Crafting an efficient bundle of property rights to determine the suitability of a Public-Private Partnership: A new theoretical framework

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Acknowledgments

The authors gratefully acknowledge the guest editors and reviewers for their extremely useful comments on earlier versions of this paper. This research was supported under Australian Research Council's Linkage Projects funding scheme (project number LP0989743).

Revised Version 2: October 3, 2016

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Abstract

A Public-Private Partnership (PPP) procurement mode is poised to play a leading role in delivering global infrastructure. However, there is no fundamental microeconomic framework to determine whether a project or part/s of a project is a suitable PPP. This paper presents the development of a new theoretical framework that overarches and harnesses the application and integration of prominent microeconomic theories, namely, transaction cost and resource-based theories, property rights theory and principal-agent theory, to explain how an efficient bundle of property rights, associated with externalised project activities, is configured or crafted. This novel framework is developed to contribute significantly to advancing the rigour and transparency of PPP selection, as well as advancing theory of the firm. In turn, this change in current PPP thinking would appreciably increase the prospect of PPPs efficiently addressing the substantial appetite for this mode of procurement.

Keywords: Competition; Flexibility; Transaction Costs; Capabilities; Public-Private Partnerships.

1. Introduction

A Public-Private Partnership (PPP) is an established mode of procuring infrastructure. The World Bank (2014) recorded more than 5,000 PPPs in 139 low and middle income countries in the last thirty years (1984 to 2012). Leveraging project finance via a PPP is likely to increasingly appeal to governments in the context of rapidly expanding infrastructure deficits, a fiscally challenged global environment and the diminishing impact of monetary policy on economic growth (World Economic Forum, 2012). It seems reasonable, therefore,

to speculate that PPPs are poised to play a leading role in delivering world infrastructure over the next few decades. This speculation is also underlined by listings of PPP projects worth hundreds of billions of US dollars across USA and China (Jackson 2015; Ballantyne, 2015).

However, it is logical to expect long-term inefficient outcomes from a PPP when a government unduly pursues private finance in cases where its cost is higher than the cost of government borrowing. It is also logical to expect inefficiencies if a government adopts an extensive risk transfer regime, such as the transfer of risks associated with activities in a new infrastructure project in which government has inherent natural advantages. Meanwhile, there is no fundamental microeconomic framework to explain whether a project or part/s of a project can be efficiently assigned to a PPP.

The purpose of this paper is to present the development of a new theoretical framework (subsequently referred to as the *PPP framework*) that overarches and harnesses the application and integration of prominent microeconomic theories to explain whether an economic or social infrastructure project, either in whole or in part, is suited to a PPP mode of procurement. Central to this suitability question are the microeconomics of bundling property rights – associated with various design, construction, operations and maintenance (DCOM) activities that allow the PPP company to demonstrate efficiency gains to offset the cost of project finance (Hart, 2003; Iossa and Mortimort, 2015). In this context, the PPP framework deploys microeconomic theories to explain how an efficient bundle of property rights associated with new infrastructure activities can be configured, or crafted, to determine whether a project or part/s of a project can be efficiently assigned to a PPP.

The paper begins with a critique of current theory and practice on assessing the suitability of a PPP in pursuance of Value-for-Money (VfM). It then builds on this critique to identify fundamental PPP parameters that explain how an efficient bundle of property rights is created to form the basis of the PPP framework. This leads to both a general and a more

specific and pragmatic hypothesis to guide the empirical testing of the PPP framework. The way in which the PPP framework deploys microeconomic theories in an implementable model is then discussed. Finally, the PPP framework's key implications (for theory, policy and practice), its limitations, and suggestions for future research are considered.

2. Current theory and practice on assessing the suitability of a PPP

2.1 Direct approaches

2.1.1 Ascertaining VfM

To assess whether a project delivered as a PPP yields long-term efficient outcomes and whether a PPP is a suitable mode of procurement, it is commonplace for governments to compare VfM from a PPP mode to VfM from traditional government financed projects (or non-PPP mode). VfM can be considered an economic concept that incorporates productive efficiency including, among other things, project finance principles (Productivity Commission, 2014, p. 70). In essence, VfM distils to achieving the best ratio between cost and benefits or *f(costs/benefits)* through the acquisition of infrastructure in whole-life terms.

A key impediment to *directly ascertaining* VfM arising from PPP versus non-PPP procurement is the intractability of data, particularly with respect to surfacing and measuring costs and benefits in the operations and maintenance stage of a facility. This is because costs are whole-life and include both internal and external transaction costs that are much less observable than production costs (comprising finance, design, construction, operations and maintenance costs). Meanwhile, benefits relate largely to the effects of the facility on the core activity, and this can be difficult to objectively isolate and evaluate (KPMG and University College London, 2010). Indeed, the National Audit Office (2011) noted that, "There is no clear data to conclude whether the use of PFI has led to demonstrably better or worse value for money than other forms of procurement".

Furthermore, VfM is a cumulative concept that would benefit from a longitudinal study of the entire life of a representative sample of PPPs and non-PPPs (Henjewele *et al.* 2011). Even if this data were available, a fundamental constraint is the extent to which it reflects PPP and non-PPP cases that have been efficiently delivered; that is, with optimal procurement decision-making from the procurement decision across the asset's entire life. This decision-making includes efficient tendering, governance (including design decision-making rights) and the exercise of real options in operations.

2.1.2 Estimating VfM

As with direct ascertainment, the comparative estimation of VfM from PPP and non-PPP procurement suffers from intractability of data and, more specifically, from the lack of historical data upon which to base estimates of future cash flows. Furthermore, the estimation of capital costs in major and mega projects is notoriously inaccurate and, in the context of this paper, not least because of the lack of accountability of project promoters (Sanderson, 2012). Indeed, there is substantial controversy surrounding the veracity of the Public Sector Comparator (PSC) that attempts to directly estimate the Net Present Value (NPV) of a project delivered via traditional government finance (based on a reference design) in order to compare it to a number of PPP bids (Winch and Schmidt, 2016).

Indirect approaches

2.1.2 Multi-Attribute Utility Approach

The Multi-Attribute Utility Approach (MAUA) is a very popular technique that examines the criteria of clients and the preferences of expert weightings for procurement modes as the basis of procurement decision-making (Chang and Ive, 2002). In practice—for example, in Australia—Procurement Options Analysis (POA) within the National PPP Policy

Framework provides an approach to assessing the viability of PPP against other procurement methods that is consistent with MAUA (Infrastructure Australia, 2008).[2]

As MAUA does not rely on monetizing costs and benefits and can be deployed at an early stage (and within the business case), it does not suffer the same drawbacks as direct approaches. However, MAUA does suffer from its inability to reflect a whole-life orientation. Since little is known about differential costs and benefits arising from PPP and non-PPP procurement across the whole-life of infrastructure, the utility factors used in MAUA are likely to be skewed in favor of known features of alternative procurement to the end of construction and start of operations only. More fundamentally, the operation of MAUA is tautological (Chang and Ive, 2002); in other words, it matches client requirements (desired project outcomes through a likely lens at the end of construction—read *effect*) with the relative merits of alternative procurement modes (defined as a subset of, or in the same terms as, the desired outcomes of the project—read *cause*) in order to select the preferred procurement mode.

For these reasons, we need an approach that, like MAUA, is indirect (does not rely on monetizing cost and benefits) and can be deployed at the business case stage. Unlike MAUA, however, the approach we are seeking also needs to be inherently economic and reflect the whole-life of the new infrastructure project. At the same time, it must be non-tautological.

2.1.3 Bundling

'Bundling' pertains to property rights. These are theoretical constructs concerning how a resource is used and owned, including the right to earn income from goods or services. In the context of this paper, 'resources' refers to activities associated with the DCOM of a new infrastructure project. The objective is to derive efficiencies from bundling a range of property rights arising from these activities. Fundamentally, efficiency gains from bundling

[2] Australia is considered second only to the UK in terms of its PPP market maturity (Deloitte Research, 2006).

are determined by the potential for *economies of scope* that increase when activities display complementarity and the potential for synergy. That is, there is potential for relative improvements in cost and benefits when these activities are delivered in one contract and overseen by one supplier or consortium (De Bettignies and Ross, 2004).

Hart (2003) developed an approach that operationalises incentives for positive investment arising from economies of scope and property rights/bundling. Hart sees this kind of economic behaviour turning on whether it is easier to write contracts on building provision (where the building can be well specified, but the service requirements less so) or whether it is easier to write contracts on service provision (where the service requirements and effective performance measures can be well specified, but the building less so). Hart notes that these factors, in turn, drive the relative quantum of gains from either positive investment (by the buyer *and* supplier) or gains from negative investment (by the supplier only).

More recently, Iossa and Martimort (2015) developed a model of procurement in a multitask environment. This model is mostly consistent with Hart and again considers bundling to be the main feature of PPPs. Based on their model, and in conjunction with the property-rights approach, Iossa and Martimort developed a rationale for bundling that appeals to the principal-agent literature (including acknowledgement of Hart, 2003). Their model sees bundling as inducing the supplier/consortia to internalise the positive externality generated by its quality-enhancing effort on the fraction of costs that the supplier/consortium bears at the operational stage; thus, the stronger the positive externality, the greater the benefit of bundling. However, Iossa and Martimort are chary on the issue of transferring risks that create the potential for hold-up to the PPP Company. They consider that the hold-up problem is less severe under PPP, compared with traditional procurement, when there is a positive externality between the building and managing stages. This can be questioned when the possibility of hold-up lurks very strongly in PPPs (Chang, 2013a).

For the reasons given above, the question of bundling needs to account equally for both the possibility of negative opportunistic behaviour on the part of the PPP Company, and its potential to internalise positive externalities. Iossa and Martimort do acknowledge their model's limitation in being restricted to speculative advice in terms of *which sectors only* are suitable to PPPs. They consider the gains from bundling are greater for generic facilities such as leisure centers, accommodation and public housing, than for specific facilities such as prisons, hospitals and schools.

Iossa and Martimort's speculations seem unconvincing in light of the empirical evidence on the incidence of PPPs in hospitals and prisons. They also run counter to Hart's (2003) estimate of the suitability of PPPs for facilities such as hospitals—an estimate that was also based on the principal-agent theory in conjunction with property rights theory. That said, Hart's speculations also appear to be unconvincing, as it is difficult to imagine all types of hospitals being suited to a PPP. Furthermore, although Hart has operationalised the theory of bundling that turns on whether it is easier to write contracts on building or service provision, and that does not suffer from the weaknesses in direct approaches and in the indirect approach of MAUA, again this approach only serves to develop prescriptions concerning sectors. Thus, as it stands, bundling theory is not sufficiently micro-analytic to serve as an implementable model to determine the suitability of a PPP. Indeed, Coase remained critical of what he saw as 'blackboard economics' and lamented that, "since economics offers little in the way of practical insight, managers and entrepreneurs depend on their business acumen, personal judgement, and rules of thumb in making decisions" (Coase, 2012, p. 36).

To further illustrate the parlous state of current theory on the suitability of PPPs, it is not surprising to find that while governments might have developed VfM drivers or criteria for determining the suitability of a PPP (again, for example, in Australia's National PPP Guidelines), these criteria are vague. And, again, they only speak in broad terms to types or

sectors of infrastructure. The result is that it is not uncommon for governments to rely almost entirely on one basic criterion—the estimated cost of the project—to identify a project for further investigation as a PPP, and the development of a PSC. Once again, in Australia's National PPP Policy Framework (Infrastructure Australia, 2008) recommends a minimum threshold of AUD 100 million before assessing a project for PPP suitability.

Given that PPPs are poised to play a leading role in delivering global infrastructure, there is an urgent need to unlock and mobilise the theory of bundling to shed practical insights on the issue of the suitability of a project or part/s of a project for a PPP beyond mere sectors. To achieve this, we need to determine why the theory of bundling is currently dormant from a practical perspective; in other words: we need to find and operationalise the fundamental PPP parameters of efficient bundling (that includes the relevant upstream parameters) that create an efficient bundle.

3. Fundamental PPP parameters

3.1 Identifying fundamental PPP parameters

In our search for fundamental PPP parameters that explain how an efficient bundle is created, we have three key leads to follow: bundling theory based on Hart (2003); and two leads prompted by experiential evidence from the UK concerning pre-contract and post-contract market failure.

Hart's theory of bundling distils to an analysis of differential net benefits arising from production cost and performance improvements less external transaction costs (arising from moral hazard, or shirking and/or quality shading) when activities are bundled and delivered by one supplier rather than multiple suppliers. As an example of the limited use of bundling theory in practice and in the UK, the House of Lords (2010, p. 31) considered that, "The projects most suitable for private finance are those where the requirements can be *clearly specified* at the outset and which are of a *size* that consortia of private sector companies can

take on their balance sheets" (authors' emphasis). With regard to the clarity of specifications, The House of Lords have in mind a very different kind of external transaction cost to shirking and quality shading associated with moral hazard. Their notion of external transaction costs are those costs arising from suppliers appropriating quasi-rents, or *hold-up*, in the event of a change in the works. Thus, The House of Lords observe that long-term stable projects with relatively few changes tend to be better suited to a PPP as they reduce the likelihood of hold-up and post-contract market failure.

The House of Lords' observations on the issue of 'size' are related to ensuring that there is sufficient competition among bidding PPP consortia. This is fundamental in leveraging the benefits of output specifications in PPP (Grimsey and Lewis, 2004): If the PPP bundle is too large, it can yield insufficient competition or pre-contract market failure arising from small bidding numbers, or conditions akin to monopoly supply and high prices. More recently, Winch and Schmidt (2016, p. 43) comment along the lines of The House of Lords' observations by noting that a lack of competitive tension undermines VfM. This is associated with both small bidding numbers (pre-contract) and bi-lateral trade in conjunction with opportunism in making changes in operations (post-contract).

We now have three fundamental parameters to develop in order to determine an efficient bundle, namely: avoiding high prices; avoiding hold-up; and, in accordance with bundling theory, positive externalities dominating moral hazard. These are represented by the PPP framework, as depicted in Figure 1.

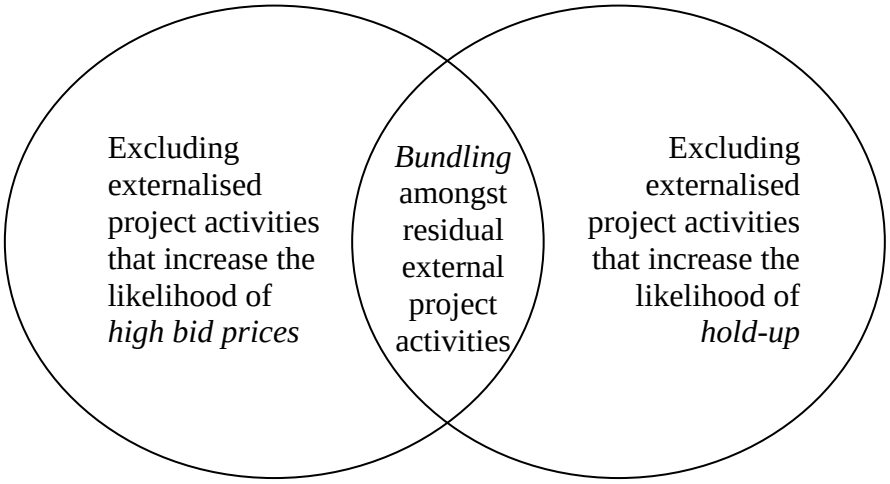

Fig. 1. PPP framework

3.2 Operationalising the fundamental PPP parameters

3.2.1 High bid prices

The number of externalised project activities is determined by the government's make-or-buy decisions and consequent vertical boundaries between the government and private sector within the scope of the project. Following the government's make-or-buy decisions, those activities identified as externalised create the potential for one or more PPP bundles. These bundles can be assessed to filter out any activities that might reduce competition and increase the likelihood of pre-contract market failure. Any activities that are large in scale (because of the size of the project) that cannot be sub-divided as per the current project boundaries (that is, discrete activities delivered by one market firm), and/or any activities that require rare technology (and therefore limit the number of potential suppliers) are likely to reduce competition.

If an activity that could limit competition pervades the entire project (for example, overall project coordination and planning), the government can check whether the project itself can be divided into a number of projects. If it cannot, a PPP is likely to be an inefficient mode. In relation to those activities that limit competition (due to the project's scale) but are not as pervasive as the example given above, the government can check whether the PPP

Company can break that activity into sub-activities (to be allocated to the next tier of firms specializing in the overall activity). If this cannot be done, government can consider excluding these activities from the bundle/s, and/or developing a tri-lateral agreement between the government, the PPP Company and the supplier/s of these activities. This would ensure that no one bidding PPP consortium gains an undue advantage by collaborating with the one or few suppliers of these activities to the exclusion of competing consortia. The government can also exclude from the bundle/s those activities that can restrict competition due to rare technology, or develop a tri-lateral agreement.

3.2.2 Hold-up

Government can also exclude from the PPP bundle those activities that are sources of hold-up. In these cases, it can directly engage the suppliers and enter into either a relational exchange (with credible commitments) or a discrete exchange (with credible threats) to pre-empt the supplier's *ex post* advantage. The New Institutional Economics represents a number of prominent theories that can be applied to the make-or-buy decision. Amongst these theories, Williamson's (1985) Transaction Cost Economics (TCE) is specifically designed to capture hold-up. Williamson holds that the firm buying goods or services from other independent market firms usually has advantages when assets are generic; however, he also holds that the advantage shifts to making or producing the outputs associated with the transaction within the firm when bilateral dependency arises as a function of asset specificity and other disturbances.

3.2.3 Bundling

Having filtered-out potentially troublesome activities that might be a source of pre-contract or post-contract market failure, the residual externalised activities can now be assessed in terms of bundling; that is, whether they have the potential to generate economies

of scope, and whether there are positive externalities that outweigh the potential for negative investments associated with moral hazard.

Design activities that have an appreciable effect on the function of the facility, and/or operations and maintenance activities whose costs significantly exceed capital costs, are prime candidates to create positive externalities. Complexity is another source of positive externalities, which can be related to scale. If a PPP bundle is complex such that its design is not obvious and not readily available from well-rehearsed solutions, opportunities to develop innovative design solutions to manage and deliver superior project outcomes are created. Furthermore, a bundle whose size is increased by its scope via bundling increases its complexity. For example, the interface of DCOM provides the potential for the PPP Company to demonstrate superior planning and coordination capabilities and to develop innovations in project management and delivery. In other words, Hart's bundling theory can now be meaningfully deployed to develop explanations and provide guidance *at the project level*. Should a suite of DCOM activities be identified as having the potential for gains from positive investment to outweigh the potential for negative investment, these activities can be provisionally combined into one or more bundles. With regard to reducing the government's external transaction costs (of the more general kind envisaged by Coase) one bundle of activities is preferable–provided its size does not reintroduce the prospect of reduced competition leading to high prices and pre-contract market failure. If so, then a multiple bundle approach would be taken. The three parameters in the PPP framework lead into a general hypothesis.

3.2.4 PPP framework's general hypothesis

The PPP framework's general hypothesis is as follows: *The more that troublesome externalised activities are excluded (via the application of the parameters of avoiding high prices and hold-up) from the bundling assessment (via the application of bundling theory), the more efficient the subsequent bundle of activities that comprise a PPP, and the more likely that government is to derive superior VfM from this PPP than from a PPP selected using current theory and practice.*

It is implicit in this hypothesis that an efficient bundle allows the PPP Company to deliver efficiency gains that offset the higher cost of private finance (in cases where government can borrow at lower rates than the PPP Company on a non-recourse or limited recourse basis). Furthermore, the PPP framework assumes that procurement follows a client's desired utility from the facility—utility that is informed by the client's business processes (Winch, 2010), as opposed to a facility that is conceived, designed and delivered to facilitate some mode of procurement (should these cases actually exist). Therefore, the existence or otherwise of the upper limit of potential positive externalities, is determined by the translation and delivery of the client's requirements (a non-procurement-related motivation). This is an implicit assumption in Hart's theory, where the activities to be assessed as a bundle are taken as a given. This further explains why current bundling theory is deficient in terms of its deployment—in a monistic fashion, at a project level.

Mindful of the extreme issues associated with direct approaches to assessing VfM—revolving around the intractability of data—and since the procurement decision is only one of many key decisions in determining VfM across the life cycle of an asset (mentioned in Section 2.1.1), the next section presents the development of a more specific and more pragmatic hypothesis to guide the empirical testing and validation of an implementable model based on the PPP framework.

4. Specific hypothesis to test and validate an implementable model based on the PPP framework

4.1 Empirical attributes

To empirically test the PPP framework, the hypothesis needs to be able to reflect the extent to which an efficient bundle has been configured to allow a PPP Company to deliver VfM superior to that derived from a bundle of activities identified using current theory and practice. As mentioned, even having developed an efficient PPP bundle, there are numerous ways in which government can undermine VfM through sub-optimal decision-making post the PPP procurement decision. Therefore, the hypothesis and empirical testing needs to be conducted at an early stage in the project's life cycle, and as close as possible to the point in time when the bundle of activities is identified (*timing attribute*).

To avoid a charge of tautology evident in MAUA *(non-tautology attribute)*, the hypothesis also needs to include a dependent variable that is distinctly different to any of the three parameters, and established externally to any of these parameters (independent of any interference by government). Ideally, this dependent variable would be a single variable that indicates the likelihood that both high bid prices (pre-contract market failure) and hold-up (post-contract market failure) have been avoided. Such a single dependent variable would then be wholly consistent with VfM (*VfM attribute*). We next develop this dependent variable as part of a more specific and pragmatic hypothesis to guide the future empirical testing and validation of an implementable model based on the PPP framework.

4.2 Pre-contract market failure

With lower levels of competition in the market, there is a lack of incentive for bidders to innovate to reduce prices and/or deliver benefits that government perceives valuable. Empirical studies in the construction industry provide evidence of a correlation between a greater level of competition (or higher number of bidders) and a reduction in the price of the

lowest bid. Surveys on critical success factors for PPP conducted in many countries (including Australia, the UK and Hong Kong) similarly identify competition as one of the key VfM drivers in PPPs (for example, Cheung *et al.*, 2009).

In ascertaining the boundary between effective and ineffective competition, Selten (1973) is among the first to show that five competitors represent the dividing line between 'few' and 'many' when modelled as moves in a non-cooperative game pertaining to a bidding scenario. In other words, four or fewer firms demonstrating their willingness to bid for a project creates tight oligopoly conditions, associated pricing constraints, and ineffective competition (for example, Beattie *et al.*, 2003). Consistent with this, the European Union stipulated a minimum of five tenderers to ensure sufficient competition in the procurement of construction projects and which led to an average of 5.4 offers (Strand *et al*. 2011, p.6). In brief, five bidders can be considered the lower limit of effective competition.

In terms of the upper limit of competition—when viewed from the lens of improvements to production costs and/or benefits—Gupta (2002) examined 1740 highway construction projects in the US over a five year period. The empirical results indicate that while the price of winning bids decreases as the number of bids increases, the effect on price becomes insignificant when the number of bidders reaches a maximum. Gupta determines this competitive threshold to be approximately eight bidders in an open tender. Also highly relevant, Skitmore (2002) analysed ten data sets (representing 1,234 projects) in a different sector, and mainly from the building industries in various countries, including the US, UK and Belgium. Skitmore's findings are consistent with Gupta's, where the regression curves show the price of the lowest bid decreases until about eight bidders, and remains constant as the number of bidders increases. Furthermore, Pereira (2002) analysed 1,035 bids (2000-2001) and showed that below five competitors, the winning bid price is 5% to 15% greater than the agency's estimate; with increasing competitors, the contract price has a clear

downward trend and starts to stabilize around 8 competitors. In summary, there is very strong evidence to show that a range of 5 to around 8 bidders is optimal in pursuance of improvements to production costs and/or production benefits arising from the effects of pre-contract competition.

4.3 Post-contract market failure

Negative opportunistic behaviour, or hold-up, is not uncommon – either in the construction industry or in the more specific context of PPPs (Sweeney, 2009; Chang, 2013a). After Williamson (1985), hold-up follows non-trivial disturbances in the works and in a construction context, variations to the works, can occur frequently. Furthermore, Henjewele *et al.* (2011) found significant potential for variations in PPPs. In long-term contacts, such as PPPs, the incidence and resolution of variations are particularly costly for government. That is, the resolution of variations revolves around bi-lateral trade with the supplier who begins negotiations in a monopoly supply position. Hence, not only is there a lack of competition and downward pressure on negotiation of the production cost component of the variation, there is also the potential for the supplier to appropriate gains from the quasi-rent or switching cost component of the variation (hold-up). Thus, variations are potentially a source of additional profits for suppliers (including contractors) and can be very lucrative, in particular for a PPP consortium who can achieve super-normal profits from the variation (for example, Turner, 2004; Rooke, *et al.*, 2004; Zheng *et al.*, 2008). Thus, the prospect of variation flows, which can be assessed from the contract documents and other related factors, can greatly motivate suppliers and not least PPP consortia to bid for a project including reducing bid profit in anticipation of at least recovering this profit in post-contract variations (for example, Crowley and Hancher, 1995; Ho and Liu, 2004; Lo *et al.*, 2007).

Indeed, hold-up behaviour has been observed as acute in PPPs and found to profoundly undermine PPPs delivering VfM (Henjewele *et al.*, 2011; Robinson and Scott, 2009; House

of Lords, 2010; Winch and Schmidt, 2016). More specifically, the House of Lords (2010) found a lack of clarity in specifying a project's requirements to be the key source of variations and Henjewele *et al.* (2011, p.838) observe the specification of project requirements in business case, "dictate the operational performance" of PPPs.

4.4 Avoiding both pre- and post-contract market failure

Based on the above empirical evidence concerning pre- and post-contract market failure, we can say that when a PPP project achieves between 5 to 8 bidders, it has demonstrated it is *sufficiently attractive* to generate the optimum level of competition vis-à-vis reductions in production costs and improvements in production benefits, and thus avoid pre-contract market failure. At the same time, this PPP project is *not overly attractive* so as to generate excessive bids or competition–again, beyond that required in achieving the upper limit in improvements to production costs and benefits. And as variation flows arising from a lack of clarity in specifying the project's requirements can greatly increase the attractiveness of the project to PPP bidders, we can also say that we have an indication that the PPP project is sufficiently clearly specified in pursuance of avoiding post-contract market failure – associated with an absence of excessive competition.

Since competition in the range of 5 to 8 bids provides an indication that the project has avoided pre- and post-contract market failure, we have a measure that is wholly consistent with the *VfM attribute* that we are seeking within the dependent variable. That is, while the PPP framework and its implementable model are designed to guide government to develop an efficient bundle of property rights in order to identify PPPs that can deliver superior VfM–in whole-life terms–to PPPs identified using current theory and practice, it simultaneously guides government in seeking optimal competition in PPPs.

4.5 Expressions of interest

For the purposes of using this competition-related dependent variable, and in the context of PPP projects, Expressions of Interest (EoI) can be deployed. EoI are the equivalent of open tender bids and reflect the extent to which the market is attracted by the project – and not affected by any subjective filtering in terms of the process of shortlisting bidding firms.

With regard to the *timing attribute*, which we are also seeking in the dependent variable, EoI are established at an early stage and, critically, *very close to the point in time when the PPP bundle is created*. Hence, EoI are not affected by any sub-optimal microeconomic decision-making post the PPP procurement decision. Finally, in terms of the *non-tautological attribute* that we are seeking the dependent variable to satisfy, EoI avoids a charge of tautology. That is, EoI are distinctly different than any of the parameters in the PPP framework, and are established externally to these parameters (independent of any interference by government).

Based on using EoI as the dependent variable, the more specific hypothesis to guide the future empirical testing and validation of an implementable model based on the PPP framework becomes: *Actual competition (Box D) is expected to be in the optimum range of competition, or 5 to around 8 EoI (Box B) in cases where actual procurement (Box C) matches the theoretical procurement (PPP or non-PPP)–informed by the implementable model based on the PPP framework (Box A); and outside the optimum range of competition in cases where there is an appreciable mismatch between actual procurement and the theoretical procurement (PPP or non-PPP).* This hypothesis is illustrated in Figure 2.

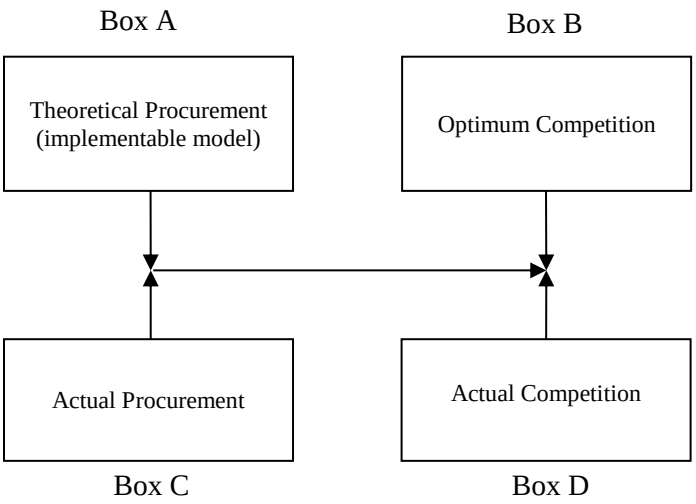

Fig. 2. Hypothesis to test and validate an implementable model

Having achieved 5 to around 8 EoI, government need not invite the entire pool of consortia expressing an interest to submit a full bid. Rather, a proportion of this pool of consortia can be invited to bid and whose behaviour can continue to be influenced by the remaining consortia in the pool. On the basis that all consortia in the pool are aware of the numbers in the pool and the government's stated reservation to revert to one or more of the initially non-selected consortia in the event that government is not satisfied with the bidding behaviour/bids from the consortia initially selected to bid.

In the next section, we discuss the way the PPP framework overarches and harnesses the application and integration of prominent microeconomic theories—namely, transaction cost and resource-based theories, property rights theory and principal-agent theory—into an implementable model.

5. Discussion

5.1 Schematic of implementable model

A schematic of the implementable model based on the PPP framework is given in Figure 3.

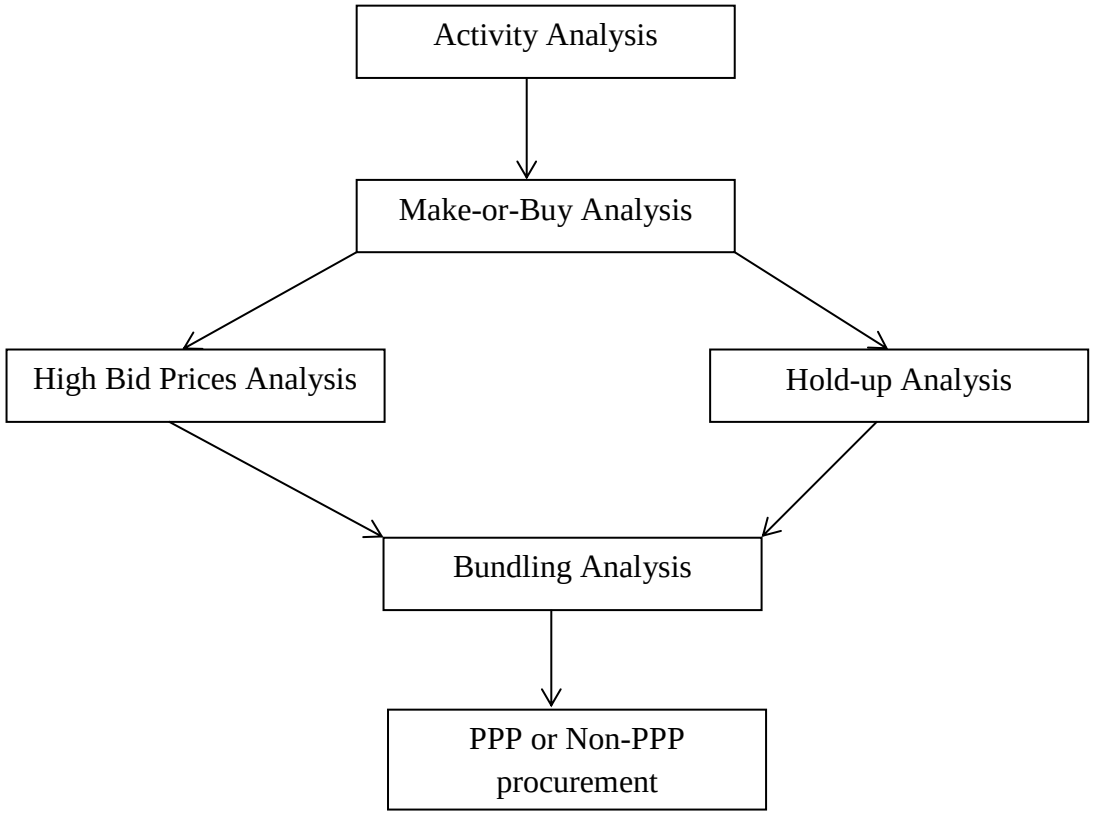

Fig. 3. Schematic of implementable model based on the PPP framework

The model depicts a series of analytical procedures that provide the framework within which to deploy a range of microeconomic theories. The New Institutional Economics (NIE) represents a number of prominent microeconomic theories that can be applied to decision-making relating to PPPs (Firmenich and Jefferies, 2016). NIE includes TCE, Property Rights Theory and Principal Agent Theory. One or more of these theories can be applied to each of the three analytical procedures pertaining to the parameters in the PPP framework. With regard to High Bid Price Analysis, we also incorporate Resource-Based Theory (RBT) as

representing the capabilities perspective, as its behavioural assumptions (in contrast to dynamic theories within the capabilities perspective) are more consistent with TCE and the NIE more generally (Barney, 2002). We next explain Activity Analysis and the way in which NIE theories and RBT can be deployed in the other analytical procedures.

5.2 Activity Analysis

An infrastructure project is broken down into activities by using transaction costs and production cost/benefit logic. A transaction cost occurs when a good or service is transferred across a technologically separable interface and helps create a natural division of labour (Williamson 1985). Deploying this logic, infrastructure can be divided into activities that correspond with the highest level of market specialization. Thus, if there are market firms specializing in an activity that lies within the boundaries of the project, then an activity has been identified.

5.3 Make-or-Buy Analysis

As mentioned, the number of activities comprising the range of externalised project activities is created by the government's make-or-buy decisions. The different emphasis and logic of these three theories as they relate to the make-or-buy decision comprise: the effect of hold-up associated with production and organisational homogeneity (TCE); internal transaction costs associated with organisational heterogeneity (Coase); and capabilities associated with product/ion heterogeneity (RBT). This means that each theory has complementary strengths. [3] Indeed, Williamson, Coase and Barney have called for the integration of their respective theories of the firm (Barney, 2002, Coase, 1991, Williamson, 2009). In particular, these make-or-buy theories would need to discern and explain troublesome activities of the kind associated with product/ion heterogeneity. These

[3] TCE sees the firm and market as alternative modes of bringing about the same result and considers that hold-up follows the fundamental transformation in conjunction with idiosyncratic investments and disturbances post-contract that create the potential for hold-up. Thus, production and organisational homogeneity pre-contract creates initial competitive neutral conditions (Barney and Peteraf, 2014).

troublesome activities are generated by suppliers operating in thin markets and delivering goods and services that are rare and costly-to-imitate (such as a rare technology, perhaps of a proprietary nature). The scale and/or scope of the activity in the project can also create a thin supply, reduce competition and increase the likelihood of pre-contract market failure. These activities need to be identified so as to be filtered-out as part of the High Bid Price parameter.

Importantly, the make-or-buy theories would also need to discern and explain troublesome activities associated with production and organisational homogeneity and which, in conjunction with sunk investment and contract disturbances, create the likelihood of hold-up and post-contract market failure. Again, this kind of activity needs to be identified so as to be filtered-out; this time, as part of the Hold-up parameter. As a different logic is required to filter-out activities within the High Bid Price parameter (a capabilities and RBT logic) than that required within the Hold-up parameter (TCE logic), this complementarity is an example of Williamson, Coase, and Barney's considerable foresight in calling for theoretical pluralism and the integration of their theories.

Following early pioneers and scholars in construction economics and management that applied TCE to construction activity in the 1980s (including Eccles, 1981; Gunnarson and Levitt, 1982; Winch, 1989, 2010), the related PPP literature has become one of the sub-fields of microeconomics that has made good progress on the integration of transaction cost and RBT theories. Jin and Doloi (2008) developed a theoretical framework comprising an integration of TCE and RBT to understand risk allocation and the make-or-buy decision in PPP projects. In a review of their theoretical framework, Chang (2013b) applauds the notion of seeking to apply both TCE and RBT in the context of PPP. However, Chang considers this integration deficient in three aspects: inappropriate choice of unit of analysis; poor specification of governance structure; and misinterpretation of asset specificity. Chang suggests that, "In future studies, researchers should re-examine the nature of PPP governance.

Transaction cost, payoff rights and property rights are all expected to offer important theoretical angles for understanding PPP governance." (2013b, p. 99). A more robust unit of analysis, such as the production activity in a PPP, would address Chang's observation that Jin and Doloi's theoretical framework is weak in terms of using risk management responsibility as the unit of analysis, and not sufficiently mediated by a governance structure (for example, market, hybrid or hierarchical governance).

The integrative framework of vertical integration developed by Bridge and Tisdell (2004) is a further approach to integrating TCE and RBT, including integrating Coase's thesis. This framework (cited and endorsed by Brahm and Tarziján, 2014) deploys the production activity as the unit of analysis, and considers an activity as a bundle of resources (non-trivial and technologically-bounded). This bundle includes planning and coordination (organisational resources) delivered by the management function. This approach, and the logic of the different theories that are operationalised in Bridge and Tisdell's framework, enable this framework to discern and explain both kinds of troublesome activities; that is, those activities associated with product/ion heterogeneity that can create pre-contract market failure (to be filtered out as part of High Bid Price Analysis) and those activities associated with homogeneity that are likely to create hold-up and post-contract market failure (to be filtered out as part of Hold-up Analysis). To enhance the accuracy in deploying the microeconomic filtering mechanisms in the model, it would also use Structure-Conduct-Performance analysis (advocated by RBT) to corroborate the identification of the troublesome activities which are filtered-out. Having filtered out these troublesome activities, the residual externalised activities can be analysed in the final procedure, using Bundling theory.

6. Conclusions

6.1 Implications for theory

This paper presents a new theoretical PPP framework and a specific and pragmatic hypothesis to guide the future development, and empirical testing of an implementable model based on the PPP framework to determine how an efficient bundle of property rights (associated with infrastructure activities) can be configured, or crafted, to identify projects or project part/s that are suited to PPPs.

Currently, the dominant microeconomic theory on the determinants of PPPs is represented by bundling theory. However, bundling theory is restricted to yielding prescriptions for PPP selection at sector level only. This is because the theory is insufficiently equipped to identify its key inputs or the efficient externalised project activities that make-up a bundle. Thus, bundling theory assumes that externalised activities across projects in particular sectors are broadly the same in terms of the extent to which they might create pre- and/or post-contract failure.

In contrast, the PPP framework develops two further parameters beyond and upstream of the bundling parameter. These further parameters filter out inefficient externalised project activities. This development unlocks the full potential and power of bundling theory—in particular, Hart's much-cited but little-used (in the context of this paper) bundling theory. In doing so, and across its three parameters, the PPP framework integrates transaction cost theories (TCE and Coase's transaction cost thesis), RBT, property-rights theory and principal agent theory. This advances theoretical pluralism and represents a sophisticated response to Williamson, Coase and Barney's calls for integration.

More fundamentally, the PPP framework contributes to advancing the theory of the firm in a number of ways. First, it identifies and articulates three key independent but

cohesive PPP parameters. Second, it explains how each of these three parameters is related. Third, in conjunction with an empirically testable hypothesis, it explains the logic underlying the selection of the three parameters, and causality vis-à-vis the underlying dependent variable, or VfM. Finally, limitations of the PPP framework, in terms of its boundaries of generalisability, are given below.

6.2 Implications for public sector procurement policy and practice

While, relative to other modes of procurement, a PPP mode can offer less budget and schedule variation until the end of construction, it does not represent the quickest procurement approach to commencing construction and subsequently commencing operations (Ive, and Chang, 2007; Ke *et al*. 2010; Raisbeck *et al.*, 2010). This is due in no small part to pre-contract complexities surrounding due diligence to execute a long-term contract and requirements associated with arranging private finance and reaching financial close. Furthermore, it is not uncommon for government to signal that they can fully finance the project in non-PPP mode. This signalling reduces its dependency on the private sector and incentivizes the latter to provide more competitive bids. It also indicates that government has allowed time to revert to a traditional process in the event that it is not satisfied with the response from potential PPP consortia. An example is the AUD 1.5 billion "Legacy Way" motorway tunnel in Australia. This project was originally developed by local government in business case as a PPP; however, upon receiving insufficient EoI, the project reverted to government finance (Guest, 2015). Hence, in pursuing a PPP mode government needs to have sufficient time to complete the project and accommodate an appropriate PPP programme. And as current theory and practice stand, government would also be prudent to include a contingency for reverting to non-PPP procurement.

As mentioned, the PPP framework and its implementable model are designed to guide government in developing an efficient bundle of property rights in order to identify PPPs that

can deliver superior VfM–in whole-life terms–to PPPs identified using current theory and practice. In doing so, the PPP framework and model simultaneously guides government in seeking optimal competition in PPPs and avoiding trial-and-error arising from the situation in which government finds itself dissatisfied with the response from potential PPP consortia (including the circumstances illustrated in the case of Australia's "Legacy Way" tunnel). As such, the model based on the PPP framework would also save government time and cost in finalising the contract.

Furthermore, the model based on the PPP framework would fully utilize known details (that can be confidently interpolated from the business case) to maximise objectivity, transparency, and accountability. At the same time, it would minimise the need to develop elaborate assumptions associated with the PSC and, therefore, reduce the scope for subjectivity—particularly political bias. Thus, it would provide a transparent public interest document that can be fully disclosed. It would supplement the full PSC in those projects where its parts are not published due to commercial-in-confidence concerns. Alternatively, it could replace the full PSC in terms of what is published as justification for a PPP approach.

More immediately, the implementable model based on the PPP framework would replace the conventional PPP suitability criteria, approaches based on MAUA, and the preliminary version of a PSC that attempts to compare an estimate of the NPV of traditional procurement to that of a hypothetical PPP bid. The production of a practical guide to using this model would reform policy on, and practice in the selection of projects that proceed to a PPP. This, in turn, would advance the procurement capability of governments on the issue of raising capital, and which is a key strategic capability of owners (Winch and Leiringer, 2016).

6.3 Limitations and future research

The key limitations of the PPP framework and implementable model relate to the static assumptions within the various microeconomic theories. These limitations are: 1) the model relies on mature markets supplying activities to deliver a PPP (Thus, model adaptations would need to be explored and further developed, particularly in low income countries where thin markets may be more prevalent); 2) the model would need to be re-applied if the procurement decision is delayed (A few months could be sufficient delay to trigger the re-application of the model if it is felt that the Structure-Conduct-Performance of market firms in the sector concerned has changed, or is in the process of changing appreciably); and 3) the model would run counter to governments seeking to develop the depth of a market in a particular sector (This is because the model—on the basis of its various microeconomic theories—emphasises a strong form of short-term maximising behaviour associated with static efficiency). In contrast, government may wish to seek longer-term dynamic efficiency. For example, to develop a market around an activity it currently internalises, and/or to develop the market in order to increase competition and reduce its dependency on a small number of market firms in a certain sector.

Furthermore, the PPP framework and model assume that government seeks to acquire a built asset upon expiry of the long-term PPP contract. Thus, the PPP framework and model would not apply in cases where government seeks to buy from the private sector only those services associated with new infrastructure. Also, the model would not strictly apply in cases where government needs to deliver the asset in the shortest possible time. This is because it assumes that the government is able to accommodate a timeline (including the time taken to arrange private finance and reach financial close) that is appropriate to PPPs. That said, running the model in these cases still has merit in terms of indicating the VfM forgone, or the opportunity cost of not adopting the procurement mode most likely to deliver superior VfM.

The schematic of the implementable model based on the PPP framework beckons further detailed development. This development would require full operationalisation of the TCE and RBT variables and Hart's bundling theory. The model also invites empirical testing using the specific hypothesis presented. The conduct of detailed case studies would seem to be an effective way to operationalise all the independent variables and test the hypothesis.

In total, the PPP framework and its implementable model would appreciably increase the prospect of PPPs efficiently addressing governments' substantial appetite for this mode of procurement. It is designed to do this by providing decision-makers with more rigorous and robust guidance–to which, no doubt, Coase would have approved.

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