, it does not follow that provision by an NP generates the greatest social benefits. This is because the NDC in an NP may work against its incentive to invest. Second, the new procurement strategy of PFI increases the scope for NP provision, compared to more traditional procurement methods. Third, a crucial role in determining the desirability of NP provision is played by the correlation between the effect of investment on social benefit and profit. Positive correlation tends to favour FP provision. Negative correlation can call for either FP or NP provision. However, when investment increases profits but reduce social benefits, NP provision

always help to safeguard social benefits. Fourth, the more investment into researching innovations is of a physical-capital rather than a human-capital type, the greater is the scope for NP provision as a means of boosting investment and safeguarding social benefits. Finally, the bargaining power of the firm when it negotiates compensation with the government, the power of the NDC in an NP, and the relative difference in care for social benefits between an NPs and an FP also matter.

In this paper we have abstracted from considerations related to corporate governance in an FP an NP. Studying how corporate governance issues impact on the efficiency of these firms in the provision of public services can constitute an interesting scope for future research.

7 Appendix

Proof of Lemma 1. Totally differentiating (3) leads to $\partial x_{TP}^N/\partial\delta > 0$ if $B_x(x_{TP}^N) + \pi_x(x_{TP}^N) > 0$, which, given (1), always holds. Since $x_{TP}^F = x_{TP}^N$ ($\delta^N = 1$), it follows that $x_{TP}^F > x_{TP}^N$. ■

Proof of Lemma 2. Totally differentiating (4) leads to $\partial x_{TP}^N/\partial\delta > 0$ if $\pi_x(x) > 0$, and vice versa. Since $x_{PFI}^F = x_{PFI}^N$ ($\delta^N = 1$), it follows that $x_{PFI}^F > x_{PFI}^N$ for $\pi_x(x) > 0$, and vice versa. ■

Proof of Proposition 1. Let $A_{TP}^j(x) \equiv \gamma\alpha B_x(x)+\gamma\delta^j\left(B_x(x)+\pi_x(x)\right)-1$. From (4): $A_{TP}^j(x_{PFI}^j) = \gamma\delta^j B_x(x_{PFI}^j) - (1-\gamma)$. Since $A_{TP}^j(x)$ is decreasing and $A_{TP}^j(x_{TP}^j) = 0$, it follows that for $A_{TP}^j(x_{PFI}^j) \leq 0$, we have $x_{PFI}^j \geq x_{TP}^j$, and vice versa. ■

Proof of Proposition 2. (i) The result follows from Lemmas 1 and 2 and Proposition 1.

(ii) From Lemmas 1 and 2, the highest investment is achieved under either TP-FP or PFI-NP. To compare investments under these two arrangements, let $H_{TP}^F(x) = \gamma(1+\alpha)B_x(x)+\gamma\pi_x(x)-1$. From (4), $H_{TP}^F\left(x_{PFI}^N\right) = \left(\gamma(1+\alpha)-\alpha\right)B_x(x_{PFI}^N)+\left(\gamma-\delta^N\right)\pi_x(x_{PFI}^N)$, which, given (A1), is positive at $\gamma = 1$. Since $H_{TP}^F(x)$ is decreasing and $H_{TP}^F\left(x_{TP}^F(\gamma=1)\right) = 0$, this implies that $x_{PFI}^N < x_{TP}^F(\gamma = 1)$. The result is then obtained from (3) by noticing that x_{TP}^F is increasing in γ, given (A1) and $B_x > 0$, and that $x_{PFI}^N > x_{TP}^F(\gamma = 0)$, where $x_{TP}^F(\gamma = 0) = 0$ (from (3) and (4).

(iii) The result follows from Lemma 2 and Proposition 1. ■

Proof of Corollary 3. Parts (i) and (ii) follow immediately from Proposition 2. Part (iii) is obtained from Propositions 1 and 2. ■

Proof of Proposition 3. The result is obtained in a few steps. (a) Comparison of PFI-FP with PFI-NP. Let $H_{PFI}^N(x) = \alpha^N B_x(x) + \pi_x(x) - 1$.

From (6), $H^N_{PFI}\left(x^F_{PFI}\right) = \left(\alpha^N - \alpha^F\right) B_x(x^F_{PFI})$. Thus, $x^N_{PFI} > x^F_{PFI}$ if $B_x(.) > 0$, and vice versa.

(b) Comparison of TP-NP with TP-FP. Let $H^N_{TP}(x) = \gamma\left(1+\alpha^N\right) B_x(x) + \gamma\pi_x(x) - 1$. From (5), $H^N_{TP}\left(x^F_{TP}\right) = \gamma\left(\alpha^N - \alpha^F\right) B_x(.)$, which is positive for $B_x > 0$, implying $x^N_{TP} > x^F_{TP}$, and vice versa.

From (a) and (b), an NP invests more under both PFI and TP if $B_x > 0$. Thus, for $B_x > 0$ the comparison boils down to PFI-NP versus TP-NP. Let $H^N_{TP}(x) = \gamma\left(1+\alpha^N\right) B_x(.) + \gamma\pi_x(.) - 1$. From (6), $H^N_{TP}\left(x^N_{PFI}\right) = \gamma B_x(x^N_{PFI}) - (1-\gamma)$, which is positive for $B_x\left(x^N_{PFI}\right) > (1-\gamma)/\gamma$, implying $x^N_{TP} > x^N_{PFI}$, and vice versa.

From (a) and (b), an FP invests more than an NP under both PFI and TP if $B_x < 0$. Thus, for $B_x < 0$, comparison boils down to PFI-FP versus TP-FP. Let $H^F_{PFI}(x) = \alpha^F B_x(x) + \pi_x(x) - 1$. From (6), $H^F_{PFI}\left(x^F_{TP}\right) = \alpha^F B_x(x^F_{TP}) - 1 + [1 - \gamma\left(1+\alpha^F\right) B_x(x^F_{TP})]/\gamma$, which is positive for $1 - \gamma - \gamma B_x(.) > 0$, which always holds for $B_x < 0$. It follows that $x^F_{PFI} > x^F_{TP}$. ■

Proof of Proposition 4. (i) follows by noticing that

$$\frac{\partial x^j_{TP}}{\delta^j} = -\frac{\left(B_x(x^j_{TP}) + \pi_x(x^j_{TP}) - 1\right)}{SOC} = \text{sign}\left[-\gamma\alpha B_x(x^j_{TP})\right];$$

$$\frac{\partial x^j_{PFI}}{\delta^j} = -\frac{\left(\pi_x(x^j_{PFI}) - 1\right)}{SOC} = \text{sign}\left[-\alpha B_x(x^j_{PFI})\right].$$

(ii) Let $H^j_{TP}(x) \equiv \gamma\alpha B_x(x^j_{TP}) + \gamma\delta^j\left(B_x(x^j_{TP}) + \pi_x(x^j_{TP}) - 1\right)$. Then from (8), $H^j_{TP}(x^j_{PFI}) \equiv \gamma\alpha B_x(x^j_{PFI}) + \gamma\delta^j\left(B_x(x^j_{PFI}) - \alpha B_x(x^j_{PFI})\right) = \gamma\left(\delta^j + \alpha\left(1-\delta^j\right)\right) B_x(x^j_{PFI})$. Thus, $x^j_{PFI} > x^j_{TP}$ if $B_x < 0$, and vice versa.

■

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