

# The Theory of Public Private Partnerships

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## 1. Introduction and Motivation

This report explores the theoretical underpinnings for governments' use of Public-Private Partnerships (PPPs) as opposed to more traditional procurement (TP) methods. The key ingredient of a PPP is that some or all of the different stages in social service delivery – i.e. infrastructure design (D) and building (B), financing (F), and operation (O) – are “bundled” in a long-term contract (commonly 25-30 years) between government as “buyer”, and a firm or consortium of firms as “provider”. Many variants are possible, such as “DBO”, “BO” or “DBFO”. Under TP, by contrast, the government contracts for each stage individually with separate providers. Furthermore, PPP contracts specify required outputs while leaving private providers to determine how best to provide those outputs. In contrast, TP contracts specify inputs to a greater degree. At the same time, PPP contracts transfer both greater risk and incentives to the provider, while TP contracts commonly involve payment mechanisms that transfer less of both. Finally, under TP government retains ownership of the relevant assets, while under PPPs the provider retains ownership throughout the contract period, with asset ownership either transferred to the government or retained by the provider at the contract's conclusion.

Since the development of the Private Finance Initiative (PFI) in the UK in 1992, PPPs have been increasingly used in many parts of the world, and in a wide range of sectors, for the development of infrastructure and provision of public services. This development has largely preceded theory, with major theoretical contributions on the conditions under which PPP is to be preferred to TP arising only in the last decade. Even now that theory leaves many important aspects of PPPs unexplored, so it remains a rich area for further inquiry. The importance of this theory lies in the significance of PPPs across the world for providing infrastructure and services, the fact that the evidence on PPP performance and experience has been mixed, and because of the significant long-term risks that PPPs create to public finances and social service delivery. Hence the stakes for determining when PPPs should and should not be used, and how best they should be structured and used, are high.

The incidence of PPPs is now well established. Iossa and Martimort (2008) report World Bank data on PPPs indicating investments of US\$786 billion over 1990-2003 (in 2002 dollars), including 1,000 projects, or 47% of PPP investment, in Latin American and Caribbean (LAC) countries. PPPs have been used in the US, EU, UK, Eastern Europe, LAC countries, China, Canada, Australia and New Zealand. They include sectors as diverse as transport (roads, bridges, tunnels, airports, canals, railroads), power generation, water supply (dams, irrigation, sewerage, drainage), solid waste management, and information technology (IT). PPPs have also been used – especially in the UK – for the provision of traditionally “core” public-sector services such as schools, hospitals and prisons.

Auriol and Picard (2011) trace the antecedents of modern PPP schemes to the private provision of turnpike roads in seventeenth century Britain, followed by canal and railway concessions in both the UK and US. As for their modern counterparts, such schemes were often motivated by a need for infrastructure development when public finances were not available for outright government procurement. More contemporary schemes have often been motivated by governments' desire to procure service delivery while keeping the capital costs “off balance sheet”,

for example to technically satisfy macroeconomic stability rules in the EU.<sup>1</sup> Aside from such cynical motivations, however, PPPs are often motivated by a desire to introduce private sector innovation and efficiency in investment and management into areas traditionally dominated by government provision. Specifically, governments have sought to use PPPs to improve infrastructure design, reduce building times and cost overruns, accelerate project delivery, and improve levels of service delivery as well as responsiveness to changing needs. PPPs are expected to deliver such improvements by transferring risks to private providers, while also “bundling” activities in such a way that private operators take a “whole-of-life” approach to building and managing facilities (enabling synergies and efficiencies across stages of service delivery). Such risk transfer, bundling of activities, and compensation schemes, are intended to produce strong incentives for good performance by PPP providers.

The experience with PPPs has offered some encouragement for this expectation, but with mixed or discouraging evidence also. Iossa and Martimort (2008) cite evidence that PFI schemes in the UK have led to a greater delivery of projects on time and within budget as compared with traditional procurement. Similarly, Iossa and Martimort (2011b) report that design innovations leading to operational cost savings are also an often-cited benefit of PPPs (e.g. better prison designs leading to lower staffing requirements), and that PPP benefits have increased over time as more experience has been gained (e.g. by officials responsible for PPP design and implementation). However, PPPs have also been associated with higher user charges, renegotiation of PPP contracts is common, and there have been high-profile failures with PPPs, especially in areas such as IT. Interestingly, these authors cite studies showing that governments often initiate renegotiation, particularly in LAC countries, rather than simply providers seeking extra funds for cost overruns. Moreover, PPP processes are lengthy and costly, taking an average of 34 months, and with procurement costs reaching 5-10% of capital cost. Finally, PPP tenders commonly involve only a handful of bidders, implying a risk of bidder collusion.

In the balance of this report I provide a brief survey of the key theoretical considerations regarding the suitability of PPPs for procurement, and apply those considerations in a discussion of when, and how best, to structure and use PPPs. The report is structured as follows: Section 2 summarises some important institutional features of PPPs that motivate the later theoretical discussions. Section 3 discusses the main theoretical frameworks used in PPP analyses. Section 4 surveys some of the major theoretical contributions to PPP analysis, with a particular focus on the leading contribution, Iossa and Martimort (2008). Section 5 presents outstanding questions and areas for further research, while Section 6 concludes with a summary of when PPPs are to be preferred to TP.

## **2. Key Ingredients of PPPs**

Key PPP ingredients were introduced in the opening paragraph to this report. Following Iossa et al. (2007), in this section I elaborate on three additional ingredients – payment mechanisms and their associated risk allocation, contract flexibility and renegotiation, and contract length. To this list I also add PPP award procedure. These PPP features lie at the heart of PPP effectiveness, and so motivate the theoretical discussion in Section 4.

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<sup>1</sup> De Bettignies and Ross (2004) list other cynical motivations for PPPs, including the avoidance of public sector unions, hiding information from the public, and deflecting political blame for failures.

## 2.1 Payment Mechanisms and Risk Allocation

An important aim of PPPs is to transfer risk from the government to PPP providers. This is not only for political expedients, but also to make PPP providers responsible for risks that they are better able to manage, and by so doing to spur them to perform well. Important risks include infrastructure design, which can affect service quality as well as operating costs, and also demand and financial risks. Clearly, any risk transferred will need to be compensated for by way of a risk premium.

Clearly there are certain classes of risk which, if transferred to the PPP provider, could in fact prove counter-productive. These include macroeconomic and policy risks which are more amenable to government than provider control. But they also include any risk in respect of which the government is less risk-averse than the provider, which strikes at the nature of the parties as much as the risk itself. Indeed, Iossa et al. (2007, p. 21) set out two key principles that should govern efficient risk allocation:

“(P1) given partners with similar risk-aversion, the risk should be allocated to the party that is responsible or has relatively more control over the risk factor, and

“(P2) given partners with similar responsibility or control over the risk factor, the risk should be allocated to the party that is more able to bear it, i.e. the less risk-averse party.”

Critical to P1 is the non-contractibility of the action taken by the PPP provider to control the risk factor, since if the action was contractible then the government could achieve efficiency by specifying which action should be undertaken. P2 is explained by the desire to minimise total project cost, isolating risk-averse parties from risk and thus avoiding unnecessary risk premiums. Under these principles, risk is optimally allocated to the provider if it is less risk-averse than government, which ensures incentives over non-contractible actions. However, transferring risk to the provider when it is relatively more risk-averse creates a trade-off for the government: incentives are ensured but the provider must be paid a socially excessive risk premium to compensate it for risk bearing (i.e. there is a trade-off between incentives and insurance).

At the heart of risk transfer under PPP contracts is the payments mechanism. How the PPP provider is rewarded for providing its services, relative to contracted output specifications, determines its risks and incentives. While some PPP schemes involve direct payments from government, others (“concessions”) commonly allow the provider to recover investment and operating costs through *user charges*, sometimes with bonus (abatement/penalty) payments where performance standards are exceeded (not met). All demand risk is therefore borne by the provider in the latter case, which provides both strong incentives to generate demand as well as considerable risk. This is often appropriate in transport PPPs such as toll roads. At the opposite extreme are PPPs in which the government pays the provider for infrastructure *availability*, which weakens incentives to generate demand and also leaves all demand risks to the government. This is more appropriate for schools, prisons and hospitals, where demand is more a function of policy. An intermediate case involves *usage payments*, under which government collects user charges but makes periodic payments to the provider based on a payments schedule related to usage and other factors.

Where some provider tasks are unverifiable, either those tasks are unbundled from verifiable ones to avoid skimping on the unverifiable task (as shown to arise in Holmstrom and Milgrom (1991)), or devices such as customer satisfaction surveys are used in lieu of direct measurement. Finally, to ensure providers are not unduly exposed to uncontrollable risks, PPP payment mechanisms often include indexation, e.g. tying tariff increases to movements in general price levels, or to exchange rates when overseas financing is used.

## 2.2 Contract Flexibility and Renegotiation

PPP contracts are commonly of long duration. By their nature contracts reduce flexibility but enhance predictability, which is useful in general to support long-term investments that can otherwise be prone to hold-up risks. However, the direct costs of contracting, particularly in an uncertain environment (which makes it harder to contract for all eventualities), means that PPP contracts do not cover all possible contingencies and consequently become outdated as circumstances evolve. Hence PPP contracts often require *ex post* renegotiation, with outcomes depending on the bargaining power each party enjoys due to its threat points/outside options and mutual “lock-in”.

While *ex post* renegotiation improves efficiency by responding to new information, anticipating such renegotiation causes *ex ante* distortions in the original PPP contract and bidding process. For example, if bidders in a PPP tender anticipate that cost over-runs or demand short-falls will be compensated for in *ex post* renegotiations, this induces them to bid more aggressively (i.e. unrealistically) to secure the PPP contract. This incentive is exacerbated in the case of less knowledgeable bidders, implying a greater risk to government of contracting with a poor provider. Indeed, Iossa et al (2007) report evidence that competitive PPP tenders have resulted in higher renegotiation rates than negotiated PPPs. Contractual incompleteness thus results in a trade-off between *ex post* efficiency and *ex ante* incentives. Potential solutions to this problem include more comprehensive contracting, or realistically, limiting the scope of possible renegotiation by contracting on principles, procedures and forums for resolving unforeseen contingencies without resorting to bare-knuckled *ex post* bargaining.

## 2.3 Contract Length

PPP contracts are commonly of long duration, in part to give the provider a long enough period in which to recover outlays via user or other charges. This is particularly important for large, long-lived and/or specific investments. A longer duration also gives the provider more time to benefit from learning, and to exploit economies of scope between activities. Conversely, shorter contracts enable the government to introduce more competition into sequential procurements, adapt to changing user needs without *ex post* renegotiation, and to reward good provider performance through contract renewal. Fixing PPP length therefore involves a range of trade-offs. Endogenising PPP length might be a useful way of managing risks (e.g. increasing the contract term if demand grows more strongly than first anticipated), but doing so comes at the cost of incentives.

## 2.4 Award Procedure

PPP projects commonly involve infrastructures for which there is little or no effective competition, hence to avoid simply awarding monopolies to PPP providers the award of PPP contracts is often determined through competitive processes. A cost of this approach is that such processes can be expected to perform well for standardised items and where all parties are equally (un) informed. In the context of PPPs, however, both government and potential providers will each enjoy informational advantages in different respects, meaning that direct negotiations can be a more effective way to formulate PPP contracts despite involving less competitive pressure. However, as discussed above, competitive pressure can come at the cost of inducing over-aggressive bids when bidders anticipate that *ex post* renegotiation will be viable - a form of “bait and switch”. Hence the choice of PPP award procedure also involves important trade-offs.

### 3. Summary of Main Theoretical Frameworks for Analysis

To date, the analysis of when PPPs are to be preferred over TP has drawn on two main literatures which we discuss in general terms here, with specific papers surveyed in the following section. The first is the *property rights* literature based around incomplete contracting (e.g. Hart and Moore (1990)). The other is *agency theory*, in which contracting is complete but incentive issues arise due to asymmetric information (e.g. Laffont and Tirole (1993)) or moral hazard (Holmstrom and Milgrom (1991) in a multi-task environment). More recently, these two literatures have been combined to enable insights to be gained from both perspectives.

The property rights literature begins from the premise that contracts cannot be written to cover all possible contingencies. Such incompleteness can arise, for example, due to contracting being costly, actions or outcomes not being verifiable or observable, or because some contingencies are simply unforeseeable. Additionally, agents can suffer from bounded rationality, in that they optimally restrict attention to only a subset of all relevant information. Incompleteness leads to problems when parties contract over long-lived and/or specific investments, since *ex post* renegotiation can arise in response to contingencies not covered in the contract. Renegotiation results in the investing party being “held up”, with the other party using its *ex post* bargaining power (since the investment is now sunk) to extract rents from the investing party. While renegotiation is *ex post* efficient, anticipating it distorts investment incentives *ex ante*, with the classic result that under-investment occurs. Ownership – interpreted as having residual rights to control an asset’s use – restores incentives by removing hold-up risk, if the party that values the asset most highly owns the other party.

This literature has been adapted to analyse the relative merits of PPPs and TP, with the first major contribution made by Hart (2003), followed by that of Bennett and Iossa (2006). Key to Hart’s adaptation is treating both PPPs and TP as private provision of infrastructure and services (i.e. building and operation), but distinguishing them in terms of bundling (PPP) and unbundling (TP) those activities. By contrast, Bennett and Iossa compare the merits of bundling building and operation when firms can make non-contractible investments in innovation at the building stage which give rise to externalities in the operating stage.

The agency theory literature takes the alternative view that incentive distortions arise when agents have hidden information or can take hidden actions. Contracting is assumed complete, in that all possible contingencies can be included in the contract.<sup>2</sup> However, the principal faces trade-offs when contracting with an agent. If the agent is privately informed, then the trade-off is between achieving efficiency and extracting information rents from the agent. Conversely, if the agent can take hidden actions, the principal’s trade-off is between providing incentives for efficient actions, and insuring the agent for bearing the associated risk. Martimort and Pouyet (2008) make an important contribution to the analysis of PPPs under this approach. Key to their analysis is their characterisation of PPPs as agency problems in a multi-task (i.e. design, building, etc) environment. Bundling tasks can, under circumstances described in the next section, lead to “rent savings” – economies of scope can arise between different PPP tasks in which the rent used to incentivise the PPP partner on one task (e.g. building quality) can have positive spinoffs for other tasks (e.g. reduced maintenance costs).<sup>3</sup>

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<sup>2</sup> While the complete contracting approach assumes that contracts cannot be written on unverifiable actions or information, this does not stop them from specifying *ex ante* which agent is in control (Schmitz (2005)). Thus non-verifiability of actions or information, *per se*, is not a cause of contractual incompleteness.

<sup>3</sup> See also Schmitz (2005) for an application of this idea when agents have limited liability.

Hart (2003) criticises the agency theory approach for leaving no role for ownership. If contracts are complete, then there are no residual matters to be addressed by ownership, so whether or not the government has residual control rights over an activity is immaterial. Martimort and Pouyet (2008) counter that the property rights literature overplays the difficulties in contracting, and is not rich enough to allow analysis of issues arising under PPPs such as collusion between providers and procuring agencies.<sup>4</sup> In response, Iossa and Martimort (2008) merge elements from both agency theory and property right literatures.

Finally, in an important earlier contribution to the literature, Bajari and Tadelis (2001) avoid simply imposing contractual incompleteness. They characterise procurement contracts as being more about *ex post* adaptation than *ex ante* screening, with devices such as competitive bidding, reputation and default insurance being used to address adverse selection problems arising under asymmetric information. However, unlike incomplete contracting models in which incompleteness is exogenous, they develop a model of procurement that endogenises a procurer's optimal choice of incompleteness when contracting is costly. They focus on the trade-off between *ex post* renegotiation costs and *ex ante* incentives, which differ under contract types. Fixed price contracts are optimal when projects have low complexity and more complete design (it is cost-effective to write complete contracts and renegotiation is less likely). Conversely, cost-plus contracts are optimal when a project is complex and uncertain, in which case it is too costly to fully contract and hence it is optimal to rely on renegotiation. These ideas can also be usefully applied in the PPP context, explaining why cost over-runs may be an equilibrium phenomenon.<sup>5</sup>

The main PPP contributions, with a particular emphasis on Iossa and Martimort (2008) – given its comprehensive scope, rigour, and diversity of approach – are discussed further in the following section.

#### **4. Survey of Major Theoretical Contributions**

Following the literature classifications of Section 3, in this section I survey selected, key theoretical contributions to the analysis of PPPs. I start with property rights models, then move to an agency theory model, and in greater depth consider the synthesising approach of Iossa and Martimort (2008). Useful surveys of theories relevant to the analysis of PPPs are provided in De Bettignies and Ross (2004), Dewatripont and Legros (2005), Iossa and Martimort (2011a, 2011b), and Iossa et al. (2007).

##### **4.1 Property Rights Models – Hart (2003), and Bennett and Iossa (2006)**

Hart (2003) examines the determinants of the boundary between public and private firms, where investments are neither verifiable nor observable to the government (hence non-contractible). He extends the multi-task framework used by Hart *et al.* (1997) to delineate the circumstances under which privatisation is to be preferred to public ownership, in which a manager can make both productive (i.e. efficiency-enhancing) and unproductive (i.e. cost-and-quality

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<sup>4</sup> Furthermore, Maskin and Tirole (1999) provide an irrelevance theorem under which the supposed difficulties giving rise to incomplete contracting – which difficulties present certain internal inconsistencies in the property rights literature – can be side-stepped.

<sup>5</sup> Indeed, Dewatripont and Legros (2005) apply similar reasoning when they argue that evidence showing that PPPs are less prone to cost-overruns than TP may in fact be revealing a problem. Cost over-runs should be expected in equilibrium, as PPP procurers optimally trade off the costs of more extensive and precise contracting against the expected rents to be paid if they instead face cost overruns and/or renegotiations. Hence the outright avoidance of cost overruns is not likely to be optimal.

reducing) investments. Under public ownership the manager makes neither since the benefits of doing so are held up (i.e. appropriated) by the government. Conversely, under private ownership a manager faces stronger incentives to make both types of investment. Whether or not the activity should be privately owned rests on whether cost efficiency is most important and quality can be contracted for (favouring private ownership) – if not then public ownership can be preferable.

In his extension Hart assumes all provision is private, but contrasts bundled building and operation (i.e. PPP) with unbundled building and operation (i.e. “conventional” provision). The government contracts with a conventional provider for a prison of a certain kind, or instead with a PPP provider for what sort of prison services should be provided. The contract is incomplete in that the builder can modify the prison without violating the contract, by making both productive and unproductive investments. Productive investments produce social benefits and reduce private costs; unproductive investments reduce both.

In the resulting trade-off, unbundling means the builder internalises neither the social benefits nor the private costs of its investments, resulting in too little productive investment but the socially desirable level of unproductive investment. Conversely, under bundling (i.e. PPP), at least some socially beneficial investment is made (though less than first best), while too much unproductive investment (with just private benefits) is also made. Thus conventional provision is best where the quality of the facility can be well specified but the quality of the service cannot – i.e. where it is easier to contract on facility provision than on service provision. Conversely, PPP is to be preferred when the reverse is true – when service quality can be well measured and contracted for, but facility quality cannot. Hart concludes that prisons and schools are best provided by conventional procurement, since it is easier to contract on building than it is on operation. Conversely, hospitals are offered as an example where contracting on service quality may be relatively easy compared with contracting on complex facilities. These predictions differ to those of later, richer models.

Bennett and Iossa (2006) also use an incomplete contracts framework, in which firm investments in innovation-oriented research are non-contractible *ex ante* but verifiable *ex post*. They examine whether to bundle building and operation phases as in PPP, or separate them as in TP. They highlight the role of innovation as an important source of operating cost savings under PPP, and also examine the impact of facilities ownership at contract termination. Unlike Hart (2003), in which private investments are neither contractible nor verifiable, here ownership matters since the owner of project is assumed to have the right to implement innovations as it chooses, whereas under TP (i.e. without ownership) innovations require renegotiation, which shares innovation gains, but also internalise social benefits to the innovator. The UK version of PPP – namely PFI, in which activities are bundled and the provider takes ownership of the facilities – is a motivating framework. PFI has been used for health, education, defence, prisons and roads, typically involving a contract with a consortium of private firms for a period of 25-30 years, bundling DBFO. Commonly, facilities return to government when the contract expires (in the case of schools, hospitals, prisons) but in some cases remain with the consortium (e.g. accommodation and IT systems). Under TP, by contrast, facility ownership remains public both during and after the contract period.

Bennett and Iossa find that bundling (i.e. PPP) is always to be preferred to unbundling (i.e. TP) when innovation results in reduced management costs in later project stages – i.e. creates a positive externality between stages – since it internalises the benefits of that externality. Unbundling, by contrast, may be optimal if innovation increases management costs (i.e. produces a negative externality). The latter result arises because the hold-up problem arising under incomplete contracts leads to underinvestment, in which case it can be optimal not to internalise the externality to the

firm as doing so reduces incentives even further. Furthermore, PPP is more likely to be optimal if the effect of innovation on social benefit is relatively small, and if the effect on residual facility value is relatively large. It is also more likely to be optimal the more likely it is that private residual value will exceed public residual value, and the lower the specificity of the facility for public use at contract end (which increases the relative residual value to private facility owners). With a positive externality, the automatic transfer of asset ownership to the public sector reduces investment incentives and weakens the case for PPP. Conversely, giving the firm an option to sell the facility to the government improves investment incentives and strengthens the case.

#### **4.2 An Agency Theory Model – Martimort and Pouyet (2008)**

In contrast to the above two models, Martimort and Pouyet (2008) take a complete contracts approach to examine when bundling (i.e. PPP) and unbundling (i.e. TP) are respectively to be preferred, disentangling the effect of bundling on both incentives and risk-sharing. They focus on the agency problems arising when efforts in building and managing assets are non-verifiable, and hence when delegation by government comes with moral hazard regarding these effort choices. They argue that ownership is not the key to understanding whether bundling or unbundling is optimal. Rather, technology is the primary driver, with bundling to be preferred when improved building lowers operational costs (i.e. creates positive externalities), but unbundling to be preferred with negative externalities. Hence, their predictions echo those of Bennett and Iossa (2006).

The authors show that under moral hazard there is a trade-off between incentivising an agent to improve facility quality and insuring a risk-averse agent against adverse shocks to realised quality. This means that incentives need to be made less powerful than those required to elicit first best efforts, resulting in a sub-first best building effort. In the case of a positive externality, the resulting reduced building quality increases operating costs, which is a cost to the operator that is not internalised by the builder when tasks are separated. Hence in this case bundling is favoured. Conversely, with a negative externality between stages, separation is preferred since solving the agency problem on one task worsens the incentive problem for the other.

Martimort and Pouyet extend their analysis to allow for the capture of PPP decision-makers by providers. This requires an extension to their pure moral hazard model to also allow for asymmetric information, since neither the builder nor the operator enjoy any rents to capture in that framework. Specifically, the authors now assume that the decision-maker has private information regarding the sign of the externality, meaning it can take decisions that differ to the public interest. Also, asymmetric information regarding average costs introduces rents to an operator that is considering backward integration/bundling into building. With these extensions a positive externality favours bundling so as to raise incentives for cost improvements, but it also increases information rents, thus reducing the attractiveness of bundling. Indeed, a privately informed, non-benevolent and hence strategic decision-maker might collude with an operator that wishes to bundle – even when the true externality is negative – by misreporting that it is positive, and hence opting for bundling (the operator might wish for this manipulation because it increases information rents). Cost-reimbursement rules under bundling and unbundling must become more alike to reduce this incentive, reducing the benefits of bundling. Thus where collusion is a problem the dominance of bundling (under a positive externality) weakens, and unbundling is more desirable.<sup>6</sup>

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<sup>6</sup> In a political economy model of capture Maskin and Tirole (2008) examine how institutions such as public accounting systems, and in particular, spending caps, can be used to mitigate the costs arising when

The authors then refine their analysis by introducing agency considerations between distinct consortium members in the case of bundling (i.e. as opposed to assuming the builder and operator are one in the same). Assuming the consortium is a joint venture between the builder and operator, they abstract from internal agency problems to focus just on risk-sharing. They find that bundling is to be even more preferred when there are positive externalities, since the joint venture internalises the effort externality as before, but reduces the risk premium required to induce effort due to more efficient risk-sharing.

Finally, presaging the synthesis between complete and incomplete contracting provided by Iossa and Martimort (2008), Martimort and Pouyet extend their model by assuming facility quality is now non-verifiable, and hence ownership is important in providing incentives due to contractual incompleteness. They find that social welfare is the same with either bundling or unbundling under public ownership for a negative externality, while bundling dominates unbundling for a positive externality (since in this case the merged entity still benefits from reduced operating costs due to an improved build, despite not enjoying ownership). Conversely, private ownership with bundling is best when the incentive effects of ownership are not strong enough to induce good effort and need to be enhanced through bundling. Finally, public ownership and unbundling is to be preferred when externalities are negative and the risk on realised asset quality is high. In this case ownership must be assigned to the builder in order to induce a good building effort, but this requires that the builder be compensated for bearing risk regarding realised asset quality, with public ownership preferred when insuring the builder becomes too costly.

#### **4.3 A Synthesising Approach – Iossa and Martimort (2008)**

Iossa and Martimort (2008) provide a unified theoretical framework – combining both moral hazard and features of property rights models – for analysing the main incentive issues and shape of optimal contracts in PPPs. As in Martimort and Pouyet (2008), their basic model is one of procurement in a multi-task environment in which a risk-averse agent chooses unobservable efforts in quality improvement and cost reduction, allowing them to study how the bundling of building and ownership affect incentives and risk transfer. They also extend this model to examine the optimal allocation of demand risk (with implications for user charges and contract duration); the impact of private finance; the dynamics of PPPs (i.e. cost overruns); and the importance of the institutional environment. Given this is the most comprehensive treatment of PPPs to date, I give it relatively greater treatment than the other contributions, focusing on its most important results.

The basic, pure moral hazard model is similar to that in Martimort and Pouyet (2008). The builder and/or operator incur private costs when they exert (non-verifiable) quality-improving and cost-reducing efforts, with the social benefit of investments hardly verifiable. Operating costs are observable and hence contractible, though random. There are positive or negative externalities across tasks, with quality-improving investments in infrastructure reducing operating costs, or raising them, respectively. Government is risk neutral and maximises social welfare, while the firm is risk averse and maximises expected utility.

Under unbundling the builder is offered a fixed fee and therefore exerts no quality-enhancing effort. The government is assumed to offer the operator a linear cost reimbursement rule (ranging from cost-plus to fixed price). Given the builder's effort the operator maximises the certainty

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public officials favour pet projects over socially desirable ones. Like Martimort and Pouyet they find that unbundling (i.e. TP as opposed to PPPs) can help to protect against capture, but in their case it is because it deprives corrupt officials of the chance to pass hidden future rents to PPP providers.

equivalent of its expected utility, with the associated incentive constraint revealing a trade-off between incentives and insurance. Increasing the power of the operator's incentive scheme (i.e. towards fixed cost) raises cost-reducing effort but also requires it to bear more risk. This then requires payment of a socially costly risk premium (i.e. providing incentives is costly). Taking the builder's and operator's incentive constraints as given, government then maximises social welfare, with the result that second-best cost-reducing effort is lower than first-best due to the incentives-insurance trade-off inherent in the operator's incentive constraint.

Under bundling, in contrast, the consortium of builder and operator chooses both quality-enhancing and cost-reducing efforts to maximise expected payoff. With a negative externality between quality and cost-reducing efforts, the consortium exerts no quality-enhancing effort since it is not rewarded for such effort, which also worsens operating costs. Cost-reducing effort and welfare are the same as under unbundling. Conversely, with a positive externality the consortium partially internalises the benefits of quality-enhancing effort on operating costs, thus exerting higher levels of both effort types, also resulting in higher welfare than unbundling. Thus bundling (at worst, weakly) dominates unbundling in the presence of a positive externality. Furthermore, bundling is associated with higher-powered (i.e. fixed price) incentive contracts – both risk and incentives increase. Conversely, unbundling is associated with lower-powered (i.e. cost-plus) contracts. The authors suggest that these two features seem to mirror practise, in which PPPs are associated with greater risk transfer and risk premiums than traditional procurement.<sup>7</sup>

So far the above agency-only approach suggests unbundling is never to be preferred to bundling. To more clearly delineate when PPP is best, it is useful to also show when unbundling (i.e. TP) is best. Iossa and Martimort do this by redefining PPP as an organisational form comprising both bundling and private ownership of the assets during the PPP contract. Conversely, TP is unbundling with government ownership (after initial ownership by the builder) but private operation of the asset. They thus introduce elements of the property rights literature in which ownership matters by conferring residual rights on the owner – in this case to the residual value of the asset – extending the ownership discussion in Martimort and Pouyet (2008). Having such residual rights improve incentives for a private owner to maintain and invest in the asset over the contract term, since they enjoy the market value of the asset at the contract's conclusion – thus ownership can substitute for contractual completeness in providing incentives. However, the strength of the incentives provided by ownership depends on the degree of asset specificity, since this affects the residual market or use value of the asset to a private owner relative to a public owner.

It is assumed that residual value is higher to the government than to a private owner (the more so the more specific is the asset), so it is always optimal for the government to own the asset at the operating or PPP contract's termination. While this value cannot be specified *ex ante* in a contract, it can be verified and hence bargained over *ex post*. Under public ownership, incentives for builders and operators – bundled or unbundled – are as before, so efforts and welfare are unchanged. This is contrasted with private ownership by the builder, who controls quality-enhancing effort and hence can clearly affect asset value.<sup>8</sup> From Nash bargaining with equal weights the authors show that the payment received by the private asset owner when transferring it to government is increasing in quality-enhancing effort, which enhances incentives for a builder-owner

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<sup>7</sup> These results are also shown to be robust to more general specifications of the contract between government and the builder under unbundling.

<sup>8</sup> In fact asset maintenance choices by the operator could also affect residual value, creating a rationale for operator ownership, but this case is not considered by the authors.

to enhance asset quality. This payment is also decreasing in asset specificity, since specificity increases the private owner's hold-up problem when bargaining with government over transfer price.

Iossa and Martimort thus conclude that private ownership always dominates public ownership, but the gain from private ownership is decreasing in asset specificity. Furthermore, private ownership and bundling (i.e. PPPs) strictly dominates private ownership and unbundling (i.e. TP) but only if externalities are positive. Conversely, if externalities are negative, unbundling leads to strictly lower efforts with private ownership. While private ownership induces better quality-enhancing effort than public ownership, and more so as the asset becomes less specific, the builder still only partially internalises the social benefits of quality, so continues to exert less than the socially optimal quality-enhancing effort.

The next major contribution of the paper is to consider how allocating demand risk – i.e. through the payment mechanism – is a critical ingredient in PPPs. Assuming inelastic, random demand, zero marginal cost of service provision (hence no incentive problem on the cost side), and a payment mechanism linear in revenues, they find that higher-powered incentives (i.e. user charges) are warranted when risk aversion and demand risk are small, while lower-powered incentives (i.e. availability charges) arise in the reverse case. The optimal payment mechanism trades off incentives and insurance – transferring demand risk to the contractor improves incentives for the contractor to improve service levels and demand, but also requires payment of a higher, socially-costly risk premium. Thus, for sectors such as transport (e.g. bus services) higher user charges are warranted, while for prisons, schools and hospitals, where demand is less amenable to contractor control (and more affected by policy) less demand risk and hence higher availability charges are warranted. In the PFI variant of PPPs, private finance is required, with the associated costs recouped through user charges over a long enough contract term. The authors find that more demand risk and greater risk-aversion call for reducing incentive power and more insurance, which is obtained by reducing contract length.

Iossa and Martimort then consider how private financing affects the desirability of PPPs. They start with the basic moral hazard model from before, but with no social benefit from quality-enhancing effort. Financiers have access to a noisy signal on contractor effort, on which they condition their required payments from the operator. As in Dewatripont and Legros (2005), the resulting incentive constraint reveals that only part of the benefits of operator effort are captured by the operator, with the balance accruing to financiers, which dampens incentives for effort. However, at the same time, financiers improve incentives by conditioning repayments on effort, which captures the idea that they may have skills not shared by governments in monitoring operator effort. Thus, while outside finance reduces incentives, it also increases risk-sharing, and on balance incentives improve due to the assumed information structure. Government effectively free-rides on the improvements this brings to PPPs.<sup>9, 10</sup>

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<sup>9</sup> The authors conjecture that the benefits to government from private finance will diminish where financiers specialise in PPPs and hence enjoy specialist skills but less diversification, and also greater market power.

<sup>10</sup> Dewatripont and Legros (2005) go further, showing that the incentive-diluting effect of outside finance is less severe for debt financing than for equity financing, since debt contracts typically do not entitle the financiers to participate in project upside. Thus the incentive dilution under debt financing is concentrated on downside risks. De Bettignies and Ross (2009) add that external financing can also avoid the refinancing of inefficient projects (e.g. where political imperatives favour continuation), but the inability of private borrowers

Finally, the authors consider the issues of cost over-runs and institutional framework. Contracting occurs with large uncertainty about future costs and demand, often resulting in PPP renegotiation, tariff increases, increased cost pass-through, reduced payments to government, and/or reduced or delayed investments. They find that the optimal menu of contracts to avoid over-runs reduces incentive power to less efficient firms and provides incomplete insurance. In turn this reduces the motive for bundling, though since the risk of over-runs also arises in traditional procurement, bundling under positive externalities is likely still to be preferred. As to institutional framework, if it is assumed that government has no commitment power but all bargaining power in post-contract negotiations, unsurprisingly investment is lower, and optimal cost-reimbursement rules become more tilted towards cost-plus (i.e. weaker incentives but more insurance).

## **5. Extensions and Conjectures**

While important progress has been made in the theoretical understanding of when PPPs are to be preferred, significant areas remain for future research. I summarise these under the headings of: (1) agency issues within PPP consortia, (2) award processes, limited liability, imperfect competition and renegotiation, (3) multiple interactions and reputation, (4) political economy and risk aversion, and (5) general equilibrium, and lifecycle considerations. Each is discussed in turn.

### **5.1 Agency Issues within PPP Consortia**

As discussed above, Iossa and Martimort (2008) partially open up the PPP “black box” and explore risk-sharing issues within PPP consortia (i.e. joint ventures between builder and operators). However, they do not explore internal agency issues. Hence, for example, it could be predicted that some of the benefits of internalising economies of scope across PPP stages will be attenuated once internal conflicts are accounted for between PPP consortium partners. Indeed, Maskin and Tirole (2007) question whether bundling is beneficial since the best builders are unlikely to also be the best operators. Hence it should be expected that PPP consortia will comprise disparate partners with quite different risk preferences, investment horizons, and expertise. For example, a builder partner would likely prefer not to remain in the consortium for the full contract duration simply because it creates a greater risk of any building compromises being revealed – this makes specialist builders awkward bedfellows for long-term operators. Consequently, the implicit assumption that bundling involves a seamless reconciliation of these differences between consortium partners is likely to be overly optimistic. Hence the nature of the internal contracts and ownership delineation among those partners should be of critical importance for PPP performance.<sup>11</sup>

### **5.2 Award Processes, Limited Liability, Imperfect Competition and Renegotiation**

A recurring theme in many PPP studies is that they are prone to renegotiation, and also that the competitive tendering of PPP contracts may induce bidders to be overly-optimistic regarding future costs or demand. It would appear plain that there are important strategic issues confronting

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to commit to repaying their debts limits the size of PPPs that can be debt-financed. Iossa and Martimort (2011a) emphasise that private financiers can also bring expertise in evaluating project risks.

<sup>11</sup> Bennett and Iossa (2007) explore when not-for-profits might be desirable PPP partners, finding there are circumstances under which they are even to be preferred to for-profit firms (indeed, in some cases TP is the preferred model with for-profit firms). This reflects the fact that not-for-profit objective functions can include social goals which better align them with governmental objectives, since for-profits commonly do not value social benefits from their effort choices beyond profit consequences. Thus the PPP partner’s objective function – which can be complicated under PPP coalitions – is an important consideration.

PPP bidders that should, in fact, *induce* them to behave this way. PPP projects are typically for facilities and services that are not easily provided, and for which service continuity is important. Moreover, there are usually only a handful of parties able to provide the required assets and services, given economies of scale in PPP tasks, and indeed, in providing PPP provider services.

Once these features are combined with the fact that many PPPs are organised through special purpose vehicles with limited liability and non-recourse funding (i.e. without recourse to consortium member parent balance sheets) and pledging only PPP income, it is plain to see that PPP providers can have considerable *ex post* bargaining power.<sup>12</sup> If the government refuses to renegotiate then the PPP provider could declare bankruptcy and walk away from their contract. This should embolden them to rely on renegotiation to compensate them for not just unforeseen changes, but also for cost overruns or demand shortfalls relative to what was expected for costs and demands in PPP bids and initial contracts.

Rationally, therefore, anticipating this behaviour from other bidders too, each PPP bidder should bid as aggressively as they can relative to other bidders' aggressive bids in order to secure the contract. Cost overruns and renegotiation are therefore not just a matter of rational trade-offs on the government's part, but also on bidders'. The risk they face is that the government will not wholly compensate them, but that is weighed against losing the bid. These incentives to bid over-aggressively may be reduced in less competitive award processes, which rely on direct interaction rather than competition to resolve selection problems (though with greater risk for officials, who can hide behind sub-optimal but defensible competitive processes).

### **5.3 Multiple Interactions and Reputation**

An important shortcoming of the existing literature is that it considers one-shot PPP contracting. In reality there are only a limited number of contracting partners, and these partners engage with the government on a repeated basis over time. Consequently, reputational concerns should constrain builders under TP from under-exerting effort on quality. As above, this should narrow the gap between TP and PPPs. Simultaneous bidding on a number of PPPs may not provide as great a reputational discipline – a builder could skimp on all projects and rely on the faults arising after their money has been made. However, bidding on sequential projects might allow faults from earlier projects to be revealed when contracting for later ones, and a reputation for earlier failures is unlikely to be an asset in later bidding processes. Modelling two sequential PPP bids should allow these issues to be explored. Furthermore, taking a more relational contracting approach to PPPs should reveal the potential for “swings and roundabouts” to discipline PPP relationships, since each party will have occasion to seek to renegotiate contract features over a long-lived contract. Acting too aggressively or opportunistically in one round of renegotiations could prejudice the outcomes of subsequent rounds. Modelling more than one possible renegotiation round would shed light on this.

### **5.4 Political Economy and Risk Aversion**

Implicit or explicit in most PPP analyses is the assumption that government is less risk averse than providers. This assumption is questionable, particularly when the PPP is for a significant one-off facility or service for which the government has a high political exposure, or where the PPP provider is a specialist with potentially many such PPP projects under its management around the country or

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<sup>12</sup> See Iossa et al. (2007) for details of funding structures. Also, Iossa and Martimort (2011b) report that DBFO PPPs commonly have 90% debt and only 10% equity funding.

world. Indeed, the PPP contract does not simply shift risks from the government to PPP providers, but it also transforms political risks – from the risk of direct delivery failure by the government, to the risk of policy attack by political rivals, and the risk of governance and regulatory failure when PPP contracts fail to perform. These are rich and real issues which remain to be explored.

### **5.5 General Equilibrium and Lifecycle Considerations**

It is clear from the PPP literature that an important motivation for governments when embarking on PPPs is the conservation of scarce public resources, both in developing and advanced economies. Also, the risk of PPP renegotiation – by either PPP partners or governments – is correlated with the risk of macroeconomic crises/currency shocks (especially when foreign capital is required). There are thus important interactions between the state of public finances and the desirability of PPPs, suggesting possible path-dependencies and growth-dynamics in the adoption of PPPs. Governments may adopt PPPs when demand for public services is strong while public finances are episodically weak. Conversely, countries with weak public finances and fragile economies may be attracted to PPPs early in their growth path, but do so with an elevated risk of renegotiation. Both sets of considerations motivate further inquiry at a general equilibrium level to explore how the need for, and prospects of, PPP should evolve as economic circumstances and institutions develop.

## **6. Conclusions – When PPPs are Best**

A recurring theme in the studies surveyed here is that PPPs can better traditional procurement when there are economies of scope between different stages in the construction of facilities and delivery of social services – i.e. in the presence of positive externalities. This is more so where the physical facilities have direct impacts on operating costs, such as in prisons, but less so where human capital plays a bigger role in service delivery (e.g. hospitals and schools). Bundling tasks in such circumstances, and transferring risks to operators, cause operators to take a “whole-of-life” approach to asset construction and operation, leading to enhanced asset quality and cost efficiencies. This result arises under differing theoretical approaches, and is robust to a number of modelling changes (e.g. it is even stronger when the risk-sharing benefits of joint ventures between consortium members are considered). Conversely, the case for PPP is either weaker or non-existent when externalities between stages are negative, or when PPP award or oversight processes are vulnerable to capture.

Another important theme is that transferring risk to PPP partners is desirable, but not without limits. In particular, transferring demand risk is appropriate when PPP partners are in a position to affect demand through good asset quality and service delivery, since this spurs better provider effort – examples include water and transport. Hence provider revenues are appropriately derived from user charges in this case. Conversely, when demand or other risks are beyond provider control – such as demand risk in respect of hospitals, schools and prisons, or the risk of macroeconomic crisis – then transferring such risks to PPPs would require the payment of socially-wasteful risk premiums. Indeed, insulating PPP providers from such risks can be justified in this case, so as to preserve incentives in respect of controllable risks while economising on the payment of risk premiums. Provider revenues based on facilities and service availability are more appropriate in this case. Additionally, provider incentives can be enhanced by allowing ownership of PPP assets to remain with providers, particularly when assets are less specific in nature. Even when they are specific, automatic ownership transfer to government at the PPP contract’s conclusion may be less efficient than simply allowing providers to sell the assets to government if they choose to.

The predisposition of PPPs to cost overruns and renegotiation (initiated by either government or providers) raises questions about their suitability, but do not clearly demonstrate they are better or worse than TP. Certainly the risk of renegotiation reflects trade-offs between the costs of contracting and the risk of renegotiation on the part of governments. However, it possibly also reflects rational strategies by PPP providers who are induced by competitive bidding processes to bid overly-aggressively to win contracts and then rely on *ex post* bargaining power to manage cost overruns or demand shortfalls. Indeed, greater use of direct negotiations may alleviate this possible downside of competitive tenders (despite their apparent transparency and rent-reduction advantages). However, the possibility of PPP award processes being captured, especially when there are only few bidders, potentially adds to these problems. Such considerations point to the desirability of robust PPP award and oversight procedures, and to the value of learning by doing on the part of both PPP designers and bidders. They also suggest that PPPs are likely to work best for less complex assets and services, and in more stable environments (e.g. in terms of politics, demand or technology). They should also work better in environments with greater macroeconomic stability and higher commitment power by governments.

Private finance can be a double-edged sword in PPPs. In many cases the attraction of off-balance sheet financing is precisely why PPPs are adopted, particularly in less-developed countries with shallow or immature capital markets. Furthermore, specialist PPP financiers can bring useful expertise – as delegated monitors of governments – assessing project risk, and inducing better asset quality and operation through monitoring expertise and financing contract incentives. However, they come at the cost of diluting performance incentives (less so when debt financing is used), and of creating stronger threat points for PPP operators when renegotiating terms in the face of financial shortfalls (worse so with debt financing, and the use of non-recourse, special purpose vehicles). This serves to illustrate the importance of looking beyond the PPP “black box” and paying attention to internal agency issues within PPP consortia, when assessing any PPP project’s desirability.

Many theoretical questions regarding the case for PPPs remain unanswered, and it is possible that the case (in the case of positive externalities) will weaken with further research. Among the important questions are the role of reputation in ensuring incentives for building quality under TP, which narrows the gap between TP and PPP. So too might an examination of the internal agency issues in PPP consortia. However, reputational and relational concerns could also demonstrate less harmful effects from renegotiations under PPPs, especially when providers interact repeatedly with governments on multiple projects. This could point to additional advantages of PPPs over TP. These themes, and others such as the general equilibrium and lifecycle analyses of PPPs, remain rich areas for future research.

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