Public-Private Partnerships and the Privatization of Financing: An Incomplete Contracts Approach

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Abstract

Governments have begun to embrace public-private partnerships (P3s) as vehicles for providing public services. This paper considers the controversial question of when private financing of public projects is optimal. Private development can dominate public financing through more efficient termination decisions for bad projects, resolving soft budget constraint problems. Due to contractual incompleteness, on the other hand, private developers cannot commit to large debt repayments, and hence can finance only a subset of valuable projects. Public developers, who do not face the same commitment problems, can finance a larger set of projects.

JEL Codes: H11, G32, D23, L20.

Keywords: public-private partnerships; incomplete contracts; soft budget constraints.

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1 Introduction

Over the last fifteen years, governments around the world have embraced public-private partnerships (P3s) as vehicles for the delivery of a wide variety of public services in major areas such as education, transportation, health care and corrections. Pioneered by the United Kingdom with its Private Finance Initiative of the early 1990s, the P3 strategy is being adopted in countries of all wealth levels and on all continents.¹

To economists, P3s may be seen as a simple extension of vertical disintegration or contracting out by governments. Rather than simply contracting out the construction of a new bridge for a fixed price, for example, a government may contract for the provision of “bridge services” including the design, construction, operation, maintenance and even the financing of the bridge. The idea behind such projects is most often expressed in general language as harnessing the efficiencies and innovativeness associated with a competitive private sector to help government achieve its public service goals at lower cost.

Our aim is to be more precise about some of the tradeoffs involved. In our view, two features of modern P3s set them apart from simple contracting out.² First, the number of tasks that are contracted out to the same party or consortium is larger, as in the bridge example just given. Second, the privatization of the finance function - i.e. the delegation of the financing responsibility to a private firm or consortium - at one time extremely rare, has become a central feature of P3 projects involving the construction of expensive facilities or assets such as bridges, roads, schools, medical facilities and prisons.

It is the privatization of the finance function that has been the most controversial aspect of P3s. Opponents of P3s argue that governments are capable of raising debt at a lower rate of interest than private borrowers, and, for that reason, that the financing function – at a minimum – should remain with the government. At the same time, the ability to draw outside finance to develop popular projects without adding to politically sensitive levels of public debt is the very feature that many governments find most attractive about P3s.³ The central purpose of

¹See, e.g. de Bettignies and Ross (2006), and Vining, Boardman and Poschmann (2005), for examples of countries, industries and projects in which P3s were used.
²See de Bettignies and Ross (2004).
³Public sector labour unions are among the strongest opponents of P3s. Though not directly relevant for the cases we explore here, it is worth noting that the argument that governments are more reliable borrowers does not hold for all governments. For example, governments in developing countries may be less credit-worthy than the companies with which they might partner in P3s. P3-type projects have been promoted by (among
this paper is to analyze the conditions under which either public or private finance ought to be preferred over the other. To do this, we incorporate important elements of modern industrial organization theory which focus on the consequences of incomplete contracts and commitment problems. In addition, our model sheds light on the positive, political economy, question of when governments will choose private over public finance. The following two subsections provide an overview of the model and the major results, and review the most relevant related literature.

1.1 Overview of the Model and Key Results

The model considers a particular project, the construction and operation of a bridge, for example, which can be financed and developed by a private firm/consortium, or by a government agency. Whomever undertakes the project, private or public developer, must secure the initial capital required from an investor. Using an incomplete contracts framework, we determine the optimal (debt) contract between the developer and the investor in the case of public development and of private development, and analyze the tradeoffs between the two types of financing.\(^4\)

The project lasts for two periods and at dates 1 and 2 produces benefits of profits and consumer surplus. The project can be terminated at date 1, in which case the assets are redeployed and termination profits and consumer surplus are generated in the second period. The payoffs of the project are not known with certainty ex ante; in fact its ex post value depends on whether it has been managed well or poorly. Good management, which occurs with a given probability, produces a “good” outcome while poor management produces a “bad” outcome. The actual state becomes clear (to the people involved in the project) only when the first period payoffs are obtained.\(^5\) We assume that if Nature reveals the developer to be bad, others) the World Bank for developing countries, in part because they may have no other way to fund important infrastructure.

\(^4\)That contracts might be incomplete seems reasonable in the context of P3s. The difficulty in negotiating P3 contracts is, in part, due to the typical length of these agreements - 20 to 30 years is not uncommon when large facilities are involved - and in part it is due to a wide variety of risks that can have an impact on the value obtained in the partnership. These risks can include engineering risk, construction risk, regulatory risk, demand risk and environmental risk. Attempts to allocate these risks in the most efficient manner and to anticipate all important shocks over many years will undoubtedly leave gaps that can be exploited opportunistically.

\(^5\)We take the probability of each state – that is, the probability that the developer is good or bad – as exogenous here because our interest is not in moral hazard related to effort, but rather in moral hazard related to the continuation decision. To focus on issues related to the incentives to terminate projects, we abstract from other differences between public and private development by assuming the probabilities of good and bad management are the same for public and private developers.
it is socially desirable to terminate the project at date 1 rather than continue into the second period. Conversely, if the developer turns out to be good, it is socially desirable to continue.

With private development, two issues arise. The first is related to contractual incompleteness. For the investor to agree to provide the loan to the private developer, he must make non-negative returns in expectation on his investment. He may worry that the developer will not repay the loan and will thereby “put” the project back to him. Loan repayment in this model is not assumed exogenously, it must be the preferred option for the borrower. The profit maximizing private developer in particular may have an incentive to “strategically default,” if the benefit from defaulting (not having to make the debt repayment) is larger than the cost (loss of control and forfeiture of second period returns). This caps the amount the private developer can commit to repay, and limits the amount a lender is willing to provide to the developer in the first place. Accordingly, it leads to an inefficiently small number of projects being financed - to ex ante inefficiency.

Second, an externality emerges in that the private developer maximizes profits rather than social surplus, and thus ignores the impact of her decisions on consumer surplus. This has two consequences with regards to financing: 1) The private developer might make decisions that are socially inefficient, even though they are profit maximizing. This lowers the total social surplus, generating ex post inefficiency. In turn, it has a negative impact on the debt repayments that can be made to the investor and on the number of projects that can be financed in the first place. 2) Of that total social surplus generated, the private developer extracts profits, but does not internalize the consumer surplus, and this also lowers the size of the debt repayments she is willing to make and the number of projects financed.

We show, however, that government intervention under private development may help mitigate these concerns. In our model, the government can design a simple mechanism to elicit truthful revelation of the developer’s type at date 1, and induce efficient termination/continuation decisions. This, together with a degree of cofinancing at date 0, helps reduce both ex post and ex ante inefficiencies.

With public development, i.e. when the government does the borrowing, the problem is different. While our governments in general seek to maximize total surplus, they do have some interests of their own to serve. They value total surplus only when in power; in other

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6Throughout the paper we treat the project developer as female and the investor as male.
circumstances they are “regular” self-interested citizens whose utility is assumed independent of the project analyzed here. At some time between dates 1 and 2, an election is to be held, and governments perceived as being better managers are more likely to be re-elected. For political reasons, then, governments do not want to reveal the fact that they may be bad managers. The termination of a project after period 1 may be taken as a sign of a weak government for voters, and hence will carry a political cost. As discussed further below, this is very much in the spirit of the literature on soft budget constraints. In equilibrium, weak governments have an incentive to continue projects which should be terminated, in an attempt to manipulate the electorate’s belief about their type.

The focus up to and including section 6.1 is on the normative question regarding the conditions under which private development using public-private partnerships are to be socially preferred to public development. A key result is that when both types of financing are available, private development may be preferred, as it “hardens” the project budget constraint and avoids inefficient continuation by weak public developers. On the other hand, private developers can only commit to smaller debt repayments, and hence can only find lenders for a subset of socially valuable projects. Public developers, who do not have the same commitment problems, can finance a larger set of projects, including some that could not be financed under private development. Section 6.2 of the paper briefly takes up the positive question of which approach governments are likely to take – that is, knowing what we know now, are they likely to implement P3s? Finally, section 7 discusses some of the key assumptions of the model and concludes.

1.2 Related Literature

P3s have recently received much attention in political circles and in the media, yet relatively little academic research from economists has emerged on the topic. Prior work has focused on the more general trade-off between public and private provision, without particular attention to financing (Schmidt, 1996; Hart et al., 1997; Shleifer, 1998; Besley and Ghatak, 2001), and on one of the key aspects of P3s, namely the “bundled” outsourcing of both construction and operation to a private consortium (King and Pitchford, 2000; Bentz et al., 2002; Bennett and Iossa, 2003; Hart, 2003). We believe that our paper is novel in explicitly and formally examining
the other key characteristic of P3s - private financing - and in analyzing the trade-off between private and public development through a “financing” lens.

To that end, we draw from the corporate finance theory literature, and particularly from Bolton and Scharfstein (1990, 1996), and Hart and Moore (1998). Our benchmark framework of private financing follows these classic models in assuming non-verifiable cash flows and contractual incompleteness in a two-period setup where, consequently, debt emerges as optimal contract. As is well known from this literature, in this type of setup debt is not first-best efficient, one reason being that contractual incompleteness places an upper bound on the amount the private developer can commit to repay to the investor, leading to an inefficiently small number of projects being financed. As noted above, this feature of the previous literature is also present in our setup. We depart from prior work in placing issues of social welfare, as well as the role of government, at the forefront of the analysis. This departure yields the four primary contributions mentioned above: (i) we show that the externality associated with the profit maximizing private developer has a real impact on financing, generating both ex post and ex ante inefficiencies; (ii) we find that government intervention, through careful contractual design and co-financing, may have an impact on social welfare under private development, mitigating both types of inefficiencies (iii) unlike the corporate finance literature which generally focuses on private financing, we propose a new model of public financing, where manipulation of electorates’ beliefs leads to ex post and ex ante inefficiencies; and (iv) we compare both types of financing, and show that while private financing may dominate from an ex post point of view, public financing tends to dominate ex ante.

Our modeling of public development is also related to the literature on the “soft budget constraint” (SBC), pioneered by Kornai (1979, 1980, 1986), and formalized more recently by Dewatripont and Maskin (1995) and others.7 This literature attempts to explain why governments may tend to bail-out or continue projects that should be terminated. In our framework this tendency is an attempt by governments to manipulate the electorate’s belief about their intrinsic quality, and hence to increase their reelection probability.8 The hypothesized implica-

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7 See Kornai et al. (2003) for an excellent review of that literature.
8 Under their list of possible motives for the inefficient continuation of failed enterprises, Kornai et al. (2003, p. 1009), referring also to Shleifer and Vishny (1994), suggests that “Politicians [...] may be politically motivated to obtain subsidies for firms in financial difficulty [...] to save jobs so as to increase their popularity and political influence, and improve their chance of reelection.”
tions of such soft budget constraints for the continuation of weak projects have been documented by many researchers.\(^9\)

Finally, the two papers on the efficiencies of government spending that come closest to what we do here are those by Dewatripont and Seabright (2006) and Coate and Morris (1995). Both of these papers model governments that make “inefficient” decisions in order to improve their chances at re-election (because they derive a utility benefit from being in government). Like the present paper, both consider that governments can be either “good” or “bad” in terms of their talents or true objectives and that they will take actions consistent with making voters believe they are good (or in order to hide evidence that they are bad). Coate and Morris focus on decisions to redistribute resources toward groups favoured by the government (but not voters), while Dewatripont and Seabright consider decisions governments make take to proceed with projects (even those that may be wasteful) so as to be seen by voters to be working hard.\(^{10}\)

2 A Model of Project Financing

We consider a positive net present value (NPV) project which, if undertaken at date 0, requires an investment outlay of \(k\), and lasts for two periods, with no discounting. The project can be developed in one of two ways. With \textit{public development} - which corresponds to the traditional provision of public services - the government or one of its agencies develops the project, keeping full control at all stages of development. Alternatively, with \textit{private development} - which corresponds to the creation of a P3 - a private firm is given control rights over the project, including the rights to develop the project and to make continuation/termination decisions, and full control over the profits generated. The characteristics of the game are described immediately below; its timing is depicted in figure 1.

\(^9\)See Boardman et al. (1993, p. 544) on this point: “There may be strong political support for continuation of a venture even though it may not be justifiable on efficiency grounds [...]. The classic example is the Tellico Dam in Tennessee where [...] the social costs of completion exceeded the social benefits. Nonetheless, Congress decided to complete the project.” On the same idea, see also Vining et al. (forthcoming); and Osborne and Gaebler (1992), particularly at pp. 287, 345 and 347. Finally, an interesting related case study of the “escalation problem” in which governments are reluctant to terminate projects, even in the face of rapidly escalating costs (and in which reelection issues loomed large) is found in Ross and Staw’s (1986) analysis of the cost overruns associated with Expo 86 in Vancouver, Canada.

\(^{10}\)Dewatripont and Seabright do not consider how to deliver public projects (i.e. the choice considered here between private and public developers), their focus is on governments beginning projects and not necessarily terminating them when efficiency dictates they should.
Neither the government nor the private firm have any cash available to finance the project at date 0, and hence the developer - public or private - must secure financing from an investor.\footnote{We make this “symmetry” assumption to facilitate comparison between private and public development. If we allow for the public developer to have more initial wealth than the private developer, then the only difference is that ceteris paribus the public developer will be able to finance more projects.} There is a competitive supply of investors, hence the developer will make the investor a take-it-or-leave-it offer at the beginning of the game.

**Two types of government, two types of firm.** The government and the private firm each are of one of two types $i = g, b$, where $g$ stands for “good” and $b$ for “bad.” Whether a public or private development, the probability of being of type $g$ is $p$, while the probability of being of type $b$ is $1 - p$. A good developer can successfully implement the project, which yields social benefit $s_g$ at date 1, and $S_g$ at date 2.\footnote{We use lower case letters to represent first period variables, and capital letters to represent second period variables.} In contrast, a bad developer implements a less successful project which yields $s_b$ at date 1, and $S_b$ at date 2.\footnote{Rather than assume, as we do, that a good developer is systematically successful at implementing the project, while the bad developer is systematically unsuccessful at it, we could formulate our model more generally by assuming that the good developer is relatively more likely to successfully implement the project, and that the bad developer is relatively less likely to do so. As shown in the appendix, the more general formulation of the model yields the same results as our reduced-form version. We use the reduced-form version for simplicity.} The developer’s type is not known at date 0, and is revealed only to herself and the investor at date 1 when the first period surplus is realized. In the case of private development, the government is uninformed about the developer’s type. Throughout the paper we refer to the good (resp. bad) state as the situation in which the developer turns out to be of type $g$ (resp. $b$).\footnote{We could also allow for the possibility that good projects depend both on the quality of the management and the intrinsic quality of the project which may not be observable ex ante. In a case like this, a bad outcome could be the result of bad management or the project may have been doomed from the start. As shall become clear below, a bad outcome is for the observation of a bad outcome to lead voters to update their beliefs on the quality of the government, with the effect of lowering that government’s probability of reelection. If this updating represents a significant enough change, it will produce the results presented here.}

The project can also be terminated at date 1 (after the date 1 surpluses have been generated). In that case, the assets are liquidated and redeployed in another project, which yields date 2 expected social benefit $S_t$. We assume that continuation is socially optimal for the type $g$ developer, while termination is socially optimal for the type $b$ developer: $S_g > S_t > S_b$.

**Government election.** At some point between dates 1 and 2 an election is scheduled to take place. The electorate wants to reelect the incumbent government if and only if it is good (type $g$), but at the time of the election does not know the government’s type. The electorate
can, however, form posterior beliefs about the government (using Bayes’ rule), based on prior probabilities, and, if the government is the developer, on observable actions such as the choice between continuation or termination of the project (a decision which takes place at date 1). The incumbent government’s probability of reelection thus is the electorate’s posterior belief that the government is of type $g$, $\Pr(\text{gov: type } = g)$. For example, with public development, the probability of reelection conditional on observing continuation at date 1 is $\Pr(\text{gov: type } = g/p, \text{ cont.})$. In contrast, with private development the electorate has no information other than the prior and therefore the probability of reelection is $\Pr(\text{gov: type } = g/p) = p$. Put another way, the electorate will not punish (i.e. vote out of office) the government for a failed project if it fails using investor rather than taxpayer funds: voters will correctly perceive that the failures were due to poor private sector management. Alternatively, one might argue that the quality of government may be correlated with the quality of the private developer, in the sense that bad government is more likely to select a bad private developer. We discuss this in section 7.

Clearly we do not have a complete model here of how voters choose between supporting incumbent officials or their rivals. Rather, we focus only on the marginal effect of a good or bad project on the probabilities that voters will support the incumbent in the next election. Under public development, having observed a project terminated, voters will rationally conclude that they are (more likely) served by a less competent government. This translates into negative perceptions about the government’s ability to make good decisions in the future, lowering the value to voters of its re-election. Implicit in our formulation is that the project must be undertaken – that is we assume the government is compelled to see that the service is provided in some way. We do not explore formally the question of how governments decide which projects to undertake. In an interesting related paper, Dewatripont and Seabright [2006] explore “wasteful” public spending in the context of a model in which governments undertake projects (some of which may turn out to be socially wasteful) to signal their diligence to voters and voters reward these efforts.

**Objective functions.** The government derives a benefit from generating social surplus – through public or private development – *but only if it remains in power*.15 For simplicity we assume that this private benefit equals social surplus. Accordingly the expected private benefit to the government at dates 1 and 2 can be expressed respectively as $s_i$, $i = g, b$, and

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15This is analogous to the government objective function employed by Coate and Morris [1995, p. 1216].
Pr (gov. type = g/) S_j, j = g, b, t, where Pr (gov. type = g/) is the probability of reelection in period 2. Our assumption that governments care about social welfare only so long as they remain in power illustrates the idea that economic agents may have different objectives depending on their activity. As a member of government, the economic agent cares about social surplus; but as a citizen, the same agent cares only about its own utility, which may be unrelated to this project, hence the zero payoff when the agent is not in power. The private developer makes decisions to maximize profits.

**Profits and Tax Revenue.** In the case of private development, the developer extracts as profits a portion \( \pi_i, i = g, b \), of the social surplus \( s_i \) at date 1; and a portion \( \Pi_j, j = g, b, t \), of the social surplus \( S_j \) at date 2. Naturally we assume that the type \( g \) developer receives more profits than the type \( b \) developer: \( \pi_g > \pi_b \) and \( \Pi_g > \Pi_b \). However, we restrict our attention to situations where profits from termination are lower than the continuation profits for the type \( b \) developer: \( \Pi_t < \Pi_b \). This parameter restriction greatly simplifies presentation, without loss of generality. Indeed, the case where \( \Pi_b \leq \Pi_t < \Pi_g \) yields very similar results, with only a few differences which we point out below where relevant; and the case where \( \Pi_t \geq \Pi_g \) turns out to be economically less interesting since, as will become clear below, it implies that the private developer would start the project with the implausible intention of liquidating it at the first available opportunity.

We assume that contracts are incomplete, in that profits are not verifiable and hence they cannot be contracted upon at date 0. This assumption fits squarely within the recent corporate finance theory literature and is now common in that line of research.\(^{16}\) It is often justified in two primary ways, both of which naturally apply to the kind of project analyzed in this paper:

“First, it is often difficult to judge whether particular expenses are necessary; what looks like justifiable expenses may really be managerial perquisites with no productive value. Thus there is scope for [developers] to divert resources away from investors to themselves. A second, related reason is that the firm might be affiliated with another firm [as in a P3 consortium], thus providing some flexibility in the joint allocation of costs and revenues.” (Bolton and Scharfstein, 1990, bracketed terms added)

This contractual incompleteness assumption has the additional advantage of ruling out equity contracts, and of allowing us instead to focus on debt contracts, the most common type of financial instrument used in P3s. However, the key insights of our model are not dependent on this assumption or the resulting optimality of debt, and in section 7 we discuss the implications of our model when profits are verifiable.

We posit that while the government can extract as cash the consumer surpluses \( c_i = s_i - \pi_i \) at date 1, and \( C_j = S_j - \Pi_j \) at date 2, in the form of taxes and user charges, it cannot tax firm profits. We make this assumption for simplicity and clarity purposes; but - as should become clear below - the main insights of the model would still hold even if government could tax a fraction \( \lambda \) of profits, for all \( \lambda < 1 \). In the case of public development, the government can still extract consumer surplus using taxes and user charges, but also has a claim on profits, and hence has the option of extracting as cash the entire social surplus at dates 1 and 2.

**First-Best Scenario.** We define the first-best (FB) outcome as the case in which a benevolent social planner with no binding wealth constraints would take actions to maximize the social surplus. Our planner is not a perfect project manager however, and has the same probabilities of being good or bad as applied to our private and public developers. At date 1, a social planner of type \( i, i = g, b \) continues the project if and only if the second period social surplus from continuation, \( S_i \), is larger than the surplus from termination, \( S_t \). The FB expected net social payoff from a date 0 perspective, \( R_{FB} \), can thus be expressed in the following way:

\[
R_{FB} = p(s_g + S_g) + (1 - p)(s_b + S_t) - k.
\]  

(1)

In the FB, the project is undertaken if and only if \( R_{FB} \geq 0 \). Let us define \( k_{FB} = p(s_g + S_g) + (1 - p)(s_b + S_t) \) to be the critical level of \( k \) such that only projects with initial capital requirement \( k \leq k_{FB} \) should be financed. Note that \( R_{FB} \) is a measure of the NPV of the project; and that, everything else equal, varying \( k \) is like varying the “intrinsic” return of the project. Indeed, throughout the paper we interpret low \( k \) projects as high return projects, and vice versa.
3 Private Development - No Government Intervention

In this section we examine the case of private development without government intervention. In the next section we allow for government to intervene when it is in its interest to do so.

3.1 Equilibrium

How can the developer convince the investor to advance funding for the project when the payoffs cannot be contracted upon? As shown in Bolton and Scharfstein (1990, 1996), and Hart and Moore (1998), in this type of framework the optimal contract specifies at date 0 that a debt repayment \( d^r \) from the developer to the investor - henceforth referred to as “lender” - is to be made at date 1.\(^{17}\) If the payment is made, the developer retains control (ownership) of the project. In case of default, the lender seizes control, terminates the venture, liquidates the assets and redeploy them in another project. As mentioned above, this generates a social benefit \( S_t \) and expected profits \( \Pi_t \).

The question naturally arises as to what makes this kind of relationship a P3 as opposed to, for example, simple contracting out. Indeed, to some extent P3s are really just extensions of contracting out, so the differences are more of degree than kind. In our view, contracting out reaches the stage at which we can usefully call it a P3 when certain conditions are met, including: (i) the private sector partner is responsible for the financing; (ii) multiple tasks such as financing, construction and operation are assigned to the same private partner (or consortium); and (iii) the private sector partner provides the operation of the facility.\(^{18}\) These three conditions are not generally met in simple contracting out arrangements, but are present (at least implicitly) in the model we develop here.

We determine the (subgame-perfect Nash) equilibrium by backward induction.

Date 1 Decisions

If the developer is of type \( g \), she anticipates that if she defaults on payment, renegotiation with the lender will occur since there is a surplus to be gained (\( \Pi_g > \Pi_t \)). Assuming that the developer has full bargaining power in renegotiation with the lender, the outcome of renegotia-

\(^{17}\)The superscript \( r \) indicates that we are in the “private developer” scenario. It is implicitly assumed that the payment \( d \) is verifiable.

\(^{18}\)See, e.g., Bettignies and Ross (2004).
tion would therefore simply be a payment $z = \Pi_t$ from the developer to the lender, in exchange for keeping control in the second period.\(^\text{19}\) Thus, if debt payment $d^r \leq \Pi_t$, the developer pays it and gets a return $\pi_g + \Pi_g - d^r$, which is superior to her return if she defaults, $\pi_g + \Pi_g - \Pi_t$. Conversely, if the debt repayment $d^r > \Pi_t$, the developer is better off strategically defaulting, since her payoff after renegotiation is superior to her payoff in case of debt repayment. Regardless, with a type $g$ developer the project is always continued.

If the developer is of type $b$, one option is for her to make the debt payment and continue the project, in which case her payoff is $\pi_b + \Pi_b - d^r$ (she would not willingly terminate since $\Pi_b > \Pi_t$). Alternatively, she can strategically default.\(^\text{20}\) In that case renegotiation with the lender occurs since $\Pi_b > \Pi_t$, the developer pays $\Pi_t$ to the lender and continues the project into period 2, with a total payoff of $\pi_b + \Pi_b - \Pi_t$. Thus, a type $b$ developer defaults if and only if $d^r > \Pi_t$. Accordingly, regardless of default and/or the state of the world, continuation always occurs. This is socially efficient in the good state, since $S_g > S_t$, but socially inefficient in the bad state, since $S_t > S_b$.

**Date 0 Decisions**

From the analysis of date 1 decisions, we deduce that the expected return to the investor/lender from a date 0 perspective can be expressed as $R^*_t = pd^r + (1 - p) d^r - k = d^r - k$ for all $d^r \leq \Pi_t$, and $R^*_t = \Pi_t - k$ otherwise.\(^\text{21}\) Thus, the maximum return the lender can hope to get for a given $k$ is:

$$R^*_t \text{ max} = \Pi_t - k. \quad (2)$$

Let $d^r*(k)$ be the value of $d^r$ such that $R^*_t = 0$. The developer, who chooses $d^r$ to minimize the lender’s return, subject to $R^*_t \geq 0$, offers debt repayment $d^r*(k)$ for all projects with $k \leq \Pi_t$.

**Equilibrium of the Game**

i) When $k \leq \Pi_t$:

\(^\text{19}\) The results of the model are robust to other allocations of bargaining power in renegotiation, including Nash bargaining. We choose this assumption for simplicity.

\(^\text{20}\) Throughout the paper we assume that profits in period 1, regardless of the state of the world, are sufficiently large so that debt repayments are not constrained by date 1 cash flows. Accordingly, in our model default, if it occurs, is not the result of insufficient cash: rather, it is a strategic decision taken by the borrower.

\(^\text{21}\) Throughout the paper, the subscript $I$ stands for “Investor”. Other subscripts used below are $E$, $W$, and $G$, which stand for “Developer,” “Welfare,” and “Government,” respectively.
The developer never defaults, makes the debt repayment \( d^r (k) = k \) in both states of the world \((g \text{ or } b)\), and extracts all rents from the lender, and continues the project into the second period in both states of the world. Her expected return, \( R^r_E \), is:

\[
R^r_E = p(\pi_g + \Pi_g) + (1 - p)(\pi_b + \Pi_b) - k. \tag{3}
\]

The social return, \( R^r_W \), is:

\[
R^r_W = p(s_g + S_g) + (1 - p)(s_b + S_b) - k. \tag{4}
\]

The government’s expected payoff with private development, \( R^r_G \), can be expressed as:

\[
R^r_G = p(s_g + pS_g) + (1 - p)(s_b + pS_b) - k; \tag{5}
\]

where the \( p \)'s in the first and third brackets reflect the probability of reelection, which under private development coincides with the prior probability of being of type \( g \).

\( \text{ii) When } k > \Pi_t: \)

Let us define \( k^r \) as the value of \( k \) such that \( R^r_I \text{max} = 0 \). This gives \( k^r = \Pi_t \). For projects with \( k > k^r \), the maximum debt repayment that the private developer can commit to repay, \( d^r = \Pi_t \), is too low for the lender to make a non-negative return. As a result, the lender refuses to finance the project in the first place and the project is not undertaken.

3.2 Efficiency

How efficient is private development? We assess efficiency at the two decision-making stages: ex post inefficiency related to the continuation/termination decision, and ex ante inefficiency related to the decision to undertake the project initially. We analyze each in turn.

**Ex Post Inefficiency** focuses on the projects that are undertaken. It is the result of what one might call the “pie effect”: the idea that due to inefficient decision-making, the total surplus generated by the contract, i.e. the total pie, may be smaller than the surplus that would be
generated in the FB scenario. Indeed, we define ex post inefficiency as the difference between
the FB pie, and the pie generated by the optimal private development contract.

Ex post inefficiency is obtained by subtracting (4) from (1), which can be verified to yield
\[ XP^r = R_{FB} - R_{W} = (1 - p) (S_t - S_b). \]
Intuitively, private development generates an externality, in that the private developer maximizes profits rather than social surplus, thus ignoring consumer surplus. This externality induces the developer to continue the project in the bad state even though termination is socially optimal: The total pie generated by private development in that case is smaller than the FB pie, generating ex post inefficiency.

**Ex Ante Inefficiency** arises because some projects that should be financed (i.e. for which \( R_{FB} \geq 0 \)), are not in fact undertaken, because for these projects the maximum amount that the lender can expect to receive, \( R_{I}^{\text{max}} \), is strictly negative. Another way to phrase this is that the cutoff level of \( k \) above which \( R_{I}^{\text{max}} < 0 \) (and thus the project cannot be financed), \( k^r \), is lower than the first-best cutoff level \( k_{FB} \). Projects with an initial capital requirement \( k \in (k^r, k_{FB}) \) ought to be financed, but are not. Following Gertner et al. (1994), we measure ex ante inefficiency as the difference in these cutoff levels of \( k \), which can easily be obtained by subtracting \( R_{I}^{\text{max}} \) from \( R_{FB} \). Ex ante inefficiency under private development can thus be expressed as:

\[ X A^r = p ((s_g + S_g) - \Pi_t) + (1 - p) ((s_b + S_t) - \Pi_t). \]  

The amount the lender can expect to obtain may be lower than the FB net benefit for two main reasons. First, there may be “pie effect”: from our description of ex post inefficiency, we know that the total surplus in the second-best may be lower than in the the FB, i.e. the total pie may be smaller. This has an ex ante impact because even if the lender could obtain all of the pie, he would still not have FB incentives to invest and would refuse to finance some projects which should in principle be financed. Second, there may also be a “slice effect,” as the lender anticipates that he will only receive a slice of the pie. Some of the profits generated by the project cannot be repaid to the investor because she would rather default than repay. Consequently, for some projects, the initial cost \( k \) is smaller than the total pie, but larger than the maximum slice that the developer can commit to return to the lender. There is thus an ex ante inefficiency for these projects which should be undertaken, but are not.

In our model, the externality associated with private development generates a pie effect,
because in the bad state the developer continues a project which, from a social point of view, ought to be terminated. Moreover, this externality also has a slice effect: since the private developer ignores consumer surpluses, she cannot commit to return that part of the social surplus to the investor. Finally, contractual incompleteness does also generate a slice effect, since the developer cannot commit to return even all of the profits generated by the venture: in both states of the world the developer has an upper bound \( \Pi_t \) on the feasible debt repayment that she can commit to repay. We can rearrange (9) in a way which highlights these three effects:

\[
XA^r = p \left[ \left( s_g + S_g \right) - \left( \pi_g + \Pi_g \right) + \left( \pi_g + \Pi_g \right) - \Pi_t \right] + \\
(1 - p) \left[ \left( s_b + S_t \right) - \left( s_b + S_b \right) + \left( s_b + S_b \right) - \left( \pi_b + \Pi_b \right) \right] .
\]

(7)

The pie effect is represented by the first difference in the second square bracket. And in each square bracket, the last two difference reflect the “externality” slice effect and the “contractual incompleteness” slice effect, respectively. We summarize the results of this section as follows:

**Proposition 1.** Due to the externality associated with profit rather than social surplus maximization, private development may be ex post inefficient, in the sense that a less-than-first-best surplus may be achieved. Due to both this externality and to contractual incompleteness, private development is ex-ante inefficient, in the sense that some positive NPV projects which should be financed in the first-best are not financed under private development.

**Proof.** Follows directly from above. ■

Recall that throughout the paper we restrict our attention to parameter values such that \( \Pi_t < \Pi_b \). The case where \( \Pi_b \leq \Pi_t < \Pi_g \) is simpler still: the fact that \( \Pi_b \leq \Pi_t \) implies that - unlike the base case - the private developer makes the socially efficient termination decision in the bad state of world. Accordingly, the pie effect described above, and its consequences on both ex post and ex ante inefficiency, disappear. As we shall see below, government intervention helps eliminate the pie effect, and hence when government intervention is feasible, the efficiency results associated with private development are the same whether \( \Pi_t < \Pi_b \) or \( \Pi_b \leq \Pi_t < \Pi_g \).
4 Private Development with Government Intervention

We now consider the scenario in which government intervention is feasible.

4.1 Interventions

At Date 1:

As noted above, without government intervention, the project would be inefficiently continued at date 1 in the bad state. The government does have an incentive to intervene to ensure efficient termination in the bad state,\(^{22}\) since its interests are aligned with social welfare:

\[ S_t > S_b \text{ if and only if the government’s expected payoff is higher with termination than with continuation, } pS_t > pS_b \text{ (recall that under private development the probability of reelection is simply the prior probability of the government being of type } g). \]

The government induces efficient continuation/termination decisions by eliciting truthful revelation of the private developer’s type, and contingently “subsidizing” termination with tax revenues. As shown in the appendix, one way the government can achieve this is by proposing the following simple mechanism: 1) If the private developer announces her type to be \(b\), then she is to receive subsidy \(t_b = \Pi_b - \Pi_t + \varepsilon\), with \(\varepsilon \to 0\), if she makes the pre-specified debt repayment to the investor and then terminates the venture; and no subsidy otherwise (e.g. in case of default). 2) If the developer announces her type to be \(g\), then she receives no subsidy.

It is easy to see why this scheme is incentive compatible. If the developer is of type \(g\), and truthfully reveals her type, she gets no subsidy as specified in the government’s proposition. If she lies and pretends to be a \(b\) type, she gets the subsidy only if she repays the debt and then terminates. But being really a \(g\) type, conditional on repaying the debt she is better off continuing rather than terminating, even though it means forfeiting the subsidy. Therefore if she is of type \(g\), she will end up getting no subsidy, and the same payoff, whether she tells the truth or lies; and we follow convention in assuming that when indifferent between telling the truth and lying, she chooses the former. And if the developer is of type \(b\), then the proposed mechanism ensures that the payoff from truthfully revealing her type weakly dominates the

\(^{22}\)While it may seem strange that the government would want to encourage the private developer from terminating a bad project, this is because there may be a high social termination value while the private developer’s termination value may be low. For example, perhaps the project required the allocation of a certain amount of land and the government had a very good alternative use for that land.
payoff from lying, ensuring incentive compatibility.

**At Date 0 (Co-Financing)**

The government may also intervene at date 0, in cases where \( k > \Pi_t \), to facilitate financing which would not otherwise occur. To see this, two points should be noted. First, the government has an incentive to intervene for all \( k > \Pi_t \) such that its expected payoff \( R_G^r \) is positive. Second, the government can credibly commit to make future payments to the lender, because it cares about the social surplus, but is indifferent about the way it is distributed between people. Assuming that the government chooses not to renege on a contract/promise unless it has an incentive to do so, such commitments are credible.\(^{23}\) As discussed above, under private development the government can extract as cash - and hence return to the lender - the consumer surpluses \( c_i = s_i - \pi_i \), \( i = g, b \), at date 1, and \( C_j = S_j - \Pi_j \), \( j = g, b, t \), at date 2. These government commitments are additional to what the private developer promises to repay, and could be viewed as a type of government co-financing. Thus, in this case, the maximum return the lender can expect to receive is \( \Pi_t - k \), plus the government co-financing:

\[
R_{rI}^{\max} = p(\Pi_t + c_g + C_g) + (1 - p)(\Pi_t + c_b + C_t) - k = R_{I2}^{r\max}. \tag{8}
\]

Note that the government anticipates that some of the consumer surplus \( c_i \), \( i = g, b \), at date 1 may be used to induce efficient termination, and hence cannot commit to give up all of \( c_i \) at date 0. However, as shown in the appendix, all of the consumer surplus given up at date 1 may be captured by the lender, and hence in equilibrium \( R_{rI}^{\max} \) remains unchanged.

Let us define a critical level \( k^{rt} \) of \( k \) such that \( R_{rI}^{\max} = 0 \). Then, assuming that the parameters of the model are such that \( R_G^r \geq R_{I}^{r\max} \), the government has an incentive to propose co-financing of the type just mentioned, to ensure financing of the project, and this for all \( k \in (k^r, k^{rt}] \).

**Proposition 2** When government intervention is feasible under private development, the government can and will intervene in two instances. At date 1, it may offer (contingent) tax subsidies to ensure efficient termination in the bad state of the world. And at date 0 it may

\(^{23}\)This holds even if the incumbent government is not reelected after date 1, as the next government has the same disregard for the distribution of wealth across economic agents and hence has no incentive to renege on the commitment made by the previous government.
use co-financing to ensure the financing of projects which should but would not otherwise be undertaken.

Proof. See appendix.

4.2 Impact on Efficiency

Ex post Inefficiency. By intervening at date 1, the government can ensure that the socially optimal decision is taken in both states of the world. Indeed as a result of it, the project is continued in the good state and terminated in the bad state. In other words, conditional on the project being undertaken, the total pie generated by private development corresponds to the FB pie. Private development is ex post efficient: \( XP'' = 0 \).

Ex ante Inefficiency. By intervening at date 1, and at date 0 through co-financing, the government can eliminate the pie effect and part of the slice effect, because its intervention has the benefit of offsetting the impact of the externality associated with private development. The government cannot, however, eliminate the slice effect associated with contractual incompleteness, which remains as a source of ex ante inefficiency. To see this, note that ex ante inefficiency under private development with government intervention can be expressed as

\[ XA'' = k_{FB} - k'' = R_{FB} - R_t^{\max}, \]  

or:

\[ XA'' = p ((s_g + S_g ) - (\Pi_t + c_g + C_g ) ) + (1 - p ) ((s_b + S_t ) - (\Pi_t + c_b + C_t ) ), \]  

(9)

which simplifies to:

\[ XA'' = p ((\pi_g + \Pi_g ) - \Pi_t ) + (1 - p ) ((\pi_b + \Pi_t ) - \Pi_t ) . \]  

(10)

It is easy to see that \( XA'' < XA' \), and hence:

Proposition 3 When government intervention is feasible, the government can intervene to offset the impact of the externality associated with private development. As a consequence, ex post inefficiency can be eliminated, and ex ante inefficiency can be mitigated (but not eliminated entirely).
Proof. Follows directly from above. ■

5 Public Development

5.1 Equilibrium

To understand equilibrium contracting with public provision, two points are noteworthy. First, as mentioned in our discussion of government co-financing, the government can credibly commit to make future payments to the lender, as long as they satisfy the budget constraint in each period. In the case of public development, the government has the option of extracting as cash the entire social surplus $s_i, i = g, b,$ at date 1, and $S_j, j = g, b, t,$ at date 2, depending on her type and on whether continuation or termination of the project is expected.

Second, the subgame starting at date 1 in which the public developer decides whether to continue or terminate the project, is a signaling (sub)game. When public developer of type $i, i = g, b,$ makes a continuation/termination choice, she anticipates the impact of her choice not only on the social surplus that it generates at date 2 ($S_i$ or $S_t$), but also on the electorate’s belief that she is of type $g$ (her reelection probability). In our setting, the following results can be shown:

Lemma 1 The first-best outcome from a date 1 standpoint, which is for a type $g$ developer to continue the project and for a type $b$ developer to terminate, cannot be an equilibrium with public development.

Proof. See appendix. ■

The intuition for this is simply that the type $b$ developer would never have an incentive to terminate given that the type $g$ continues, as through Bayesian updating the electorate would infer that she is of type $b$, and this would reduce to zero her chance of reelection. In other words, the FB outcome cannot hold because the type $b$ developer would have an incentive to deviate to continuation.

In fact, perhaps the most intuitive equilibrium of this subgame is a pooling equilibrium where both types - $g$ and $b$ - choose to continue the project. The good developer might choose continuation to take advantage of the higher surplus ($S_g > S_t$) associated with it. And a bad
public developer might choose to continue a project even though termination yields a higher surplus ($S_t > S_b$), in an attempt to manipulate the electorate’s belief about her type, i.e. to increase the electorate’s belief that the government is good, thus increasing the probability of reelection. Indeed in the appendix we show more formally that:

**Lemma 2** The pooling outcome where both types of public developer choose to continue the project is an equilibrium of the date 1 signaling subgame. Moreover, for parameter values such that $S_g > S_t/p$ and $S_t > S_b/p$, this equilibrium is the only one that satisfies Cho-Kreps’ (1987) “intuitive criterion” refinement.

These lemmas highlight the presence of a type of “soft budget constraint” (SBC); the (bad) public developer continues the project into the second period even though it should be terminated. In this model, in contrast to earlier work, the SBC arises as the result of the information asymmetry between the developer and the electorate, and the former’s attempt to manipulate the latter’s belief about her type. More generally, the SBC inefficiency that emerges here is the result of an externality in that the government fails to internalize the impact of its actions on social surplus in the event of not being reelected.

The overall game (which includes the signaling subgame just evoked) has many equilibria, which all yield the same outcome from a social standpoint – they differ only in how the surplus is allocated between agents (about which the public developer is indifferent). For simplicity we look at equilibria in which the lender earns a zero return from a date 0 perspective.

**Equilibria of the game**

i) **When** $k \leq p(s_g + S_g) + (1-p)(s_b + S_b)$:

As noted above, the public developer can offer to make the following payments to the lender in state $i$, $i = g, b$: any $d_i^u \leq s_i$ at date 1, and any $D_i^u \leq S_i$ at date 2. Thus, for a given $k$, the maximum return the lender can expect to make is:

$$R_i^{u\max} = p(s_g + S_g) + (1-p)(s_b + S_b) - k.$$  \hspace{1cm} (11)

As long as $R_i^{u\max} \geq 0$, there exists many values of $\{d_g^u, D_g^u, d_b^u, D_b^u\}$ such that the lender makes a zero expected return $R_i^x$ from a date 0 perspective, where:
\[ R^u_I = p (d^u_g + D^u_g) + (1 - p) (d^u_b + D^u_b) - k = 0. \] (12)

Despite the non-verifiability of payoffs, this offer is implementable, simply because neither party has an incentive to renege. By keeping control over the project in all circumstances, the public developer can ensure at date 1 that it is not terminated, and as discussed above this is optimal from her perspective.

The public developer’s expected payoff takes into account the probability of reelection, which in our “pooling on continuation” equilibrium is equal to the prior probability \( p \) of being of type \( g \). It can be expressed as:

\[ R^u_E = p (s_g + pS_g) + (1 - p) (s_b + pS_b) - k. \] (13)

The social return with private development differs from the public developer’s expected payoff in that the second period payoffs \( S_g \) and \( S_b \) are enjoyed regardless of reelection results:

\[ R^u_S = p (s_g + S_g) + (1 - p) (s_b + S_b) - k. \] (14)

ii) When \( k > p (s_g + S_g) + (1 - p) (s_b + S_b) \):

Let us define \( k^u \) as the value of \( k \) such that be such that \( R^u_I \max = 0 \). Since the maximum the developer can commit to return to the lender is \( p (s_g + S_g) + (1 - p) (s_b + S_b) \), projects with an initial cost \( k > k^u \) imply \( R^u_I < 0 \) and cannot be financed.

5.2 Efficiency

Ex Post Inefficiency, with public development, can be obtained by subtracting (14) from (1):

\[ XP^u = R_{FB} - R^u_S = (1 - p) (S_t - S_b). \] (15)

Expression (15) simply formalizes the soft budget constraint inefficiency alluded to after
lemma 2. In the bad state the public developer wants to continue the project - even though it ought to be terminated - in an attempt to manipulate voters’ beliefs about her type and to increase her probability of reelection. This creates a pie effect, in that the total pie generated by public development is smaller than the FB pie.

**Ex Ante Inefficiency** is also present with public development. On the one hand, since the developer cares about the social surplus but not about the way it is distributed between consumers and lenders, the maximum it can commit to repay to the lender is the entire social surplus. In other words, there is no slice effect.

On the other hand, the pie effect creating ex post inefficiency also creates an ex ante inefficiency. In the bad state, public development generates a total pie \((s_b + S_b)\) which is smaller than the FB pie \((s_b + S_t)\), and this has an impact on the condition necessary to undertake the project in the first place. To see this, recall that with public development, a project is undertaken if and only if \((\text{iff})\) the initial cost \(k\) is such that \(R_i^u \max \geq 0\), i.e. iff \(k \leq k^u\), with \(k^u\) defined such that \(R_i^u \max (k^u) = 0\). Looking back at (1) and (11), we can deduce:

\[
XA^u = k_{FB} - k^u = (1 - p) (S_t - S_b). \tag{16}
\]

Since there is no slice effect, only the pie effect remains and ex ante inefficiency exactly equals ex post inefficiency. In sum:

**Proposition 4** Public development is both ex post and ex ante inefficient, for the same reason: the bad public developer has an incentive to continue projects which should be terminated, in attempt to manipulate the electorate’s belief about her type and to increase her probability of reelection. As a result, the total surplus generated with public development is less than first-best (ex post inefficiency), and this in turn implies that some positive NPV projects cannot be financed under public development (ex ante inefficiency).

**Proof.** Follows from the above. ■
6 Private Vs Public Development

6.1 Normative Analysis

Ex Post Inefficiency

If government intervention is not feasible under private development:

When $k$ is such that $k \leq \min(k^r, k^u)$, so that the project can be financed with both private and public development, the question arises as to which is optimal. From the above discussion, it is easy to see that private and public development are equally ex post inefficient:

$$
\Delta XP = XP^r - XP^u = (1 - p)(S_t - S_b) - (1 - p)(S_t - S_b) = 0
$$

Note that although both private and public developers inefficiently continue the project in the bad state, they do so for different reasons: in the former case this has to do with an externality, while in the latter case it has to do with signal manipulation of the electorate’s beliefs by the government.

If government intervention is feasible under private development:

In that case government intervention ensure ex post efficiency under private development, and hence private development dominates whenever $k$ is such that $k \leq \min(k^r, k^u)$:

$$
\Delta XP' = XP'^r - XP'^u = 0 - (1 - p)(S_t - S_b) < 0.
$$

(17)

From these results we deduce the following proposition:

**Proposition 5** If both private and public development are feasible, private development is weakly superior to public development.

**Proof.** Follows directly from above. ■

Ex Ante Inefficiency

If government intervention is not feasible under private development:

Are there projects that can only be financed with one type of financing? To answer this, we analyze how ex ante efficient public development is, relative to private development. We
determine \( \Delta XA = XA^r - XA^u = k^u - k^r = R^{u}_{I_{\text{max}}} - R^{r}_{I_{\text{max}}} \), which can be expressed as follows:

\[
\Delta XA = p \left[ (s_g + S_g) - \Pi_I \right] + (1 - p) \left[ (S_b + s_b) - \Pi_I \right].
\]

The ex ante inefficiency associated with private development - due to the externality and to contractual incompleteness - is present in both states of the world, while that associated with public development - the SBC inefficiency - only affects the bad state of the world. Consequently, conditional on reaching the good state, the maximum payoff the lender can expect to receive with public development is unambiguously higher than his maximum payoff with private development. Conditional on reaching the bad state, the maximum payoff the investor can expect to receive is higher with public development than with private development if:

\[
(S_b + s_b) - \Pi_I \geq 0. \quad (18)
\]

In our model, public development is “likely” to be ex ante superior to private development.\(^{24}\) In fact, inequality (18) is sufficient (but not necessary) to ensure that \( \Delta XA > 0 \), since in that case the maximum the lender can expect to receive is higher with public development in both states of the world. The direct consequence is then that \( k^u > k^r \), and hence all projects such that \( k^r < k \leq k^u \) can only be financed with public development.

*If government intervention is feasible under private development:*

The intuition is exactly the same as in the scenario in which government intervention is not feasible, except that ex ante efficiency is somewhat less in favor of public development, since government intervention improves the ex ante efficiency of private development. The difference in efficiencies can be written as: \( \Delta XA = XA^{r'} - XA^u = k^u - k^{r'} = R^{u}_{I_{\text{max}}} - R^{r'}_{I_{\text{max}}} \), which can be expressed as follows:

\[
\Delta XA = p \left[ (\pi_g + \Pi_g) - \Pi_I \right] + (1 - p) \left[ \pi_b - (S_t - S_b) \right];
\]

\(^{24}\)For \( \Delta XA \) to be strictly negative, the following must occur: condition (18) must not hold, and \( (S_b + s_b) - \Pi_I \) must be substantially larger than \( (\pi_g + \Pi_g) - \Pi_I \), or the probability of success of the project, \( p \), must be very small.
and the sufficient condition for ex ante superiority of public development in that scenario is:

\[ \pi_b - (S_t - S_b) \geq 0. \tag{19} \]

One can easily verify that (18) is less binding than (19). We summarize this as follows:

**Proposition 6** Condition (19) is sufficient (but not necessary) to ensure that \( k^u > k^{r'} > k^r \).

Then, even if government intervention is feasible under private development, projects with an initial capital requirement \( k \in (k^{r'}, k^u] \) can only be financed with public development.

**Proof.** Follows directly from above.

---

### Optimal Development

Bringing together the conclusions of our discussions on ex post and ex ante (in)efficiencies, we deduce the following results, which are depicted graphically in figure 2:

**Proposition 7** 1) Regardless of whether government intervention under private development is feasible, when both private and public development are available, the former is weakly superior to the latter. 2) Even if government intervention under private development is feasible (and a fortiori if it is not), condition (19) is sufficient (but not necessary) to ensure the existence of a region in which only public development is feasible.

**Proof.** Follows directly from above.

---

### 6.2 Positive Analysis

To determine what type of development the government chooses at date 0, we simply look back at the government’s expected payoff from a date 0 perspective.

When private development is chosen, the government’s expected payoff, which we determined in (5), is:

\[
R_G^0 = p(s_g + pS_g) + (1 - p)(s_b + pS_b) - k \quad \text{If gov. interv. is not feasible}
\]

\[
R_G' = p(s_g + pS_g) + (1 - p)(s_b + pS_b) - k \quad \text{If gov. interv. is feasible}
\]
When public development is chosen, the government’s expected payoff equals the public developer’s expected payoff, which we determined in (13):

\[ R^p_G = R^p_E = p(s_g + pS_g) + (1 - p)(s_b + pS_b) - k. \]  

From (20) and (21) it is easy to see that private development yields a higher return to the government than public development does (by assumption we have \( S_t \geq S_b \)), which implies the following:

**Proposition 8** When both private and public development are feasible, then the payoff maximizing choice for the government is private development.

**Proof.** Follows directly from above. ■

The intuition is simply that choosing private development is a way for the government to commit *not* to manipulate the electorate’s posterior beliefs at date 1, since with private development these beliefs remain equal to priors throughout the game. In the language of the SBC literature, private development is a way for the government to deliberately “harden” its budget constraint. Indeed, with private development the government can achieve the same probability of reelection \( p \) as with public development, without having to inefficiently continue projects that should be terminated. Moreover, because the government can capture all of the resulting expected efficiency gains, \( (1 - p)p(S_t - S_b) \), it makes the efficient decision at date 0: looking back at propositions 7 and 8, one can verify that the government’s actual choice is the choice that it *ought* to make.

## 7 Discussion and Concluding Remarks

Our model provides conditions under which private development – in effect a P3 with private provision of financing – dominates public funding and vice versa. We have shown that private development may be ex post superior to public financing, because under certain reasonable conditions it leads to the efficient termination of bad projects, while public developers may sustain such projects for political reasons. When both types of financing are available, private development may thus be preferred, as it “hardens” the project budget constraint. On the other
hand, private developers can only commit to smaller debt repayments, and hence can only find lenders for projects requiring smaller capital outlays, i.e. with higher expected returns. Projects with lower expected returns can only be financed by public developers, who do not have the same commitment problems.

In order to provide clear, stark, and tractable results, the model presented here is highly stylized, and some of the assumptions made implicitly or explicitly in our approach should be explained briefly. The first issue is related to our assumption of non-verifiability of profits, and the consequent optimality of debt contracts. It is certainly true that if the private developer were willing and able to provide all the necessary capital itself, without needing to borrow, the incomplete contracts problem we highlight here would not be relevant. Indeed, for many smaller projects it is not unusual for private partners to provide all the necessary capital. However, many P3 projects – and the sort we are concerned with here – are simply too large for firms that are principally in the (for example) construction, design, operation and maintenance businesses to finance out of their own resources. The amounts of capital they require demand the participation of financial firms with access to substantial pools of capital that can provide the financing without exposing themselves to inordinate amounts of risk in any single project. Even when a consortium member, for example a construction firm, does have capital it could use as equity to reduce the P3 project’s borrowing needs, it faces the problem of how best to use that capital. Does it deploy it to expand its construction activities by, for example, preparing bids on other projects, or sink the money into the current project. Given that an established project is likely to provide more attractive collateral to a lender, comparative advantage would suggest the construction company use its scarce capital on activities against which it is more difficult to borrow.

Of course, another alternative would be to assume profits to be verifiable, in which case under private development an equity contract would be optimal: At date 0, the developer relinquishes

\[25\text{We are grateful to an anonymous referee for encouraging us to discuss the motivations for some of these assumptions and their implications.}
\]

\[26\text{It is also interesting that some institutions that entered the P3 industry essentially as bankers – such as Australia’s Macquarie Bank – have now integrated into providing more non-financial services in many projects.}
\]

\[27\text{It is easy to compile a list of billion-dollar and larger P3 projects. Examples projects of about this size or larger would include (to name only a few): the Rion-Antirion Bridge in Greece, the Chicago Skyway (Chicago, USA), the Canada Line (Vancouver, Canada), Channel Tunnel (UK-France); Sydney Cross-City Tunnel (Sydney, Australia), Cross-Israel Highway (Israel), Paris A-86 tunnels (France), Indiana Toll Road (USA), and the Vasco da Gama Bridge (Lisbon, Portugal).}
\]
a fraction of the equity to the investor such that his expected share of expected profits exactly equals his initial capital investment. In this scenario, the inefficiency that was previously associated with contractual incompleteness disappears, but without government intervention the pie and slice effects associated with the externality, and its consequent impact on ex post and ex ante inefficiencies, remain. As in our base model, however, government intervention can help eliminate the inefficiencies associated with this externality, and hence with verifiable profits and government intervention, private development is both ex post and ex ante efficient. In contrast, under public development, the verifiability of profits has no impact. The outcome in terms of inefficiency is the same with both debt and equity contracts. With both types of contracts, the public developer (in the bad state) has an incentive to continue projects that ought to be terminated as an attempt to manipulate the electorate’s belief about its type. Indeed, we conjecture that allowing for verifiable profits would tilt the tradeoff between public and private development in favor of the latter, which would strictly dominate the former.

The second issue is related to our implicit assumption that the project and the associated debt will be typically be “ring-fenced”. That is, the project will be delivered by a special-purpose corporation owned by the consortium members but having no claim on further resources from its parents. Should the project fail and be unable to repay its debts, creditors will typically not be able to secure repayment from the consortium members themselves. The reasons for ring-fencing in P3 projects are similar to those for ring-fencing many joint ventures. The success of these kinds of joint projects will typically depend on the efforts of all consortium members and failure can be the product of poor performance by even just one member. In such a situation, without ring-fencing the venture, each consortium member is exposed to risks created by the actions of other members. For example, unsatisfied creditors may press for repayment from a parent not responsible for the project’s failure or parents may be pursued for compensation in product liability actions for harms created through no fault of their own. As already described, many of these projects – and therefore the magnitude of the potential risks they present – are very large. Ring-fencing, for essentially the same reasons, facilitates commitment by partners to not bail out troubled projects – which encourages all partners to pull their weight in order to minimize the probability of poor outcomes. Other reasons for developing a joint venture (or P3) as a separate stand-alone entity relate to the fact that in this form it will be easier for partners to sell their interests should they wish to at some point (alienability) and the
standard incentives argument that it will be easier to motivate and assess venture management if it is operated as an independent entity rather than combining its operations with those of its parents.

Third, we assumed that the quality of the private developer was independently distributed from that of government, and consequently under private development, the electorate does not infer anything about government from the private developer’s actions. But the quality of government may actually be correlated to the quality of the private developer, in the sense that bad government is more likely to select a bad private developer. An extreme example would be the case of perfect correlation between developer type and government type. In that case, the kind of signal manipulation that we analyzed under public development in the base model would also take place under private development: In the bad state, the bad government would have an incentive to bribe the bad private developer to continue a project which ought to be terminated, thus generating additional inefficiencies under private development. Accordingly, in such cases the tradeoff between public and private development would tilt in favor of the former.

Fourth, while we do not incorporate any considerations of moral hazard in our model, some qualitative guidance as to the possible effects can be derived from the work of Dewatripont and Seabright (2006) cited earlier. In their paper, the authors assume that governments must exert effort to find good projects. In the context of our model (in which some project must go forward) this kind of effort decision would seem to reinforce the forces that already encourage governments to maintain bad projects they are developing. Whether a project is going badly because the government selected it poorly or developed it incompetently might not matter so much to voters at election time – they will be unhappy in either case. What is potentially different is the reaction of governments when they have chosen the private development alternative. If the government needs to undertake no effort in this case (i.e. if the developer is responsible for the effort decision) nothing need change in our model. However, suppose the government undertakes the effort before deciding whether to develop the project itself or permit private development. In this case a project terminated by the private developer could signal to voters that the government did not exert sufficient effort; and voters might respond by punishing the government at election time. This will strengthen the government’s interest in bailing out failing private projects reducing the benefit from private development.
Another possible extension of the model would be to examine the consequences of assuming the developer’s type to be known at date 0 rather than at date 1. We conjecture that the results of our base model should be broadly robust to this change in timing of the game, although some interesting differences should be pointed out, and would be worthy of further examination in future research. For example, under this new timing, some projects which are known to be bad at date 0 might not be financed, while they might be financed in our base model where this information becomes available at date 1, because from a date 0 point of view, there is still some probability that the project will turn out to be good.

Finally, certain important features of P3s were not considered at all. Importantly, the potential advantage of private funding we work with here has nothing to do with the private sector being more innovative or having lower costs of production, two of the reasons frequently offered in support of private involvement in P3 projects.28 And the government’s loss of control over managerial decisions, often used as an argument against P3s by opponents, is also absent from our model. We look forward to incorporating such dimensions of P3s in future research.29

A Appendix

Proof of Proposition 2:

Date 1 Intervention. Let the government propose the following mechanism to the private developer: 1) If the private developer announces her type to be \( b \), then she is to receive subsidy
\[
t_b = \Pi_b - \Pi_f + \varepsilon,
\]
with \( \varepsilon \to 0 \), if she makes the pre-specified debt repayment to the investor and then terminates the venture; and no subsidy otherwise (e.g. in case of default). 2) If the developer announces her type to be \( g \), then she receives no subsidy.

It is easy to see why this scheme is incentive compatible.

- If the developer is of type \( g \), then:

\[28\]It has also been argued that it may be optimal to privatize the finance function because of complementarities between various project tasks; specifically, the bundling of the finance task with the construction task provides enhanced incentives for private developers to complete projects on time and budget. See, e.g. de Bettignies and Ross (2004).

\[29\]For an interesting treatment of these and related dimensions in the context of privatization, see the recent work by Debande and Friebel (2004).
– If she truthfully reveals her type, she gets no subsidy and, her expected payoff is 
\[ \max \{ \pi_g + \Pi_g - d^r; \pi_g + \Pi_g - \Pi_t \} \], depending on whether she repays the debt or
defaults, respectively.

– If she lies and pretends to be of type b, she still gets no subsidy in equilibrium.
Conditional on repaying the debt, she would prefer to continue the project and
forfeit the subsidy, rather than terminate and get it, since the former payoff is higher
than the latter, by definition: \( \pi_g + \Pi_g - d^r > \pi_g + \Pi_b + \varepsilon - d^r \). And conditional on
defaulting, there is no subsidy available anyway.

– Thus, a type g developer gets the same equilibrium expected payoff, which can be
written \( \max \{ \pi_g + \Pi_g - d^r; \pi_g + \Pi_g - \Pi_t \} \), whether she tells the truth or lies. We
make the conventional assumption that when indifferent between lying and telling
the truth, the agent chooses the latter, and incentive compatibility for the type g
thus follows.

• If the developer is of type b, then:

– If she tells the truth and repays the loan, she is better off terminating, since her
expected payoff in that case (taking the government subsidy into account), \( \pi_b + \Pi_b + \varepsilon - d^r \) is higher than her continuation payoff \( \pi_b + \Pi_b - d^r \). If she tells the truth
but defaults, her payoff is \( \pi_b + \Pi_b - \Pi_t \). Thus, conditional on telling the truth, her
expected payoff is \( \max \{ \pi_b + \Pi_b + \varepsilon - d^r; \pi_b + \Pi_b - \Pi_t \} \).

– If she lies and pretends to be of type g, she gets \( \pi_b + \Pi_b - d^r \) in case of debt
repayment, and \( \pi_b + \Pi_b - \Pi_t \) in case of default. This yields an expected payoff of
max \( \{ \pi_b + \Pi_b - d^r; \pi_b + \Pi_b - \Pi_t \} \).

– The truth-telling payoff weakly dominated the payoff from lying, ensuring incentive
compatibility.

Thus, this revelation mechanism with contingent subsidy ensures socially efficient continu-
ation/termination decisions by both type g and type b developers. Moreover, it is financially
feasible as long as the tax revenue (i.e. the consumer surplus) available to the government in
the bad state, is superior to \( t_b = \Pi_b - \Pi_t + \varepsilon \), which we assume for simplicity.

Date 0 Intervention. The proof follows directly from the text. □
Proof of Lemma 1:

The electorate’s prior belief that the government is of type $g$ is simply $p$. However, after observing the public developer’s action at date 1, namely continuation or termination of the project, the electorate updates its belief using Bayes’ rule. We denote the electorate’s belief that the public developer is of type $g$ after observing continuation as $\Pr(i = g/\text{cont.})$. Similarly the electorate’s belief that the public developer is of type $g$ after observing termination at date 1 is denoted $\Pr(i = g/\text{term.})$.

Thus, for a public developer of type $i$, $i = g, b$, the expected payoff from playing continuation is $\Pr(i = g/\text{cont.})S_i$, while the expected payoff from playing termination is $\Pr(i = g/\text{term.})S_t$. At date 1, the public developer of type $i$ chooses to continue if and only if her expected payoff from doing so is higher than her expected payoff from terminating. $\square$

The FB outcome from a date 1 standpoint, which is for a type $g$ develop to continue the project and for a type $b$ developer to terminate, cannot be an equilibrium with public development for the following reason. If type $g$ chooses continuation and type $b$ chooses termination, Bayesian updating yields $\Pr(i = g/\text{cont.}) = 1$ and $\Pr(i = g/\text{term.}) = 0$. As a result, type $b$’s expected payoff if she plays termination is $\Pr(i = g/\text{term.})S_t = 0$, which is less than her expected payoff if she plays continuation, $\Pr(i = g/\text{cont.})S_b = S_b$. Thus this cannot be an equilibrium. $\square$

Proof of Lemma 2:

Proof that a pooling outcome with both types choosing continuation is an equilibrium:

In the case of pooling on continuation, the posterior belief conditional on observing termination equals the prior belief, i.e. $\Pr(i = g/\text{cont.}) = p$. We denote by $q_1$ the out-of-equilibrium belief that the developer is of type $g$ after observing continuation. It is optimal for type $g$ to play termination if and only if $pS_t \geq q_1S_g$. Similarly, it is optimal for type $b$ to play termination if and only if $pS_t \geq q_1S_b$. Clearly, playing continuation is optimal for both types for any $q_1 \leq p\frac{S_t}{S_g}$. Therefore, the strategies of playing continuation for both types, the posterior belief $\Pr(i = g/\text{cont.}) = p$, and the out-of-equilibrium belief $q_1$, are a pooling perfect Bayesian equilibrium for any $q_1 \leq p\frac{S_t}{S_g}$.

Proof that, if $S_t > S_b/p$ and $S_g > S_t/p$, a pooling outcome with both types choosing continuation is the unique pure strategy equilibrium satisfying Cho-Kreps’ “intuitive criterion”: 33
We have already shown that even without this restriction on parameters, the separating outcome with type $g$ choosing continuation and type $b$ choosing termination is not an equilibrium.

For similar reasons, separation with type $g$ choosing termination and type $b$ choosing continuation is not an equilibrium either. In that case, bayesian updating yields $\Pr(i = g/cont.) = 0$ and $\Pr(i = g/term.) = 1$. As a result, type $b$’s expected payoff if she plays continuation is $\Pr(i = g/cont.)S_b = 0$, which is less than her expected payoff if she plays termination, $\Pr(i = g/term.)S_t = S_t$. Thus this cannot be an equilibrium.

If $S_t > S_b/p$, then a pooling outcome with both types playing termination cannot be an “intuitive” equilibrium. The reasoning goes as follows. With pooling on termination, the posterior belief conditional on observing termination equals the prior belief, i.e. $\Pr(i = g/term.) = p$. We denote by $q_1$ the out-of-equilibrium belief that the developer is of type $g$ after observing continuation. It is optimal for type $g$ to play termination if and only if $pS_t \geq q_1S_g$. Similarly, it is optimal for type $b$ to play termination if and only if $pS_t \geq q_1S_b$.

If $S_t > S_b/p$, then continuation is equilibrium-dominated for type $b$, in the sense that the developer prefers termination over continuation for all out-of-equilibrium belief $q_1 \in [0,1]$. As a result, the electorate anticipates that if continuation is observed, then the deviator must be of type $g$, and hence the out-of-equilibrium belief can be restricted to $q_1 = 1$. But then it is not optimal for the type $g$ developer to stay on termination, and she would deviate to continuation, since $S_g > S_t$ implies $S_g > pS_t$. Thus pooling on termination cannot be an equilibrium.

If $S_g > S_t/p$, the outcome where both types choose continuation, the posterior belief $\Pr(i = g/cont.) = p$, and the out-of-equilibrium belief $q_2 = 0$ that the developer is of type $g$ after observing termination, is the unique pooling perfect Bayesian equilibrium satisfying the intuitive criterion. To see this, note that with pooling on continuation, the posterior belief conditional on observing continuation equals the prior belief, i.e. $\Pr(i = g/term.) = p$. It is optimal for type $g$ to play continuation if and only if $pS_g \geq q_2S_t$. Similarly, it is optimal for type $b$ to play continuation if and only if $pS_b \geq q_2S_t$.

If $S_g > S_t/p$, then termination is equilibrium-dominated for type $g$, in the sense that the developer prefers continuation over termination for all out-of-equilibrium belief $q_2 \in [0,1]$. As a result, the electorate anticipates that if termination is observed, then the deviator must be of type $b$, and hence the out-of-equilibrium belief can be restricted to $q_2 = 0$. With these
beliefs, both types of developers have an incentive to play continuation, which is therefore an equilibrium. This completes our proof. □

Proof that the Results are Robust to a More General Formulation of the Model:

Suppose we change the model in the following way: The developer can turn out to be either of type $G$ (good) or of type $B$ (bad) with probabilities $p$ and $(1-p)$, respectively. A type $G$ developer systematically is successful at implement a $g$ (good) project. A type $B$ developer implements a $g$ project with probability $y$ and a $b$ (bad) project with probability $(1-y)$.

Under private development:

Whether one uses this formulation of the model, or the simpler one used in the text, has not impact on the results (just on notation)

Under public development:

There are 8 potential equilibria. We examine each one in turn.

1) $\{Gc, Bgt, Bbt\}$. This refers to the potential equilibrium in which $G$ chooses $c$ (continuation), $B$ chooses $t$ (termination) if project implementation was successful, and $B$ also chooses if implementation was not successful. This separating outcome is never optimal for $B$, whose probability of reelection can be expressed as $\Pr(i = G/term.) = 0$, and therefore cannot be an equilibrium.

2) $\{Gt, Bgc, Bbc\}$. This separating outcome is never optimal for $B$, whose probability of reelection can be expressed as $\Pr(i = G/term.) = 0$, and therefore cannot be an equilibrium.

3) $\{Gc, Bgc, Bbc\}$. This pooling on $c$ outcome is an equilibrium for the same reason as in the reduced-form model.

4) $\{Gt, Bgt, Bbt\}$. This pooling on $t$ outcome cannot be an “intuitive” equilibrium for the same reasons as in the reduced-form model.

5) $\{Gc, Bgc, Bbt\}$. In that case, $\Pr(i = G/term.) = 0$ and $\Pr(i = G/cont.) = p/(p + (1-p)y)$. Given these posterior beliefs, it is optimal for $G$ to play $c$, but not optimal for $Bb$ to play $t$. Thus this cannot be an equilibrium.

6) $\{Gc, Bgt, Bbc\}$. In that case, $\Pr(i = G/term.) = 0$ and $\Pr(i = G/cont.) = p/((p + (1-p)(1-y))$. Given these posterior beliefs, it is optimal for $G$ to play $c$, but not optimal for $Bb$ to play $t$. Thus this cannot be an equilibrium.

7) $\{Gt, Bgc, Bbt\}$. In that case, $\Pr(i = G/term.) = p/(p + (1-p)(1-y))$ and $\Pr(i =
Given these posterior beliefs, it is optimal for $G$ to play $t$, but not optimal for $B_g$ to play $c$. Thus this cannot be an equilibrium.

8) $\{G_t, B_{gt}, B_{bc}\}$. In that case, $\Pr(i = G/\text{term.}) = \frac{p}{p + (1 - p) y}$ and $\Pr(i = G/\text{cont.}) = 0$. Given these posterior beliefs, it is optimal for $G$ to play $t$, but not optimal for $B_b$ to play $c$. Thus this cannot be an equilibrium.

Thus, with this more general formulation of the model, the only “intuitive” equilibrium under public development is pooling on continuation, just like in the reduced-form model used in the text. $\square$
References


Figure 1

At date 0, the developer offers a debt contract to the lender which stipulates an initial capital outlay $k$. The developer is of type $g$ with probability $p$, and of type $b$ with probability $(1-p)$.

At date 1, Nature reveals the developer’s type, and the associated payoffs. The developer decides whether to make the debt repayment $d$, or to default on the loan. In case of default, the lender takes over the asset and terminates the project. If the developer makes the debt payment and keeps control, she decides whether to continue the project, or to terminate.

At date 1.5, an election occurs. The incumbent government’s probability of reelection is the voters’ posterior belief that the government is of type $g$.

At date 2, final payoffs are realized. They depend on the developer’s type, and on the continuation/termination decision.
Figure 2

Figure 2: Private Versus Public Development
Private development is ex post superior to public development. This ex post superiority is measured by the difference in total surpluses, \((1 - p)(S_i - S_b)\), and implies that private development should be used whenever possible. However, while private development can only be used when the initial cost of the project, \(k\), is such that \(k \leq k^r\) (with co-financing, or \(k \leq k^{r'}\) without it), public development can be used for all \(k \leq k^{u}\). The ex ante superiority of public development over private development is measured by the difference in threshold levels of \(k\), \(k^u - k^{r'}\).

Finally, for \(k\) sufficiently large (\(k > k^u\)), neither private nor public development can be used, even though some of these projects would be undertaken in a first-best world.