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 and externalities, 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.

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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 approach is being adopted in countries of all wealth levels and on all continents.\footnote{See, e.g., Bettignies and Ross (2006), and Vining, Boardman and Poschmann (2005), for examples of countries, industries and projects in which P3s were used.}

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 (Bettignies and Ross, 2004), two features of modern P3s set them apart from simple contracting out. 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 more recently become a central feature of P3 projects.

In this paper we focus on the second and most controversial feature of P3s - the privatization of the finance function.\footnote{Opponents of P3s (e.g. public sector labor unions) 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. 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. 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. P3-type projects have been promoted by (among others) the World Bank for developing countries, in part because they may have no other way to fund important infrastructure.} Incorporating elements of industrial organization and corporate finance theory in a normative public policy analysis, we analyze the conditions under which either public or private finance ought to be preferred over the other. The model also sheds light on the positive question of when governments will choose private over public finance.
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. Whoever undertakes the project, private or public developer, must secure the initial capital required from an investor. We draw from the incomplete contracts frameworks\(^3\) of Bolton and Scharfstein (1990, 1996), and Hart and Moore (1998) to determine the optimal (debt) contract between the developer and the investor; and derive several key results:

With private development, two issues arise. The first issue is related to contractual incompleteness: the possibility of strategic default by the developer caps the debt repayment that she\(^4\) can commit to make, and limits the amount a lender is willing to provide to the developer in the first place. Accordingly, contractual incompleteness under private development leads to fewer projects being financed relative to the first-best benchmark. The second issue results from the private developer maximizing profits rather than social surplus, and thus ignoring the impact of her decisions on consumer surplus. This has two consequences here: 1) The private developer might make profit maximizing but socially inefficient decisions. This lowers the social surplus relative to the first-best benchmark. 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 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. Thus, contractual incompleteness and externalities both make private development \textit{ex ante} inefficient in limiting the number of projects being financed. Externalities also yield an \textit{ex post} inefficiency in reducing surplus generated by the projects that are indeed financed. We show, however, that government intervention may help mitigate these concerns: Through simple contract design and co-financing, the government can eliminate all externality-related inefficiencies.

With public development - when the government does the borrowing - the problem is different. To the extent that the electorate can use the public developer’s observable actions to

\(^3\)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.

\(^4\)Throughout the paper we treat the project developer as female and the investor as male.
infer information about the government’s underlying quality, the public developer may take actions that are socially inefficient, in an attempt to manipulate the electorate’s beliefs about government quality, and improve reelection prospects. We show that these attempts also lead to both ex post and ex ante inefficiencies.

Comparing private and public financing from both ex ante and ex post standpoints, we find that -when both types of financing are available - private development may be preferred, as it gets around the belief manipulation problem faced by the public developer. 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. Indeed, some projects can only be financed by public developers, who do not have the same commitment problems.

From a methodological standpoint, our model is most closely related to the incomplete contracts papers mentioned above; and indeed the possibility of strategic default under private development was identified in that literature previously. However we do depart from that line of research in placing issues of social welfare, as well as the role of government, at the forefront of the analysis; and believe the other key results of our model to be novel.

In the P3 literature, the focus so far has been on the 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 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; Iossa and Martimort, 2008). Our contribution here is in examining a different characteristic of P3s - private financing - and in analyzing the trade-off between private and public development through a modern corporate finance lens.

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.\textsuperscript{5} This literature attempts to explain why governments tend to bail-out or continue projects that should be terminated. This tendency is central to our modeling of public financing, and here reflects an attempt by governments to manipulate the electorate’s belief about their intrinsic quality, and hence to increase their reelection probability.\textsuperscript{6} The hypothesized implications of such soft budget constraints for the continuation of

\textsuperscript{5}See Kornai et al. (2003) for an excellent review of that literature.

\textsuperscript{6}Under their list of possible motives for the inefficient continuation of failed enterprises, Kornai et al. (2003, p.
weak projects have been documented by many researchers.\footnote{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.}

The two papers on the efficiencies of government spending that come closest to ours are those by Dewatripont and Seabright (2006) and Coate and Morris (1995). Both papers model governments that make “inefficient” decisions in order to improve their chances at reelection. 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. 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 may take to proceed with projects (even those that may be wasteful) so as to be seen by voters to be working hard. Importantly, however, neither paper examines how to deliver public projects as a choice - considered here - between private and public developers.

The paper is organized as follows: Section 2 sets up the basic model. Sections 3 and 4 examine private development. Section 5 focuses on public development. Section 6 compares the two types of financing from both normative and positive standpoints. Finally, section 7 discusses key assumptions of the model and concludes. Proofs are in the appendix.

\section{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 deci-
sions, and full control over the profits generated. The characteristics of the game are described
immediately below; its timing is depicted in figure 1.

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. \(^8\)
There is a competitive supply of investors, hence the developer makes the investor a take-it-or-
leave-it offer at the beginning of the game. \(^9\)

**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 developer, the probability of being of type \(g\) (resp. \(b\)) is \(p\) (resp. \(1 - p\)). A
good developer can successfully implement the project, which yields social benefit \(s_g\) at date
1, and \(S_g\) at date 2. \(^10\) A bad developer implements a less successful project which yields \(s_b\) at
date 1, and \(S_b\) at date 2. 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. Under private
development, the government is uninformed about the developer’s type. We refer to the good
(resp. bad) state as the situation in which the developer turns out to be of type \(g\) (resp. \(b\)). \(^11\)

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

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\(^8\)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 all else equal the public developer will be able to finance more projects.

\(^9\)Another implicit assumption merits brief discussion. In this model, the project is “ring-fenced” in the
sense that it is delivered by a special purpose corporation owned by consortium members but having no further
claim on the resources of its parents. This is indeed how large P3 projects are typically structured, the reasons
being related to those for the ring-fencing of many other joint ventures. For example, (i) ring-fencing provides
some protection for consortium members from risks related to the poor performance of other members; (ii)
it facilitates the sale of ownership shares; and (iii) the independent structure makes it easier to design and
implement incentive schemes for senior project managers.

\(^10\)Lower case letters represent 1st period variables, and capital letters represent 2nd period variables.

\(^11\)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 such a case, a bad outcome
could be the result of bad management or the project may have been doomed from the start. All we need here
is for the observation of a bad outcome, under public development, 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.
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 its 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.\footnote{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 possibility in section 7.}

**Objective functions.** The government derives a benefit from generating social surplus – through public or private development – but only if it remains in power, as in the government objective function employed by Coate and Morris (1995). 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 $\Pr (\text{gov: type } = g) S_j, j = g, b, t$, where $\Pr (\text{gov: type } = g)$ is the probability of reelection in period 2. 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 attention to situations in which profits from termination are lower than the continuation profits for the type $b$ developer: $\Pi_t < \Pi_b$. This parameter restriction 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 as will become clear below, the case in which $\Pi_t \geq \Pi_g$
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.\textsuperscript{13} It also has the additional advantage of ruling out equity contracts, and of allowing us to focus instead on debt contracts, the most common type of financial instrument used in P3s.\textsuperscript{14}

We posit that under private development 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, but 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 $\lambda < 1$. Under public development, the government can still extract consumer surplus using taxes and user charges, but also has a claim on profits, and hence can extract as cash the entire social surplus at dates 1 and 2.

\textit{[Insert Figure 1 here]}

\textbf{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 as $R_{FB} = p(s_g + S_g) + (1 - p)(s_b + S_t) - k$.

In the FB, the project is undertaken if and only if $R_{FB} \geq 0$. We 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. We interpret low $k$ projects as high return projects, and vice versa.


\textsuperscript{14}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.
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

As shown in Bolton and Scharfstein (1990, 1996), and Hart and Moore (1998), in the type of framework analyzed here, 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.\(^{15}\) If the payment is made, the developer retains control (ownership) of the project. In case of default, the lender seizes control, terminates the venture, and redeployes the assets in another project. As mentioned, this generates a social benefit $S_t$ and expected profits $\Pi_t$. 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 renegotiation would therefore simply be a payment $z = \Pi_t$ from the developer to the lender, in exchange for keeping control in the second period.\(^{16}\) 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 strategically defaults, 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.\(^{17}\) 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

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\(^{15}\)The superscript $r$ (resp. $u$) indicates that we are in the “private developer” (resp. “public developer”) scenario. We implicitly assume that payment $d$ is verifiable.

\(^{16}\)The general results of the model are robust to other allocations of bargaining power in renegotiation, including Nash bargaining. We choose this assumption for simplicity.

\(^{17}\)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.
period 2, with a total payoff of $\pi_b + \Pi_b - \Pi_t$. Thus, a type $b$ developer defaults if and only if $d^r > \Pi_t$. Thus, regardless of default and/or the state of the world, continuation occurs. This is socially efficient in the good state ($S_g > S_t$), but inefficient in the bad state ($S_t > S_b$).

**Date 0 Decisions.** From the analysis of date 1 decisions, we deduce that the expected return to the lender from a date 0 perspective can be expressed as $R^r_l = pd^r + (1 - p)d^r - k = d^r - k$ for all $d^r \leq \Pi_t$, and $R^r_l = \Pi_t - k$ otherwise.\(^\text{18}\) Thus, the maximum return the lender can hope to get for a given $k$ is $R^r_l|_{\text{max}} = \Pi_t - k$.

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

**Equilibrium of the Game**

i) When $k \leq \Pi_t$: The developer never defaults, makes the debt repayment $d^{r*}(k) = k$, extracts all rents from the lender, and continues the project into the second period in both states of the world ($g$ or $b$). The developer’s expected return $R^r_E$, the social return $R^r_W$, and the government’s expected payoff $R^r_G$, can be expressed as follows:\(^\text{19}\)

$$R^r_E = p(\pi_g + \Pi_g) + (1 - p)(\pi_b + \Pi_b) - k,$$
$$R^r_W = p(s_g + S_g) + (1 - p)(s_b + S_b) - k,$$
$$R^r_G = p(s_g + pS_g) + (1 - p)(s_b + pS_b) - k.$$  \hspace{1cm} (1)

ii) When $k > \Pi_t$: Let us define $k^r$ as the value of $k$ such that $R^r_l|_{\text{max}} = 0$. 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.

\(\text{3.2 Efficiency}\)

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

\(^{18}\)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.

\(^{19}\)Note that in $R^r_G$, 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 $g$. 

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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 $R_W$ from $R_{FB}$, which can be verified to yield $XP^r = (1 - p) (S_t - S_b)$. 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 under private development is smaller than the FB pie, generating ex post inefficiency.

**Ex Ante Inefficiency** arises because the maximum payoff that the lender can expect to obtain is lower than the FB net benefit. As a result there are some projects that ought to be financed (i.e. for which $R_{FB} \geq 0$), which are not in fact undertaken because they yield a strictly negative return to the investor. More formally, the cutoff level of $k$ above which $R^\text{max}_I < 0$, $k^r$, is lower than the FB cutoff level $k_{FB}$, and projects with $k \in (k^r, k_{FB}]$ are not financed, even though they should be. Following Gertner et al. (1994), we measure ex ante inefficiency as the difference between these cutoff levels of $k$:

$$
XA^r = k_{FB} - k^r = R_{FB} - R^\text{max}_I = p ((s_g + S_g) - \Pi_t) + (1 - p) ((s_b + S_b) - \Pi_t). 
$$

For explanatory purposes, let us rearrange (2) as follows:

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

The maximum expected payoff for the lender is lower than the FB net benefit for three reasons. First, even if the lender could commit to return 100% of the social surplus, this amount would be less than the FB surplus, due to inefficient continuation in the bad state: Indeed the “externality pie effect” described above may have - in addition to an ex post impact
- an ex ante impact. This is captured by the first difference in the second square bracket in (3).

In addition, there may also be two types of “slice effects,” as the lender anticipates that he will only receive a slice of the pie generated. The “externality slice effect” arises because the private developer ignores consumer surpluses, and thus cannot commit to return that part of the social surplus to the investor. In fact, due to incomplete contracts, the developer cannot commit to return even all of the profits generated: in both states of the world she has an upper bound $\Pi_t$ on the feasible debt repayment that she can commit to repay (above which she would rather default than repay). We call this the “contractual incompleteness slice effect”. The former and latter slice effects are captured in each square bracket, in the last two differences, 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 in fact financed.

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 also 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

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. What if the government can intervene? The government does have an incentive to intervene to ensure efficient termination in the bad
state, since its interests are aligned with social welfare: \( S_t > S_b \) if and only if the government’s expected payoff is higher with termination than with continuation, \( pS_t > pS_b \) (recall that the probability of reelection here is simply the prior probability of a type \( g \) government).

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 \( t_b = \Pi_b - \Pi_t \), 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 gets 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. Similarly, if she is of type \( b \), then the proposed mechanism ensures that truthful revelation weakly dominates 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 \( R_G^e \) 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. Assuming that the government chooses not to renege on a contract/promise unless it has an incentive to do so, such commitments are credible. As discussed above, under

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20While it may seem strange that the government would want to encourage the private developer to terminate 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.

21This holds even if the incumbent government is not reelected after date 1, as the next government is similarly indifferent to the distribution of wealth across economic agents and hence has no incentive to renege on the commitment made by the previous government.
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:

\[
R_t^{\text{max'}} = p(\Pi_t + c_g + C_g) + (1 - p)(\Pi_t + c_b + C_t) - k.
\] (4)

Note that, anticipating that some of the date 1 consumer surplus \( c_i, i = g, b \) may be used to induce efficient termination, the government cannot commit to give up all of \( c_i \) at date 0. The consumer surplus given up at date 1, however, can be captured by the lender (since the government transfer is conditional on debt repayment), and hence \( R_t^{\text{max'}} \) remains unchanged.

We define a critical level \( k'' \) of \( k \) such that \( R_t^{\text{max'}} = 0. \) Assuming that the model parameters are such that \( R_{G}^r \geq R_t^{\text{max'}} \), the government has an incentive to propose co-financing of the type just mentioned, to ensure financing, and this for all \( k \in (k', k''). \)

**Proposition 2** When feasible, government intervention will occur in two instances under private development. At date 1, the government may offer (contingent) subsidies to ensure efficient termination in the bad state of the world. And at date 0 it may use co-financing to ensure the financing of projects which should but would not otherwise be undertaken.

### 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 the world. The project is continued in the good state and terminated in the bad state. The externality pie effect disappears, and private development is ex post efficient: \( XP^{r'} = 0. \)

**Ex ante Inefficiency.** By intervening at date 1, and at date 0 through co-financing, the government can eliminate the externality pie and slice effects. However, the slice effect associated with contractual incompleteness 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 \( XA^{r'} = k_r - k'' = R_{FB} - R_t^{\text{max'}}, \) which simplifies to:
\[ XA' = p((\pi_g + \Pi_g) - \Pi_t) + (1 - p)((\pi_b + \Pi_t) - \Pi_t). \quad (5) \]

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 is eliminated, and ex ante inefficiency is mitigated (but not eliminated).

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 \( (S_i \text{ or } S_t) \), but also on the electorate’s belief that she is of type \( g \) (her reelection probability). In this setting, we show:

**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 under public development.

The intuition for this is simply that the type \( b \) public developer would never have an incentive to terminate given that the type \( g \) continues, since through Bayesian updating the electorate would infer that she is of type \( b \), and this would reduce to zero her chance of reelection. Indeed, the type \( b \) developer would always 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 the 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, 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 \(d_t^u \leq s_i\) at date 1, and any \(D_t^u \leq S_i\) at date 2. Thus, for a given \(k\), the maximum return the lender can expect to make is:

\[
R_t^{u \text{max}} = p (s_g + S_g) + (1 - p) (s_b + S_b) - k. \tag{6}
\]

As long as \(R_t^{u \text{max}} \geq 0\), 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 $R_I^u$ from a date 0 perspective, where:

\[ R_I^u = p(d_g^u + D_g^u) + (1 - p)(d_b^u + D_b^u) - k = 0. \quad (7) \]

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 the prior probability $p$ of of being of type $g$:

\[ R_E^u = p(s_g + pS_g) + (1 - p)(s_b + pS_b) - k. \quad (8) \]

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:

\[ R_S^u = p(s_g + S_g) + (1 - p)(s_b + S_b) - k. \quad (9) \]

\[ \text{ii) When } k > p(s_g + S_g) + (1 - p)(s_b + S_b): \text{ We define } k^u \text{ as the value of } k \text{ such that be such that } R_I^{u_{\text{max}}} = 0. \text{ Since the maximum the developer can return to the lender is } p(s_g + S_g) + (1 - p)(s_b + S_b), \text{ projects with } k > k^u \text{ imply } R_I^u < 0 \text{ and cannot be financed.} \]

\section*{5.2 Efficiency}

\textbf{Ex Post Inefficiency} can be obtained by subtracting $R_S^u$ from $R_{FB}$:

\[ XP^u = R_{FB} - R_S^u = (1 - p)(S_t - S_b). \quad (10) \]

Expression (10) simply formalizes the SBC 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.** 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: 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 the initial cost \(k\) is such that \(R_i^{\text{max}} \leq 0\) or \(k \leq k_u\), with \(k_u\) defined such that \(R_i^{\text{max}}(k_u) = 0\). Looking back at \(R_{FB}\) and \(R_i^{\text{max}}\), we can deduce:

\[
XA_u = k_{FB} - k_u = (1 - p) (S_t - S_b).
\]  

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).

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.

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 \( k \leq \min(k^r, k^u)\):

\[ \Delta XP' = XP'^r - XP'^u = 0 - (1 - p) (S_t - S_b) < 0. \] (12)

From these results we derive the following proposition:

**Proposition 5** If both private and public development are feasible, private development is weakly superior, in terms of ex post efficiency, to public development.

**Ex Ante Inefficiency.** If gov. 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 \( \DeltaXA = XA^r - XA^u = k^u - k^r = R_{I}^{\text{max}} - R_{I}^{\text{max}} \), which can be expressed as follows:

\[ \DeltaXA = p[(s_g + S_g) - \Pi_t] + (1 - p) [(S_b + s_b) - \Pi_t]. \]

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:

$$(S_b + s_b) - \Pi_t \geq 0.$$  \hfill (13)

In our model, public development is “likely” to be ex ante superior to private development.\footnote{For $\Delta XA$ to be strictly negative, the following must occur: condition (13) must not hold, and $(S_b + s_b) - \Pi_t$ must be substantially larger than $(\pi_g + \Pi_g) - \Pi_t$, or the probability of success of the project, $p$, must be very small.} In fact, inequality (13) is sufficient (but not necessary) to ensure that $\Delta X A > 0$, 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: $\Delta X A = X A^{r'} - X A^u = k^u - k^{r'} = R_i^{u \text{max}} - R_i^{r \text{max}}$, which can be expressed as follows:

$$\Delta X A = p[(\pi_g + \Pi_g) - \Pi_t] + (1 - p) [\pi_b - (S_t - S_b)];$$

and the sufficient condition for ex ante superiority of public development in that scenario is:

$$\pi_b - (S_t - S_b) \geq 0.$$ \hfill (14)

One can easily verify that satisfying (14) guarantees that (13) is satisfied, but not the reverse. We summarize this as follows:

\textbf{Proposition 6} Condition (14) 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.
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:

[Insert Figure 2 here]

**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 (14) is sufficient (but not necessary) to ensure the existence of a region in which only public development is feasible.

### 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.

Under private development, the government’s expected payoff - determined in (1) - is:

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

\[
R_G' = p(s_g + pS_g) + (1 - p)(s_b + pS_b) - k \quad \text{If gov. interv. is feasible}
\]

When public development is chosen, the government’s expected payoff equals the public developer’s expected payoff, which we determined in (8):

\[
R^n_G = R^n_E = p(s_g + pS_g) + (1 - p)(s_b + pS_b) - k.
\]  \hfill (16)

From (15) and (16) it is easy to see that private development yields a higher return to the government than public development does (by assumption we have \( S_t \geq S_b \)). This implies:

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

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 (to serve efficiency).

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 should be explained briefly. First, a question that naturally arises is 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
(iii) the private sector partner provides the operation of the facility. These three conditions are not generally met in simple contracting out arrangements, but are present (at least implicitly) in the model we develop here.

The second issue is related to our assumption of unverifiable cash flows. An 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 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. Thus 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.

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 with 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,

\[23\text{See, e.g., Bettignies and Ross (2004).}\]
some qualitative guidance as to the possible effects follows 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.

Finally, we remind the reader that certain important features of P3s were not considered here at all. Importantly, the potential advantage of private funding we work with in this paper 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. And the government’s loss of control over managerial decisions, often used as an argument against P3s by opponents, is also not an element of our model. We look forward to incorporating such dimensions of P3s in future research.

A Appendix

Proof of Proposition 1:

Follows directly from the text. □

24It has also been argued that it may be optimal to privatize the finance function because of complementaries between various project tasks; specifically, the bundling of the financing task with the construction task provides enhanced incentives for private developers to complete projects on time and budget. See, e.g. Bettignies and Ross (2004).

25For an interesting treatment of these and related dimensions in the context of privatization, see the recent work by Debande and Friebel (2004).
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 \( t_b = \Pi_b - \Pi_t \), 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.

Assuming that the developer follows the government suggested action when indifferent, it is easy to see why this scheme is incentive compatible.

- If the developer is of type \( g \), then:
  - If she truthfully reveals her type, she gets no subsidy and, her expected payoff is \( \max \{ \pi_g + \Pi_g - d'; \pi_g + \Pi_g - \Pi_t \} \), 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: \( \pi_g + \Pi_g - d' > \pi_g + \Pi_b - d' \). 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 \( \max \{ \pi_g + \Pi_g - d'; \pi_g + \Pi_g - \Pi_t \} \), whether she tells the truth or lies. Under 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, her expected payoff from terminating (taking the government subsidy into account) is \( \pi_b + \Pi_b - d' \), equal to her continuation payoff. Again by convention we assume that when indifferent she follows the government suggestion and terminates. If she tells the truth but defaults, her payoff is \( \pi_b + \Pi_b - \Pi_t \). Thus, conditional on telling the truth, the project is terminated, and her expected payoff is \( \max \{ \pi_b + \Pi_b - d'; \pi_b + \Pi_b - \Pi_t \} \).
- 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 is equal to the payoff from lying. Again, by convention the agent is assumed to choose truth-telling, ensuring incentive compatibility for the type $b$.

Thus, this revelation mechanism with contingent subsidy ensures socially efficient continuation/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 $t_b = \Pi_b - \Pi_t$, which we assume for simplicity.

*Date 0 Intervention.* The proof follows directly from the text. $\square$

**Proof of Proposition 3:**

Follows directly from the text. $\square$

**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 $\Pr(i = g = \text{term.})S_i$. 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, \( \Pr(i = g/cont.)S_b = S_b \). Thus this cannot be an equilibrium. □

**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. \( \Pr(i = g/cont.) = p \). 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 \( q_1 \leq pS_t \). Therefore, the strategies of playing continuation for both types, the posterior belief \( \Pr(i = g/cont.) = p \), and the out-of-equilibrium belief \( q_1 \), are a pooling perfect Bayesian equilibrium for any \( q_1 \leq pS_t \).

*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”:*

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 $\Pr(i = g/\text{cont.}) = p$, 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. $\Pr(i = g/\text{term.}) = p$. 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 of Proposition 4:**
Follows directly from the text. 

**Proof of Proposition 5:**
Follows directly from the text. 

**Proof of Proposition 6:**
Follows directly from the text. 

**Proof of Proposition 7:**
Follows directly from the text. 

**Proof of Proposition 8:**
Follows directly from the text.
References


Figure 1: Timing of the Game

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: 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.