WORKING PAPER

ITLS-WP-12-13

Property rights, right to efficiency?

By

Demi Chung, David Hensher & John Rose

July 2012

ISSN 1832-570X

INSTITUTE of TRANSPORT and LOGISTICS STUDIES

The Australian Key Centre in

Transport and Logistics Management

The University of Sydney

Established under the Australian Research Council's Key Centre Program.

NUMBER: Working Paper ITLS-WP-12-13

TITLE: **Property rights, right to efficiency?**

ABSTRACT:

The assignment of property rights to incentivise risk-sharing in a principal-agent relationship is a recurrent theme of contract theory. This paper examines the incentive effects of property rights in a principal-agent relationship involving government as the principal, that is, the ownership concession model of public-private-partnership (PPP) procurement contracts for tollroads. Specifically, the paper investigates the effects of property rights on the agent's preference for contract structure to manage risks and to exert performance effort; and the effects on both parties' risk preferences when ownership transfer is being perceived as transferring accountability.

Analysis of data collected through an online experiment surveying stakeholders who have been engaging in road contracts procured under the PPP model in 32 countries concludes that: (1) property rights offer the agent a protective shield against poor planning by the principal in the meantime gives rise to *ex ante* opportunism; (2) the agent's reservation on *ex post* decision rights distorts allocative efficiency; and (3) revenue-sharing is a powerful incentive for non-revenue-enhancing performance effort.

Further investigation attests that incentive effects of property rights can be enhanced through equitable allocation of risks; nevertheless, *ex post* efficiency is debilitated by considerations of political sensitivity concerning toll pricing.

KEY WORDS: ***Ownership; risk management; contract theory; theory of incomplete contract; incentive alignment; public-private-partnerships; discrete choice models; stated choice experiment.***

AUTHORS: Chung, Hensher & Rose

CONTACT:

INSTITUTE of TRANSPORT and LOGISTICS STUDIES (C37)
The Australian Key Centre in Transport and Logistics Management

The University of Sydney NSW 2006 Australia

Telephone: +612 9351 0071
Facsimile: +612 9351 0088
E-mail: business.itlsinfo@sydney.edu.au
Internet: http://sydney.edu.au/business/itls

DATE: July 2012

1. Introduction

Contract theory suggests that in the presence of information incompleteness, property rights help to bring individuals with conflicting objectives within a contractual relationship into equilibrium (Jensen and Meckling, 1976; Jensen and Murphy, 1990). This paper examines the effects of property rights on incentivising risk-sharing in a principal-agent relationship that involves government as the principal and a private sector concessionaire as the agent to manage infrastructure-based service. These concession contracts post a unique management challenge because regulating the service operated by a concessionaire must consider the degree to which the convergence of private objectives of the concessionaire towards the public objectives of the regulator can be achieved (de Palma *et al.*, 2007, p. 9); under which the economics of incentives – described as "the design of rules and institutions for inducing economic agents to exert high level of effort (in broad sense), and to reveal truthfully all socially relevant information they might have" (Laffont, 1996, p. 49) must be carefully managed. Research in contracts concerning the ownership-incentives tradeoff concentrates on relationships amongst stakeholders within the private sector; in this paper, the evaluation on how the economics of incentives can induce the agent to exert highly level of performance effort and to reveal their true behaviour through the concession of ownership from a regulator to a private entrepreneur makes it a significant contribution to the contract literature.

Using empirical data collected through an online experiment surveying stakeholders from the public sector and from the private sector, who have been actively engaging in roads procured under the public-private-partnership (PPP) model, we study the following research question:

> *In the presence of contract incompleteness, to what extent do property rights in the public-private-partnership concession model incentivise contractual efficiency?*

Specifically, we explore how would the incentive of property rights influence the agent's choice for contract between structures with and without ownership concession; and their choice for contract between compensation structures with and without revenue-sharing. We further study the degree to which the agent's preference for exercising ownership right to regulate usage demand via toll prices; and both parties' views on perceived accountability transfer.

To proceed with the investigation, we require knowledge of: (1) the risks involved; (2) each contractual party's risk preference; and (3) their willingness and ability to bear risks. The identifications of risks pertaining to PPP roads and each party's willingness and perceived ability to manage risks in Chung *et al*. (2010) provide a knowledge base to the first and third requirements; they also provide the platform for knowledge gathering in relation to requirement two.

Empirical studies on contract have so far assumed the stereotype risk-neutral principal and risk-averse agent by taking the risk preferences of contracting parties as given (cf., Allen and Lueck, 1999; Martimort and Pouyet, 2008; Chen and Chiu, 2010), or have used self-reported scale to measure risk preference (cf., Gaynor and Gertler, 1995; Jin and Doloi, 2008). The first method has been under challenge by progresses made in cognitive science and management science on modelling human behaviour. There is substantial theoretical and empirical evidence on risky behaviour that offers insights on what determines risk preferences. Risk preferences are driven by a combination of influences, which have been described as situational factors such as problem framing (Kahneman and Tversky, 1979), reference points (Lopes, 1987), levels of organisational slack (Cyert and March, 1963) and escalation of commitment (Brockner, 1992); and constant factors like individual dispositions (Laughhunn *et al.*, 1980), national culture (Hofstede, 1980), and organisational culture (Morgan, 1986). Risk perceptions were found to be diverse because they were influenced by value systems, and hence by attitudes, judgements,

emotions and beliefs of the individual (Edwards and Bowen, 2003). Risk could be interpreted differently by different people (Rohrmann, 1994; Weber *et al.*, 2002) and is contextually dependent (Kahneman and Tversky, 1979); therefore some risks would even mean different things to the same people at different times in their lives or under different circumstances (Edwards and Bowen, 2003, p. 85). The self-reported scale is a representation of the reporting individual's preference accumulated over actual experience; they are referred to revealed preference data in the choice literature. Revealed preference (RP) data have the advantage of replicating real life experience, but they are bound by real constraints confronted by the same decision maker (Hensher *et al.*, 2005, p. 92); therefore, the potentials to make predictions and improvements are limited because the data offer no innovations to the known information on what have occurred or currently exist.

In order to obtain a "true" risk preference with greater relevance to the transaction context in PPP roads, we will need to empirically derive a set of PPP risk indices to the requirement of number two. For this purpose, we have included in the online survey a series of stated-choice experiment to gather stated choice (SC) data on international stakeholder perceptions of risk associated with alternative packages of attributes that define the dimensions of PPP risk. The experiment contains a number of hypothetical scenarios that are well-defined within the transaction context of PPP road contracts; this allows us to overcome real-life constraints confronted by the decision maker while maintaining the realism in the choice scenarios. For example, a decision maker who may have only experienced projects of high financial risk, their self-reported scale would reveal a strong risk-aversion to the PPP model. One of the advantages of the SC experiment is its ability to seek out the decision maker's true risk preference by offering them a number of projects with different combinations of risks and rewards to choose from. Another advantage is that making choices based on hypothetical scenarios does not impose burden on the respondent to recall experience from years ago therefore minimise hindsight or recall bias (cf., Anderson and Dekker, 2005). An advanced discrete choice model known as the latent class model (LCM) will be estimated to obtain the parameterised risk preferences; these will then be fed into RP data collected from the survey that eliciting participants' real experience in the past specifically related to risk-allocation in PPP roads.

The experiment adopts candidate attributes identified in Chung *et al.* (2010) as the basis of alternative packages of attributes that define the dimensions of PPP risk. The paper's findings on each party's willingness and perceived ability to manage risks help us making sense of the derived indices. The indices will become an important source of variables to test the ownership effect on choice of contract structures and on each sector's view on accountability transfer. The indices in themselves and the process of derivation represent a significant contribution in the contract literature. We know of no other study that takes a similarly approach that integrates SC data and RP data to estimate the "true" risk preferences and studies how can they be influenced by incentive structures.

In contrast to the common belief that contracts are entered into by a risk-neutral principal and a risk-averse agent to share risks, our study attests that both the principal and the agent are risk-averse albeit at different magnitudes. Our results contest the validity of findings that were based on the stereotype principal and agent. Further, contrary to the theory of property rights that ownership right attenuates *ex ante* and *ex post* efficiencies, the present study argues that assignment of property rights offers the agent a protective shield against poor planning by the government principal in the meantime giving rise to *ex ante* opportunism. The agent's wary of exploiting ownership entitlements to their full extent distorts allocative efficiency in rationalising road space; and (3) compensation structure without the provision of revenue-sharing acts as an disincentive for exerted non-revenue-enhancing performance effort. These findings shed important light on the effectiveness of property rights on *ex ante* inefficiency because opportunism as an outcome of reverse-holdup (Wickelgren, 2007) can produce excessive *ex ante* private investments translating into project scope and design beyond the proposed project objective; the Sydney Cross City Tunnel (CCT) is a case in point. Two aspects of *ex post* inefficiency surfaced. First, the deployment of market force to manage public

goods is one of rationales that PPPs are being actively promoted, but the private sector agent's reluctance to exercise ownership right for setting toll prices means that the PPP model fails to deploy market force to rationalise public road space. Second, contracts are structured to incentivise risk-sharing amongst contracting parties, but the model that structured to reduce market risk for the agent by removing the revenue-sharing provision has produced the opposite effect in inducing the agent's performance effort; this is a strong evidence of the contract failing to understand contracting party's risk preference and reinforces the imperative of knowing the true preference.

Further investigation discovers that this is not the failure of property rights *per se* but rather the objectives of implementation are in variant to risk-sharing that PPPs rationalise upon. PPPs are primarily exploited as a financial means to ensure government budget certainty, consequentially PPPs are perceived as transferring accountability associated with ownership, although both parties are found to be averse to suggestions that ownership concession implies accountability transfer.

The paper is organised in six sections. Section 2 synthesises the theory of property rights as well as its resonance to PPPs with the aim of developing empirical predictions. Section 3 outlines the research method and underlines the theoretical significance of the LCM and the econometric properties of the model. Section 4 provides the descriptive statistics. Section 5 details the process of deriving the risk indices named PPPRI, discusses the empirical considerations relating to the estimations and presents the results of hypothesis testing. Section 6 concludes with a summary of implications of the findings.

2. Theory of property rights and public-private-partnerships

A contract is a set of mutually agreed promises under which parties make *ex ante* reciprocal commitments in terms of their *ex post* behaviour to coordinate (Brousseau and Glachant, 2002, p. 3; Brousseau, 2008, p. 37). This interpretation is premised on two dimensions of contract: the multilateral agreements coordinated via a governance structure to reduce *ex ante* decision costs; and *ex post* behaviour conditioned on decision-making structures.

The PPP model involves government contracting with a private sector proponent for a bundled product that comprises two distinct elements, the creation of an asset and the whole-of-life asset management (WWG, 2006). During the concession term, the proponent is granted with the ownership right to design, build, finance and operate the asset for an agreed period of on average 60 years (Broadbent and Laughlin, 2005). The public sector, on the other hand, purchases a service instead of an asset, with pre-defined payment levels, which are payable only when the service meets required standards (Debande, 2002). The payment mechanism or the compensation structure is linked to the requirements set out in the output specification and the results of the risk assessment (Akbiyikli *et al.*, 2006), and comes with the conditions of penalising poor performance (English and Baxter, 2010). The principal rationale of ownership entitlement and linking compensation with service outputs only is to incentivise the private proponent to implement *ex ante* efficient technology and innovations in project design and construction (Partnerships Victoria, 2000; HM Treasury, 2006; WWG, 2006) and to adopt a proactive management approach (Forward, 2006) in order to maximise *ex post* efficiency in service delivery over the long-term.

The concept differs from other forms of private provision such as contracting out and privatisation in the dimensions of risks and rewards sharing and the greater private involvement in finance arrangements (Hodge, 2005). The compensation structure varies depending on the transfer of demand risk associated with the project. If the government bears the demand risk of the project, the financial compensation generally comes from state consolidated funds (English and Guthrie, 2003), to compensate the private proponent for the availability of the facility

(English, 2005a), and to pay for the service provision (English, 2006); no provision for revenue-sharing between the principal and the agent is provided for. This model is commonly known as the availability model (AM). If the contract transfers out demand risk, user charges become the only source of financial compensation to the private proponent (English and Guthrie, 2003); to cap returns on private investments, revenue-sharing will be triggered when real return exceeds the threshold pre-determined based on the estimated return (Chung, 2009). Regardless the funding channel, the financial compensation is the primary source of return to private capital. The private proponent may negotiate with the responsible public authority over a number of variables inherent in the procurement model, such as the term of concession, toll escalation options and traffic demand management measures (English, 2006) to ensure that the sales of the asset-based services are sufficient to discharge construction, financing, operation and maintenance costs plus a 'reasonable' profit for private investors (Duffield, 2001).

The resonance of contract theory to PPPs is principally derived from the perspective of principal-agent relationship (Laffont and Tirole, 1991; Dewatripont and Legros, 2005); the perspective of contract incompleteness (Schmidt, 1996; Hart, 2003; Bennett and Iossa, 2005); as well as the dimension of transaction costs (Parker and Hartley, 2003; Välilä, 2005; Jin and Doloi, 2008; Ricketts, 2009; Soliño and Gago de Santos, 2010).

The debate on the matter of ownership to infrastructure delivery centres on the economic and behavioural perspectives of deploying private provision in public infrastructure delivery. The economic perspective is mainly attributable to the dissatisfaction with the performance of state enterprises in the latter part of the twentieth century, with which grew a wave of reforms involving the reduction in direct state provision of goods and services across the world (Parker and Saal, 2003). It was argued by protagonists like Shlefier (1998) and Schmidt (1996), that market contracts are preferred to state ownership for the production of public goods. Arguments in favour of the pricing mechanism presume that the market would have achieved higher productive efficiency relative to the state (Meunier and Quinet, 2010). The perplexity that the apparent failure of pricing mechanism coexisted with the growth in government regulation is, in Coase's words, a phenomenon of the enforceability of property rights: "when [enforcement of property rights] is done...chaos disappears; and so does the government" (1959, p. 14) except that the necessary legal system to define property rights and to arbitrate disputes is not costless (Coase, 1960; Williamson, 1991). In the pursuit of minimising *ex post* inefficiency, the step of formalising rules of the game to define property rights and to enforce contracts must be followed by a governance structure to institutionalise the play of the game (Williamson, 2000). PPPs have become a predominant institutional structure to govern the play of the game between government authorities and private sector actors (Hodge and Greve, 2009).

The behavioural perspective is related to the inevitably high uncertainty brought by the longevity of PPP contracts which would require an elaborated governance apparatus for these specific investments (Williamson, 1979, p. 254). The idea of empowering concessionaires the ownership right attenuates *ex post* opportunistic hazard has been attested elsewhere (see Rindfleisch and Heide, 1997, for a comprehensive review). PPPs deploy similar mechanisms for the purpose of facilitating risk-sharing across contracting parties by packaging the operations of the asset with the finance of the asset. The empirical findings in Chung *et al*. (2010) have asserted that this package fosters efficiency by enabling the private owner greater flexibility to manage market and project risks, while the public sector procurer concentrates on other dimensions of risk that are best not left to the market.

Structuring contracts to share risk in light of incentive problems is the central premise of contract theory (Ross, 1973; Holmström, 1979; Mirrlees, 1999). From the *ex ante* aspects of contract, agreements to compensation structures are drawn up to facilitate risk-sharing and foster incentive alignment (Jensen and Meckling, 1976; Fama, 1980; Fama and Jensen, 1983a; Fama and Jensen, 1983b; Jensen, 1983; Jensen, 1986; Masten and Saussier, 2002); and property rights are allocated to help distributing residual surplus between contracting parties, and to encourage parties' incentives to invest (Brousseau and Glachant, 2002, p. 10); they are interpreted as efforts to overcome the incentive deficiencies of contracting traditions

(Williamson, 1985, p. 26). Contracts are considered as devices structured *ex ante* to foster *ex post* efficiency, hence *ex post* institutions of contract must be supported by governance suitable for the dimensions of the underlying transaction (Williamson, 1985, p. 29); since misalignment between transaction and governance structure is likely to associate with *ex post* performance problems (Anderson and Dekker, 2005).

The behavioural assumptions are that economic actors are rationally bounded, have different preferences toward risk (Arrow, 1971), and display the propensity of shirking opportunism (Alchian and Demsetz, 1972). These behavioural attributes translate into agency problems of inefficiencies, which in the presence of information asymmetry between the principal and the agent, will give rise to *ex ante* inefficiencies known as adverse selection and *ex post* inefficiencies of moral hazard (cf., Holmström, 1979; Mirrlees, 1999). Control of agency problems includes establishing incentives to align managerial behaviours with owner preferences and monitoring (Jensen and Meckling, 1976; also see Eisenhardt, 1989 for a review). One of the well applied incentives in PPPs is risk transfer (Evenhuis and Vickerman, 2010). Transferring risks to the agent incentivises the agent to act in the interest of the government principal. This principle of risk-transfer is to allocate the risk to the party that is least risk-averse to that risk; it is based on the assumption that contracting parties have different preferences toward different risks. Transferring all risks out without considering the other party's specific risk preferences would cost the government principal a sizeable risk premium that will outweigh the benefits of the partnership. Thus, risk transfer needs to consider the degree of risk aversion of the agent. The evidence that the risk allocation approach in PPPs was dominated by parties' loss aversion (Arndt, 2000) suggests that a party who is willing to bear a specific risk, e.g., traffic risk, is supposed to have lower risk-aversion to the risk than the other party.

Hypothesis 1: *Contracting parties of a PPP tollroad have different risk preferences toward different risks.*

Contract theory specifically cautions the tradeoff between risk-sharing and incentive provision because the principal and the agent do not share the same risk preference and the agent is more risk-averse than the principal. One of the reasons being that the agent is unable to diversity their employment whereas the risk-neutral principal is capable of diversifying their investments (Jensen and Meckling, 1976, p. 349). This conjecture is even more likely to hold true in a relationship involving government, because government has in possession powerful means (e.g., the taxing power) of resource re-allocation. The risk-sharing rationale in PPPs suggests that:

Hypothesis 2: *In a PPP contractual relationship, the private sector agent is risk-averse while the government principal is risk-neutral.*

If the above hypothesis is supported, the risk-averse agent would choose PPPPs from a menu of contracts due to the ownership right to residual claims:

Hypothesis 3: *The risk-averse private sector agent would prefer PPPs to other procurement models.*

Complex transactions that are of long duration are featured with low describability *ex ante* because of uncertainty on future states. In anticipation of large transaction costs of writing a comprehensive contract and the rigidity of court enforcement of written contract terms, parties to a relationship will rather settle with a contract that is incomplete (Klein, 1996). Distribution of rights to capture *ex post* surplus is managed through the assignment of property rights – in Hart's word: "[it is] incompleteness [that] opens the door to a theory of ownership" (1993, p. 141). Property rights empower the owner a bundle of *ex post* decision rights to i) act on uncontracted-for provisions and therefore greater incentive to invest *ex ante* (Grossman and

Hart, 1986); ii) protection against *ex post* expropriation on investments (Laffont and Tirole, 1991); and iii) residual rights to insider information (Schmidt, 1996). The behavioural assumption of bounded rationality which believes contractible variables are observable but not verifiable (Hart, 2002) necessitates the relevance of *ex ante* asset ownership (Hart, 1990).

The enhanced incentive that comes with the ownership right to improve productive efficiency has become the principle argument for PPPs being superior to traditional public procurement methods (Dewatripont and Legros, 2005; Välilä, 2005). Ownership becomes paramount in incomplete contracts because *ex post* decision rights give rise to greater efforts *ex ante* and bargaining power in non-contractible situations (Grossman and Hart, 1986). This entitles the proprietor autonomous decisions to invest without the need for contract renegotiation thus savings on transaction costs. Bundling asset construction and service provision under one ownership incites appropriate levels of productive investment, particularly so in areas like roads where the service provision can be well specified (Hart, 2003). Bundling should lead to improved efficiency related to contract specification and future maintenance costs because it relaxes the rigid requirement to specify outputs that meet the ever-changing service quality in great detail with the embedded incentives to make careful planning over the long haul, and to invest efficiently at the outset to reduce maintenance cost over the asset's life cycle. The ownership bundling structure would have stronger incentive effect whenever the clarity of project objectives from the principal is in doubt. This is often the case in procurements involving mega infrastructure projects as they have been in the past, captured by different portfolio ministers for their own gain (Chung *et al*., 2010). Dewatripont and Legros (2005) has argued that transferring ownership to the agent could provide protection against risk of unclear project objectives by the government authority, their argument casts light on the private sector agent's risk aversion to unclear project objectives.

Hypothesis 4a *Unclear project objectives will increase the private sector agent's risk aversion.*

A further implication is that PPPs would shield the contractor from the risk of unclear project objectives by the government authority because ownership entitles them the freedom to adopt measures to manage uncontracted for events. If the private sector agent dislikes risk of unclear project objectives, i.e., if Hypothesis 4a is supported, they would prefer the PPP procurement model.

Hypothesis 4b *The higher is the risk of unclear project objectives, the more preferred is the PPP model by the private sector agent.*

Ex post decision rights would entitle the proprietor the autonomy to control toll pricing to manage traffic travelling on their facility. The price control right embedded in the ownership concession should reduce the private sector agent's risk aversion.

Hypothesis 5: *The right to toll pricing control will reduce the private sector agent's risk aversion.*

We have argued in Chung *et al.* (2010), that governments were often seen to use private ownership to insulate themselves from risks related to politically sensitive matters such as direct exposure to public adverseness to toll pricing. Such perception will mar the public acceptance of the PPP model and will render the model an unfavourable option to either side of the contract.

Hypothesis 6a: *The public perception that ownership transfer is seen as to transfer ownership-related risk arising from public's adverse attitude towards toll pricing will increase risk aversion of the private sector agent.*

Hypothesis 6b: *The public perception that ownership transfer is seen as to transfer ownership-related risk arising from public's adverse attitude towards toll pricing will increase risk aversion of the government principal.*

Coordination with the agent for non-contractible effort can be enhanced through revenue sharing (Holmstrom, 1982), in particular, the incentive scheme can encourage revenue-enhancing effort (Atkinson *et al.*, 1988; Gaynor and Gertler, 1995; Cachon and Lariviere, 2005). In a contractual relationship involving the government principal who is a social welfare maximiser, the revenue-enhancing outcome is replaced by the objective to supply the general public quality road service. In this light, we expect that the revenue-sharing incentive will have little effect on the agent's risk preference. We expect that in the AM, the removal of revenue-sharing from the contract will exert the agent's effort in delivering quality service because the agent does not need to manage demand risk. This proposition will hold up for a risk-averse agent, because under the AM in which the private sector agent does not partake in toll revenue-sharing with the government principal, performance is evaluated against their service outputs meeting prescribed outcome rather than against usage demand which would expose the agent to demand fluctuations.

Hypothesis 7: *The more risk-averse is the private sector agent, the more effective is the availability model to incentivise efficient performance during the operational phase.*

3. Research method

The behavioural perspective of relevance in contracts between the parties is driven by questions of a discrete choice nature (Williamson, 1991; Sykuta, 2008). Therefore, methods of collecting discrete choice data and in particular logit models used for analysing discrete choice data (cf., Hensher *et al.*, 2005) will be considered as the primary form of research methodology in this study. Within the PPP context, the key elements of the behavioural choice framework include the translation of the theoretical and conceptual contributions into an empirical setting capable of obtaining estimates of the role of identified risk dimensions for public and private sector stakeholders. *Inter alia* is the development of an aggregate risk perception index linked to risk preferences that can assist in guiding *ex ante* contract design and its *ex post* evaluation, which we named the Public-Private-Partnership-Risk-Index or PPPRI. Quantifying PPPRI requires identification of weights to attach to the underlying dimensions of risk associated with public and private sector stakeholders. SC methods have been selected as the basis of designing choice experiments that can deliver the data required to study stakeholder choices amongst alternative packages of attributes that represent the dimensions of project risk.

Choice analysis is about explaining variability in behavioural choice response amongst a set of considered or offered alternatives in a sampled population of individuals or other units of choice-making such as firms, community groups, etc. The main task for the researcher is to capture the sources of behavioural variability at the individual decision-making level, which are initially unobserved by the researcher but assumed known with certainty by the decision maker. The challenge to the researcher is to capture as much as possible of the variability through a set of observed influences while finding ways of accommodating the remaining unobserved influences. How to account for the latter and minimise the amount of unobserved heterogeneity is at the centre of choice analysis (Hensher *et al.*, 2005).

To overcome these challenges will first require extensive inquiry to identify and compile "sources of influence", i.e., attributes that matter to the decision maker. The next step is to collect data on the identified attributes, which will be introduced into a functional form in order to establish their role in the identification of the level of utility contributed by that attribute to the overall level of utility associated with each alternative in a choice situation. That is, a given alternative *j* faced by decision maker *i* can be expressed as a vector of attributes *k* as $\boldsymbol{x_{ijk}}$, each component of which has a number of levels specified by the researcher either in absolute or relative (i.e., percentage deviation from a respondent-specified RP level) terms.

The behavioural process assumes that each decision maker *i* acts as if he or she is a utility maximiser when choosing a most preferred alternative *j* in a choice situation. Denoting the utility decision maker *i* derives from an alternative *j* as U_{ij}, the utility maximisation exercise of the decision maker *i* can be expressed in its most basic form as:

$$max_j\, U_{ij} = \beta_{ijk} \times x_{ijk} \qquad \textbf{(1)}$$

s.t. $U_{ij} > U_{in}$ for all $j \neq n$

where $\boldsymbol{\beta_{ijk}}$ represents the vector of marginal utilities respondent *i* receives for each attribute $\boldsymbol{x}$ associated with the *j*th alternative. That is, the task of the respondent is to choose one and only one alternative *j*; the alternative chosen is that which maximises his or her utility U_{ij} that can be derived from a choice among the alternatives on offer.

It is generally assumed that the researcher is only capable of observing a subset of the influences on the propensity of respondents to prefer a given alternative, and hence the resulting econometric model must specify U_{ij} as a function of observed effects V_{ij} and unobserved effects ε_{ij} (cf., McFadden, 1974):

$$U_{ij} = V_{ij} + \varepsilon_{ij} \qquad \textbf{(2)}$$

where

$$V_{ij} = \hat{\beta}_{ijk} \times x_{ijk} \qquad \textbf{(3)}$$

and $\hat{\beta}_{ijk}$ represents the vector of estimated marginal utilities respondent *i* receives for each attribute *x* and alternative *j*. Any deviations of $\hat{\beta}_{ijk}$ from the true values $\boldsymbol{\beta_{ijk}}$ are biased parameter estimates. The application of appropriate econometric models within a discrete choice framework will minimise the information loss in the unobserved effects, allowing one to more closely approximate U_{ij} with V_{ij}.

Since we know nothing about the unobserved component ε_{ij}, it is necessary to make some assumptions about its distribution over the population. The simplest starting point is that the set of unobserved components across different alternatives are independent (i.e., with no cross-correlated terms so all covariances are equal to zero) with the exact same extreme type 1 (EV1) distribution[1] such that the variances of different ε_{ij} are identical for each alternative (i.e., identically distributed). This set of assumptions is referred to as the IID condition – independently and identically distributed. Imposing such strong assumptions is a necessary but not sufficient condition to derive the functional form for the utility expression of a multinominal logit model. Where there is a concern about possible violation of the IID property, choice models that allow for less restrictive assumptions should be considered.

Given the objective that the application of choice methods is to test whether the government principal and the private sector agent are heterogeneous in terms of their risk preferences, and to

[1] The phrase "extreme value" arises relative to the normal distribution. The essential difference between the extreme type 1 and normal distributions is in the tails of the distribution where the extreme values reside (Hensher *et al*., 2005a, p. 84).

derive the PPPRI, we will review the essential elements of an advanced choice modelling method – the latent class model (LCM) and discuss how the model can identify the critical risk dimensions influencing the preferences of each stakeholder. Since the LCM is an extension of the most basic form of choice model, i.e., the multinominal logit (MNL) model, we will first examine the basic properties of the MNL model.

3.1 Multinominal logit model

The MNL model has for many years provided the fundamental platform for the analysis of discrete choice. The derivation of this basic choice model can be found in Hensher *et al*. (2005, Chapter 3). Generally, the imposed IID property makes it possible to gather unobserved influences associated with each alternative into a single unknown distribution, so the utility individual *i* receives from choosing alternative *j* can be collapsed into:

$$U_{ij} = \sum_{k=1}^{K_j} \beta_k \cdot x_{ijk} + \varepsilon_{ij} \quad \textbf{(4)}$$

The subscripts i and j attached to □are removed because the model assumes that the preferences are the same across all individuals and across all choice situations in the MNL model.

In choosing among alternatives, the decision maker compares the utility levels that they derive from each alternative within the choice situation on offer. As the researcher does not have all the information the decision maker does, they can use only the sub-set of information they have managed to compile. This is equivalent to saying that the researcher can explain an individual's choice only up to a probability of an alternative being chosen. The probability arises because the □ij are a random distribution over the population. The individual's behavioural choice rule available to the researcher is as follows. The probability of an individual choosing alternative j is equal to the probability that the utility of alternative j is greater than (or equal to) the utility associated with alternative n, i.e., Vij + □ij ≥ Vin + □in, which becomes Vij ≥ Vin + □in – □ij; after evaluating each and every alternative in the choice situation of n = 1,...j,...N alternatives. The researcher does not know what a specific person's 'location' is on the error distribution; hence there is a probability distribution of this occurring given that □ij and □in are random variables.

We assume the EV1 distribution of the random component ε in Equation (4.0) takes the following form:

$$Prob(\varepsilon_j \leq \varepsilon_n) = exp(-exp - \varepsilon) \quad \textbf{(5)}$$

The focus of Equation (5.0) is on the unobserved component of a utility expression for a specific alternative *j*; ε represents draws from a random uniform. The choice probabilities associated with each alternative, i.e., the logit probability formula of the MNL (Hensher et al. 2005):

$$Prob_{ij} = \frac{\exp V_{ij}}{\sum_{n=1}^{N} \exp V_{in}};\ n = 1, \ldots j, \ldots N \quad \textbf{(6)}$$

Equation (6.0) states that the probability of an individual choosing alternative *j* out of the set of *N* alternatives is equal to the ratio of the (exponential of the) observed utility index for alternative *j* to the sum of the exponentials of the observed utility indices for all *N* alternatives, including the *j*th alternative. V_{ij} is equivalent to V_{ij} defined in Equation (3.0).

Although the MNL model represents the most widely used choice model to date, its maintained assumptions, e.g., IID, and homogeneity of preferences, are potentially limiting. The MNL model assumes that preferences associated with each attribute are fixed across individuals; this assumption limits the model's ability to handle preference heterogeneity, hence it is of little relevance to the research application in this study. The restrictive assumptions of the MNL model have motivated our consideration for an advanced model, namely the LCM.

3.1.1 Latent class model

The LCM is one of a number of choice model forms that have evolved in the literature to handle heterogeneity in preferences. Its underlying theory posits that individual behaviour depends on observable attributes and on latent heterogeneity that varies with factors that are unobserved by the researcher (Greene and Hensher, 2003). That is, it relaxes the preference homogeneity restriction imposed in the MNL model by facilitating membership of latent classes up to a probability. In this way it engenders heterogeneity between classes. The added advantage is its ability to identify the heterogeneity in discrete clusters across the sampled individuals without the extra burden on the researcher to make specific assumptions about the distributions of parameters across individuals.

Preference heterogeneity is handled via discrete distributions in parameters. These discrete distributions are referred to as 'classes'. According to the model, each individual resides up to a probability in a 'latent' class, *Q*. In estimating the model, there exist a fixed number of classes, *Q*, where the number of classes is defined a priori by the researcher. Estimates consist of the class specific parameters and for each respondent, a set of probabilities defined over the classes. Within each class, the parameters and choice probabilities are assumed to be generated by MNL models.

The utility functions of the LCM differ to the MNL model in that there now exist several utility functions that require estimation. Firstly, there exist the class specific utility functions which are represented as:

$$U_{ij|q} = V_{ij|q} + \varepsilon_{ij|q} \quad \textbf{(7)}$$

where i = individual, j = alternative, q = class and $\varepsilon_{ij|q}$ ~ IID EV1.

Individuals are implicitly placed into a set of Q classes up to a probability, but which class contains any particular individual, whether known or not to that individual, is unknown to the researcher. Typically, the class assignment model is specified as an MNL model, which requires that an additional utility specification be defined. These additional sets of utility functions are used to help distinguish individuals in terms of class membership. We represent the class assignment model utility function as:

$$U_{iq} = \delta_q h_i + \varepsilon_{iq} \quad \textbf{(8)}$$

where h_i = represents a set of observable characteristics used to separate sampled individuals into different latent classes and δ_q associated parameters.

For purposes of model identification, at least one class assignment (typically the last) utility function is normalised to zero. If no utility function is directly specified by the researcher, then only class specific constants are used in the model to allocate individuals, up to a probability, into the different latent classes. The characteristics contained in the h_i vector must remain constant within each choice situation, and hence the class assignment model in effect assigns individuals and not choice situations to the different classes.

The central behavioural model is defined as follows:

$$Prob\,(ij|q) = \frac{\exp\, V_{(ij|q)}}{\sum_{n=1}^{N} \exp\, V_{(in|q)}} = F(i,j|q) \quad \textbf{(9)}$$

The above equation assumes heterogeneity and discrete distributions rather than continuous distributions in the parameters to be estimated.

After identifying the relevant choice model form we now describe the process of deriving the PPPRI.

3.1.2 Public-private-partnership-risk-index

The objective of the PPPRI is to obtain a single measure that quantifies stakeholder risk preferences over a wide range of issues. It can be implemented at project level to establish a project-specific risk index, or at policy level to assess whether variations in policy variables (e.g., revenue-sharing, performance indicators, relaxation of pricing regulation etc.,) will change private investors' risk-taking behaviour. It can also be applied to different institutional environments to evaluate how institutional norms and public opinions affect the risk preferences of private investors and the preference for the PPP option by public sector authorities.

We draw on the Hensher Service Quality Index (HSQI) (Hensher and Prioni, 2002; Hensher et al., 2003) as a way to establish such a set of risk indices pertinent to PPP tollroads. The HSQI represents a set of quantitative performance indicators to measure bus service delivery quality and effectiveness. Under this framework, the overall level of passenger satisfaction is measured by how an individual evaluates the total package of services offered. The evaluation process involves the search for appropriate weights attached to each service dimension to identify the strength of positive and negative source of overall satisfaction. To fulfil this objective, SC methods were used in the original study (Hensher and Prioni, 2002), whereby a sample of passengers were asked to choose their most preferred package from a number of alternative packages of service levels based on these attributes. A number of logit models were estimated to establish the relative weights attached to the statistically significant attributes, representing the contribution of each service attribute to the calculation of an overall service quality index. In addition, the reference levels must be identified to apply the weights. For this purpose, RP data of the perceptions of passengers relative to the levels of each attribute as experienced in a current trip were obtained; they were then multiplied by the relevant weight; summing these calculations across all attributes will produce the service quality index for each sampled passenger.

Although HSQI was specifically designed for a different area of research to that currently under discussion in this study, it opens up an insightful avenue for the formulation of a risk index in the domain of PPPs. To construct the risk index as an output of the estimation of the choice model using data from a SC experiment, we first need to identify the weights attached to each risk attribute, i.e., risk preferences, with the most likely source coming from SC data to parameterise the source of risks. SC data are chosen over RP data because SC data provide greater flexibility to vary the levels of risk attributes so as to create a large number of scenarios within a systematic package of risk attributes in order to identify potential tradeoffs (Hensher, 1994; Hensher et al., 1998).

Nevertheless, RP data are an important input to determine the reference levels. The preferred approach is to apply parameter estimates derived from data gathered by way of a SC experiment to the current RP levels which each participant in the sample currently experiences. Once the data are collected, latent choice models will be estimated to establish the relative risk preferences. The resulting utility indicators emanating from the estimation of models based on the SC experiment measure the expected utility that a stakeholder obtains from the average level of risk-allocation in recent contracts and how this might change under a variety of ownership-related conditions as specified in the hypotheses.

3.1.3 Survey design

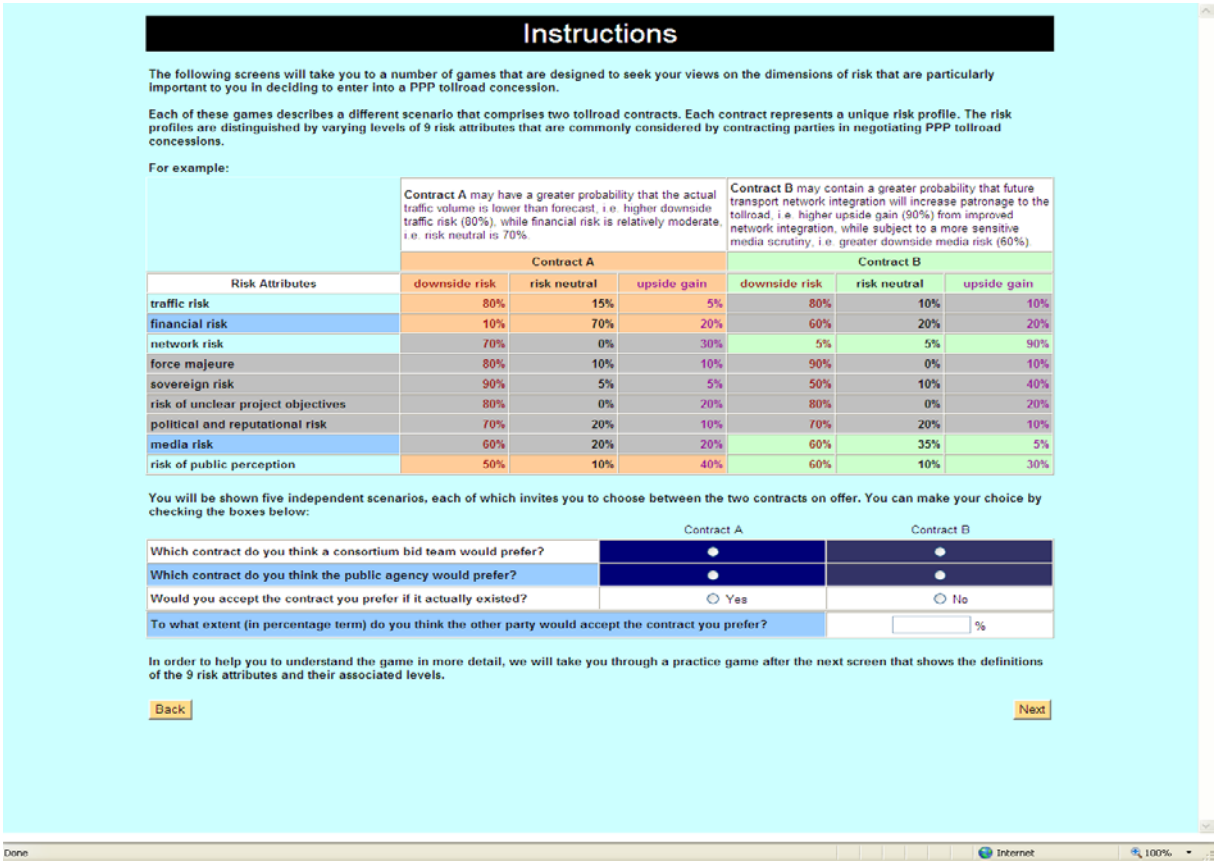
An internet-based survey is the most economical way to survey stakeholders internationally. Following the empirical testing structure developed in the last section, we designed a 'computer assisted personal survey instrument' (CAPI) which contains a SC experiment and a series of non-stated-choice questions that seek out information on the respondent's experience with PPPs as well as their subjective views on the key factors influencing their choice of contract. There are several distinct parts to the survey: (1) general questions capturing the socio-demographic covariates of respondents and other contextual effects; (2) choice menus corresponding to a

PPP-tollroad-concession setting;[2] (3) RP questions surveying respondents' "prior experience" to determine the reference level for the derivation of the risk index; (4) attitudinal questions intended to obtain respondents' preference for the PPP procurement model; and (5) questions intended to evaluate the extent to which other ownership-related variables and contractual conditions impact on respondents' decisions to enter into a PPP contract.

The SC experiment contains a number of decision choices based on hypothetical scenarios, in which a sample of individuals evaluates two unlabelled alternative contracts. An unlabelled contract is one described by a bundle of attributes with no label or brand name to characterise what the alternative might be. In contrast, a labelled experiment has a specific name attached to each of the alternatives in the experiment. For example, in the "Instructions" screen in Figure 1, a labelled experiment will have "Sydney Harbour Tunnel" instead of "Contract A" and "Chicago Skyway" instead of "Contract B". The decision to use an unlabelled experiment rather than a labelled experiment has multiple advantages. First, since this is an international study, an unlabelled experiment does not require the identification and use of all PPP tollroads in the world, representing significant savings in data collection cost and time. Second and more importantly, because a project's name acts somewhat like an alternative in a labelled experiment, a labelled experiment may invite unintended perceptions that respondents may hold with regard to that alternative to enter into their decision process, as well as induce the possibility that they will make inferences about attributes that are outside the focus of the study (i.e., that are not shown in the experiment) including assumptions based either on direct experience or second hand information as proxies for these additional attributes (Hensher *et al.*, 2005, pp. 112-114).

Each contract (A or B) represents packages of attributes that are defined by levels of risk, and respondents are asked to indicate which package they believe would be preferred by the public sector and the private consortia. The risk attributes are anchored to current experience described Chung *et al*. (2010), so that respondents can understand and relate to the attributes in a realistic way. It is then important to create the other possible levels as reasonable variations on either side of current experience (Stopher, 1998). Failure to do this may result in respondents providing poor quality and inappropriate responses, as they try to relate to attribute levels that are totally outside their experience and sometimes difficult to imagine.

[2] We adopted the nine key risk attributes pertaining to PPP tollroads identified in Chung *et al*. (2010); these are: traffic risk, financial risk, network risk, *force majeure*, sovereign risk, risk of unclear project objectives, political and reputation risk, media risk and risk of public perceptions.



Instructions

The following screens will take you to a number of games that are designed to seek your views on the dimensions of risk that are particularly important to you in deciding to enter into a PPP tollroad concession.

Each of these games describes a different scenario that comprises two tollroad contracts. Each contract represents a unique risk profile. The risk profiles are distinguished by varying levels of 9 risk attributes that are commonly considered by contracting parties in negotiating PPP tollroad concessions.

For example:

Contract A may have a greater probability that the actual traffic volume is lower than forecast, i.e. higher downside traffic risk (80%), while financial risk is relatively moderate, i.e. risk neutral is 70%.

Contract B may contain a greater probability that future transport network integration will increase patronage to the tollroad, i.e. higher upside gain (90%) from improved network integration, while subject to a more sensitive media scrutiny, i.e. greater downside media risk (60%).

	Contract A			Contract B		
Risk Attributes	downside risk	risk neutral	upside gain	downside risk	risk neutral	upside gain
traffic risk	80%	15%	5%	80%	10%	10%
financial risk	10%	70%	20%	60%	20%	20%
network risk	70%	0%	30%	5%	5%	90%
force majeure	80%	10%	10%	90%	0%	10%
sovereign risk	90%	5%	5%	50%	10%	40%
risk of unclear project objectives	80%	0%	20%	80%	0%	20%
political and reputational risk	70%	20%	10%	70%	20%	10%
media risk	60%	20%	20%	60%	35%	5%
risk of public perception	50%	10%	40%	60%	10%	30%

You will be shown five independent scenarios, each of which invites you to choose between the two contracts on offer. You can make your choice by checking the boxes below:

	Contract A	Contract B
Which contract do you think a consortium bid team would prefer?	●	●
Which contract do you think the public agency would prefer?	●	●
Would you accept the contract you prefer if it actually existed?	○ Yes	○ No
To what extent (in percentage term) do you think the other party would accept the contract you prefer?		%

In order to help you to understand the game in more detail, we will take you through a practice game after the next screen that shows the definitions of the 9 risk attributes and their associated levels.

Back Next

Done Internet 100%

Figure 1: The stated choice experiment – instructions screen

In our design, three attributes were selected for each risk; downside risk (where the actual outcome of the risk is inferior to expectations at the contract's financial close), risk neutrality (where the actual outcome of the risk is more or less meeting expectations at the contract's financial close), and upside gain (where the actual outcome of the risk is superior to expectations at the contract's financial close). Attribute levels were presented in percentage terms to represent the degree of (un)certainty of a future eventuality (the three percentages sum to one for each risk). Choice situations were assigned by a block column so that no contract will be presented more than once to the same respondent. The attributes of risk (i.e., downside, neutral, upside) that are presented in columns are randomly rotated in order to minimise left-hand-side bias.

The choice experiment provides the variability needed to parameterise the source of risks. However, the reference point is needed to apply the model within the framework of PPPRI using the sentiment of HSQI. In the screen shown in Figure 2, the respondents were asked to fill out the box of "downside risk" and the box of "upside gain" for each risk based on their past experience in terms of risks that experienced. The percentage of the "risk neutral" attribute is automatically calculated after the data are entered into the other two boxes; the percentages across the three boxes sum to 100. These RP data define the reference level for calculating PPPRI.

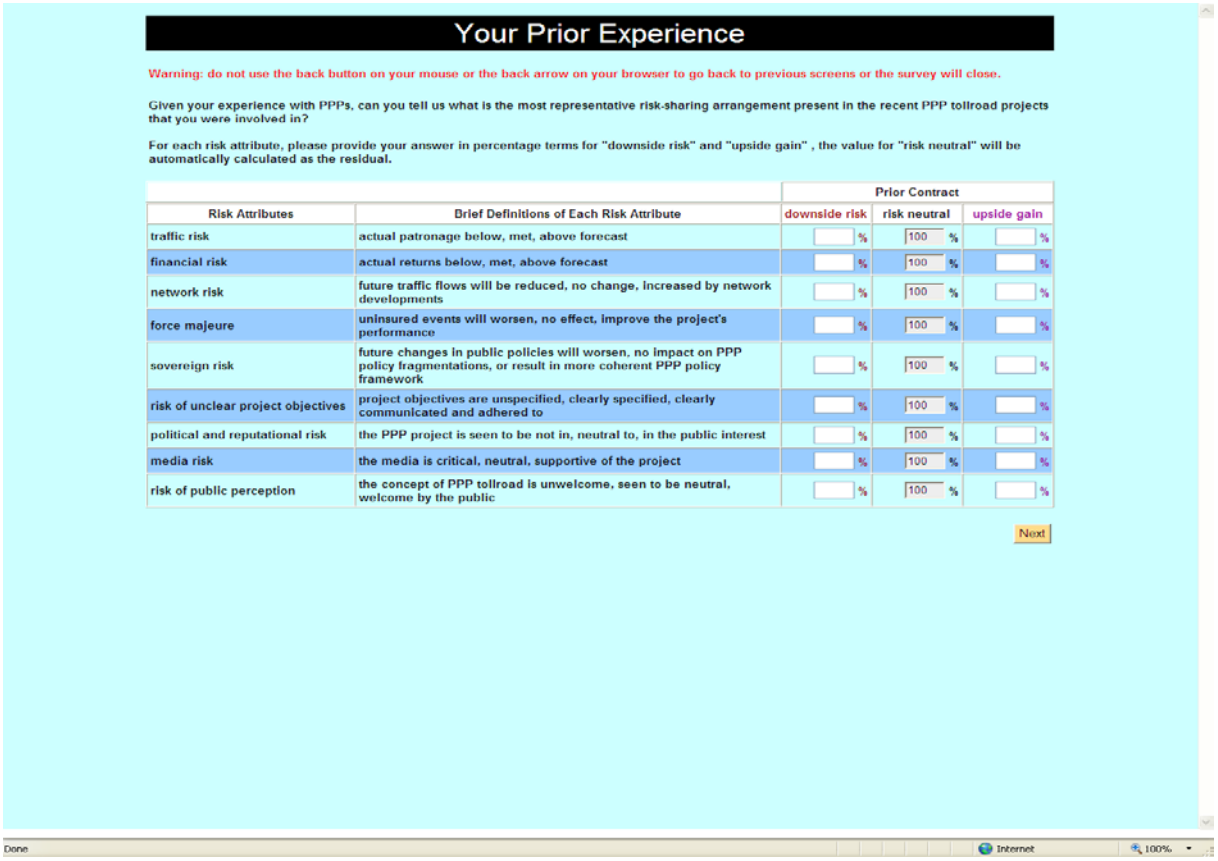


Figure 2: The revealed preference data – prior experience

The extensive literature on the choice of procurement between PPPs and other methods, discussed in Section 2, highlights an interest in attitudinal views of stakeholders. We have designed a set of attitudinal questions to get a feeling about participants' preference for the PPP procurement model. In Figure 3, participants were asked to rate on a one to seven likert scale, whether they prefer PPPs over other methods (1=PPPs are the most preferred method; 7=other methods are the most preferred method or PPPs are the least preferred method).

3.1.4 Data collection

Individuals who have had direct experience in making decisions regarding PPP tollroad concessions were invited to take part in the experiment. To mitigate the inhibiting effects of loss aversion bias, i.e., if decision makers expect that evaluation on the outcomes of their performance will take place after each choice situation, they become extremely loss-averse in terms of risk taking (Kahneman and Lovallo, 1993), all participants were informed at the commencement of the experiment that they would be invited to assess five choice situations based on hypothetical scenarios which have been designed to mimic the risk profile of PPP tollroad contracts. After the pilot study with eight participants, it was clear that the conciseness of the experiment required a detailed explanation to ensure consistent understanding across participants. Therefore, a decision was made to adopt the CAPI approach to complete the collection process.

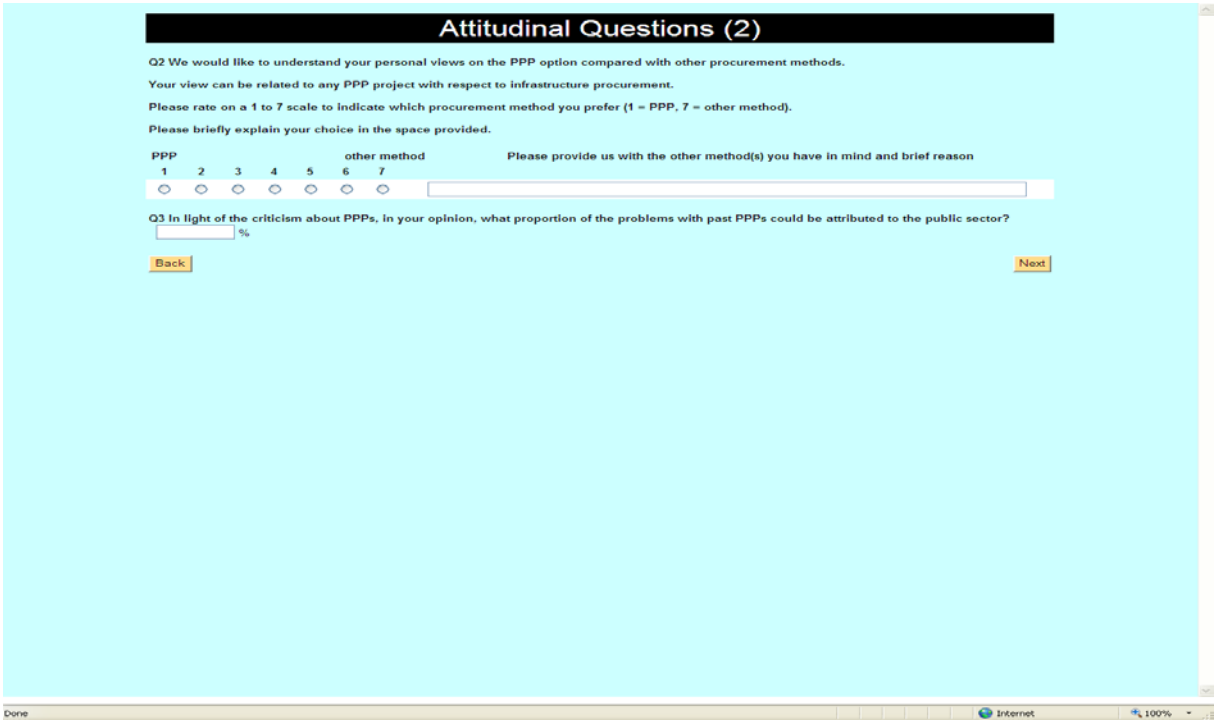


Figure 3: Online survey – attitudinal questions (2) screen

Semi-structured interviews were set up for the subsequent 93 participants. Interviews lasted on average 100 minutes. Most meetings were face-to-face, some were through skype, and two were by telephone, all undertaken by the author. Since the choice situations were assigned by the blocking column and the order of attributes was randomly rotated, the author would have no knowledge what choice situations would come up unless the participant signed into the survey with their identification number. Face-to-face and skype interviews have the advantage over the telephone interviews because these methods enable the author and the participant to share the exact information on the computer screen. In the telephone interviews, the participant had to explain to the researcher what they saw on their computer screens. Although time consuming, going through the survey with each participant has considerable empirical advantage. It enabled the author to guide the participant throughout the whole experiment process and provide instant clarification when needed.

At the beginning of the survey, participants were invited to give an account of their background and experience in the field. These accounts were recorded on tape (with permission) to provide a means of assurance to cross reference the information filled out in the survey. These 10-15 minute initial conversations benefit the research in a number of ways; i) they help make sense of the perspectives of the participant (the information is then reflected in the first part of the experiment – "About You and the Projects You Have Been Involved In", see Figure 4); ii) the information unveiled in the conversation also determines the role the participant will play in the experiments; and iii) they provide points for cross referencing with survey data when information is missing or unclear.

With this background, we were able to understand each participant's most recent experience or experience that they were most experienced in. Given the number of years of experience in the field, many participants held multiple roles and worked for different organisations across the public and private sectors. In order to obtain high quality data and minimise cross-over in their roles of play in the experiments, each participant was reminded during the survey to consistently play the role associated with their most recent experience or their most experienced role. After finishing the first choice situation, the author asked the participant the reason for their decision, these questions being framed in accordance with the information the participant provided during the initial conversation. As a way of illustration, the author asked a participant why would they

choose contract A given their background as the regulator. The participant would then finish the remaining choice situations while the author sitting on the side observing their choices. When the participant chose a contract that was inconsistent with their previous choices and accounts, the author would clarify the reason of inconsistency without influencing/changing their choice.

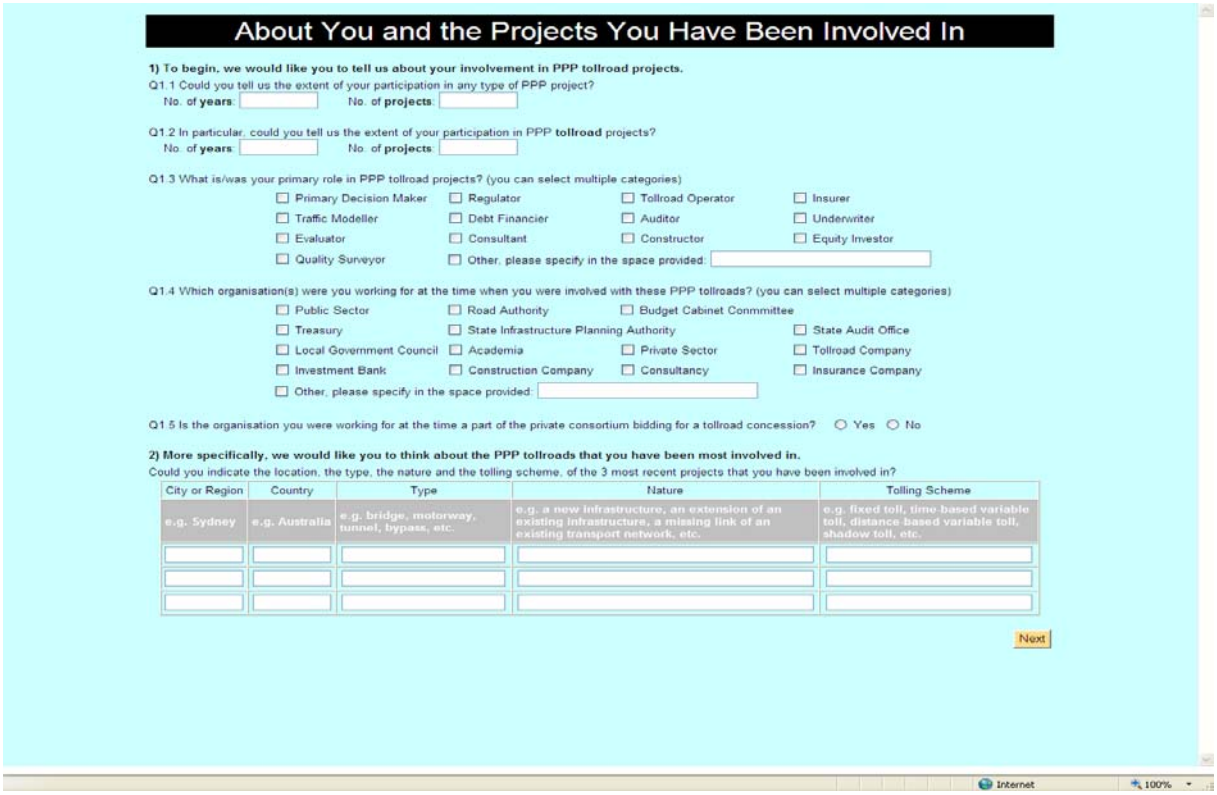


Figure 4: Information of participant

After six months of data collection and 101 interviews (eight pilots plus 93 post-pilot) with people who have had direct experience in dealing with PPP tollroad concessions, we have data capable of testing the set of hypotheses of interest.

4. Descriptive statistics

4.1 Demographic attributes

Overall, the international significance of this study is enhanced by the coverage and diversity of the experience and knowledge of participants who took part in the survey. The participants' experience in PPP years (projects) runs the gamut of one to 46 years (one to 120 projects). The participants have brought to this study their project experience in six regions covering 32 countries. One hundred and one people participated in the survey, of which 41 represent the public sector and 60 represent the private sector. The distributions in Figure 5 and Figure 6 show that the participating cohort represents a good spread in roles and organisations. Their diverse background has strengthened the study's global significance: there are 24 different roles represented, from "primary decision maker" to "consultant" that come from 14 different organisations, including steering committees and commercial banks.

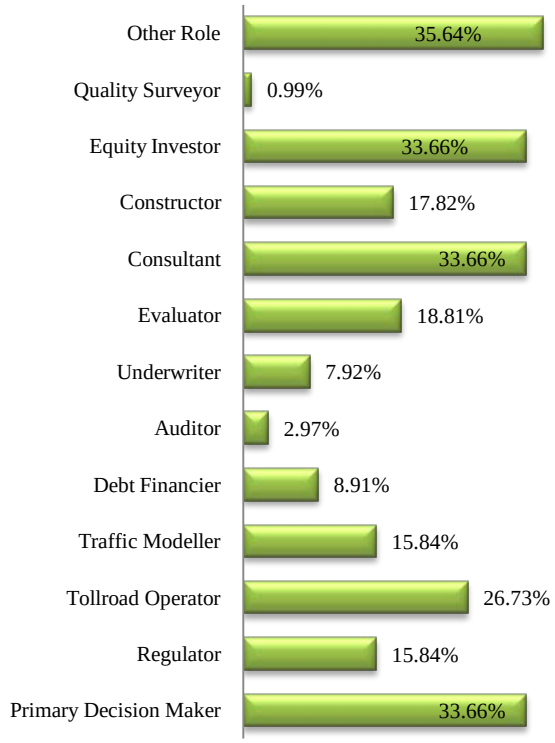


Figure 5: Distribution of roles - 101 participants

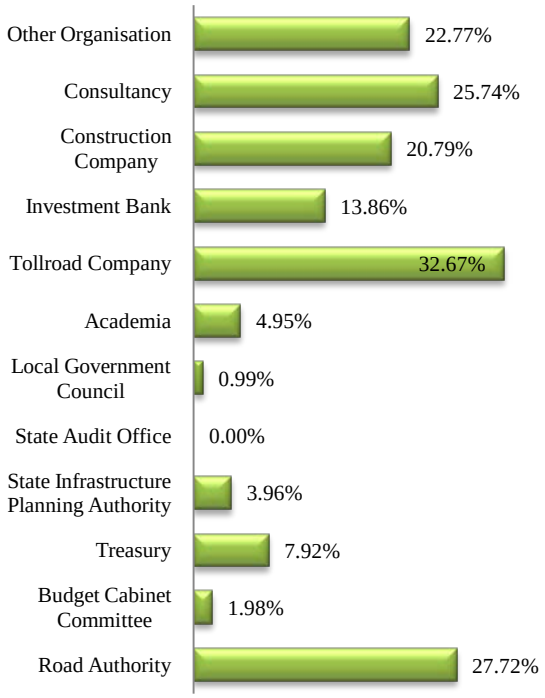


Figure 6: Distribution of organisations - 101 participants

Participants were asked to list the three most recent projects that they have been involved in. As presented in Table 1, the locations of projects are diverse showing that PPP is an important and popular procurement method of road infrastructure across the world. Private sector participants (PVSPs) were exposed to PPP projects in much more jurisdictions (166) than public sector participants (PUSPs) (110). This evidence adds to the support for PPPs; some pundits have argued that PPPs offer government the opportunity to exploit economies of scale and scope by pooling knowledgeable resources abundantly available in the market (Parker and Hartley, 2003).

Figure 7 illustrates the tolling schemes that participants have been involved in. Little less than half of the project experience (46.38 percent) applies fixed tolls, followed by 23.91 percent of project experience charging distance-based tolls and 9.06 percent charging an availability payment. 8.70 percent of project experience charge distance plus time-based variable tolls. Only one project applies High Occupancy Toll. The "no new tolls" category accounts for two refinancing projects. "OTHER" includes two projects that charge an availability payment plus a fixed toll; one started with a distance-based variable toll but has changed to an availability payment since 2003; one uses an availability payment plus 16 percent of shadow toll; and one in the US that applies a distance-based variable toll as well as a fixed toll. Only three projects apply shadow toll, they account for 1.09 percent of total project experience. The combination of shadow and availability payment regimes accounts for 2.54 percent of project experience, time-based variable toll only represents 2.54 percent of total project experience.

Table 1: Experience with tollroad projects (regions and countries)

REGION	COUNTRY	REGION	COUNTRY
Africa (2 countries)	South Africa Mozambique	Europe (continued)	France Greece Hungry Ireland Italy Netherlands Poland Portugal Spain UK
Asia-Pacific (9 countries)	Australia Bangladesh India Indonesia Korea New Zealand Russia Thailand Vietnam	North America (3 countries)	Canada Mexico USA
Caribbean (2 countries)	Jamaica Puerto Rico		
Europe (13 countries)	Austria Belgium Croatia	South America (3 countries)	Chile Brazil Colombia
		Total	32

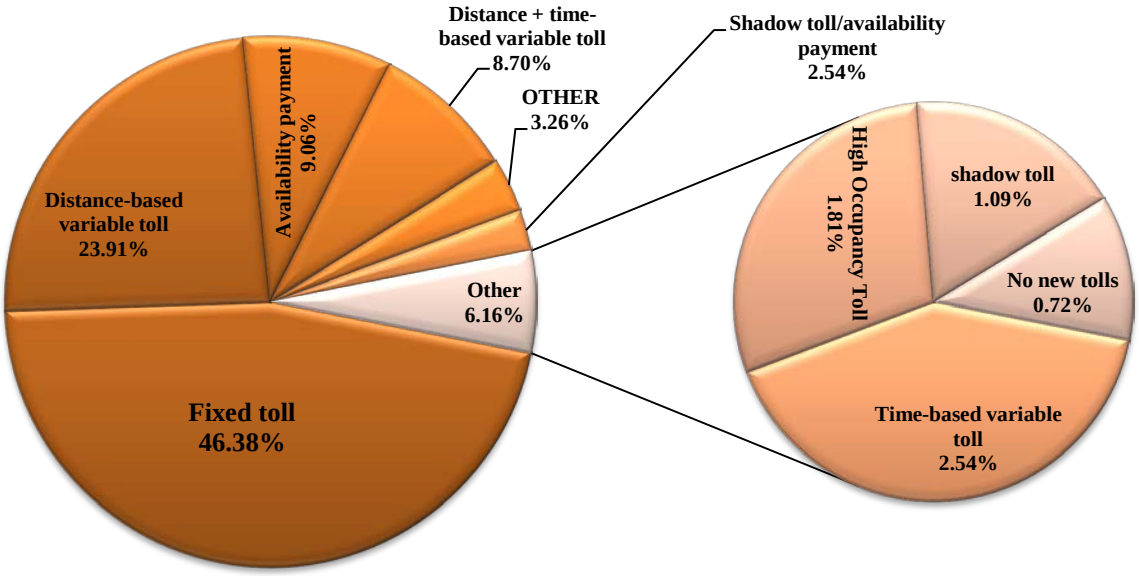


Figure 7: Involvement in tolling schemes

No systematic relationships are found between tolling scheme, types of project and the nature of project. It appears that toll price is primarily used to pay for the project rather than being implemented as a traffic demand management device. This observation highlights the potential failure of PPPs to fully exploit the market for allocative efficiency in managing road space. Interview data reveal that PPPs were perceived, by both sector participants, as primarily a financing instrument under which the benefit of PPPs, i.e., bringing in market discipline to regulate demand and supply for road space, may not have been exploited to its fullest. Such failure is not the failure of PPP *per se* but rather the exploitation of market is being obscured by political intent to bypass fiscal constraint. A retired director of a road authority succinctly pinpointed the problem:

> P_a: *To get the best outcome for the community each party should bear the risk that is in their position to do so. Unfortunately this is not happening in reality. Financing cost, tolls, and length of the concession are more than they should be. These were set in the view of not adding public debt.*

He was joined by others:

> P_b: *Design, Build, Operate & Maintain [model] brings all the benefits of a PPP without having major transaction costs + high risk profile - the only major benefit [of PPPs] is having finance that State Governments do not want to borrow or go into debt.*

> P_c: *[PPP] is a function of western democracies needing to use stretched balance sheets to provide services that cannot be funded by the private sector e.g., police, hospital and health services and school services.*

> P_d: *Currently, due to restrictions in public budget, one could tend to overestimate the benefits of PPP.*

Some went further on the myopic view of politics which may have compromised the social benefits of PPPs:

> P_e: *30-year concession period leads to big efficiency savings, [as long as it can] avoid political interference (e.g., refusing to increase tolls).*

> P_f: *There should however be opportunities [in contracts] for using pricing mechanisms to manage the network (i.e. tolls not linked to CPI).*

Most PUSPs who acted in the capacity of regulator admitted that toll pricing is a sensitive matter and therefore its level and escalation clause must be closely regulated by government. Many PPP road contracts impose strong clauses to limit the private operator's capacity to set and vary toll pricing. Figure 8 shows that only 13 percent of project experience applies, to some extent, the pricing structure (e.g., time variable, high occupancy toll) that is linked to traffic demand management compared to an 87 percent share of other tolling schemes.

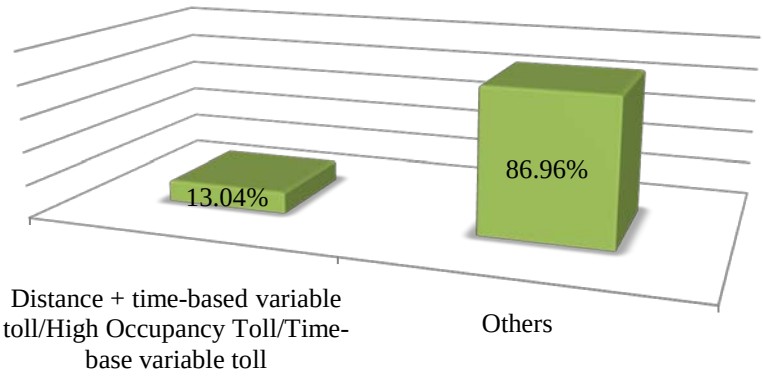


Figure 8: Tolling scheme – traffic management vs. others

4.2 Contract choice

In each of the five choice situations in the SC experiment, participants were asked to consider contract A and contract B and based on each contract's risk profile, to indicate which contract they think a private consortia would prefer ("1st row" in Figure 9) and the contract they believe a public agency would prefer ("2nd row" in Figure 9). In more than half (57 percent or 290 cases) of the 505 choice situations, respondents believed that both parties would prefer the same contract; of which an overwhelming 57 percent (165 cases) of respondents are PVSPs. It suggests that PVSPs are comparatively more confident about reaching an agreement with the road authority. The confidence may be accumulated over their greater exposure to the number of projects and exposure to a greater number of countries.

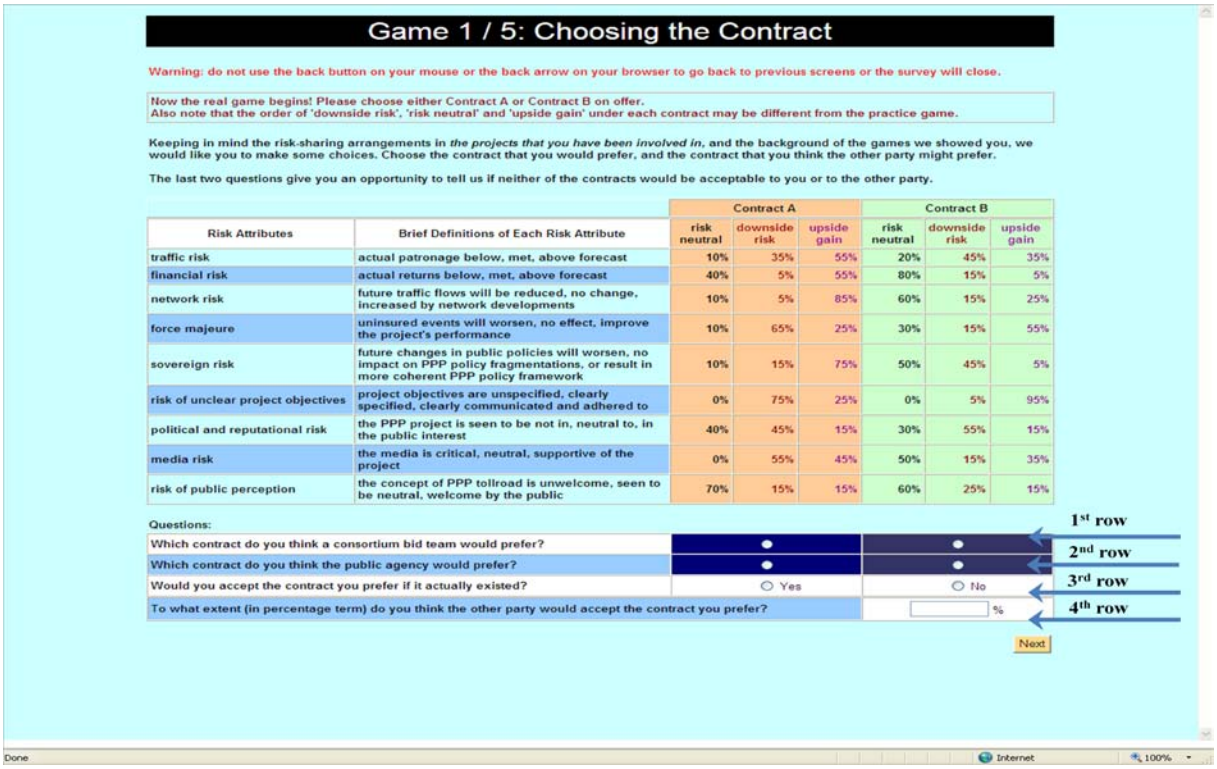


Figure 9: The stated choice experiment – contract choice

After choosing the preferred contract, respondents were asked whether they would accept the contract they prefer if it actually existed ("3rd row" in Figure 9). In 54 percent of 505 cases, respondents indicated that they would accept the preferred contract, of which 60 percent of respondents came from the private sector. Evidently, most PUSPs favour inaction. This status quo bias implies that when making decision about whether or not entering into a procurement contract, PUSPs are highly loss-averse therefore prefer avoidance of risks (Kahneman *et al.*, 1991; Tversky and Kahneman, 1991). Similar observation was explained in Tetlock and Boettger (1994) that pressures of accountability increase the status quo bias and other manifestations of loss aversion.

The average value of the extent that each individual participant thinks that the other party would accept the contract they prefer ("4th row" in Figure 9) is 55.28 percent. The average of PUSPs (55.50 percent) is very close to that of the PVSPs (55.13 percent). However, PVSPs (66.67 percent) are more likely to believe that the public sector party would definitely (not) accept the contract they prefer. That shows that the PVSPs are more optimistic in terms of reaching a deal with public authorities. Interview data confirm that many PVSPs consider that they are willing to take on any risk as long as they will be adequately compensated for.

4.3 Prior experience

Following the choice situations, participants were presented the opportunity to tell us about their real experience in terms of risk borne (refer to Figure 2). Table 2 contrasts the mean value of PUSPs and that of PVSPs for each risk attribute. The contrast shows that participants have experienced inequitable risk-sharing. The PVSPs have mostly borne downside risks associated with traffic volume and financial return and their shares of the related upside gain are far less than the losses they have suffered. Such outcomes are consistent with the risk allocation paradigm in PPP real toll programs, i.e., tolls are directly charged on users, in which the private sector is primarily responsible for these risks (Chung, 2009). Downside risk of unclear project objectives appears to have much worse impact on PUSPs (33.24 percent) relative to PVSPs (18.60 percent). The higher mean values associated with PUSPs for downside risks of social dimension such as political and reputational, media and public perceptions suggest these risks mainly rest with the public sector.

4.4 Prefer procurement method

On average, PUSPs – having a mean value of 3.49 compared with PVSPs' mean value of 2.37 – appear to be more in favour of PPPs over other methods. But Figure 10 shows that there is a much higher proportion of PVSPs who prefer PPPs (71.67 percent in ratings 1 and 2 combined) than the PUSP counterparts (24.39 percent in ratings 1 and 2 combined). The rating is related to any PPP project, not just tollroads. Many respondents held the view that the choice of procurement method should depend on the project, its characteristics, and the availability of government funding.

4.5 Other factors

We acknowledge that in addition to risks pertinent to PPP tollroads, there are a number of considerations that may influence stakeholder decisions on entering into a contract; the related data were collected through the screen depicted in Figure 11. At the time of survey design, the world was experiencing a significant economic downturn caused by the Global Financial Crisis (GFC). Particularly, the crisis highly impacted on lender's ability and willingness to invest. Further, during the pilot study, it was drawn to our attention that the AM and land acquisition responsibility are two important considerations in countries outside Australia. The addition of these two variables in our factor list has enhanced the relevance of the study to the international

community. The mean values[3] reported in Table 3 show that both PUSPs and PVSPs share similar views on the importance of these factors.

Table 2: Prior experience of risk borne (contrast of mean)

	PUSPs	PVSPs	Difference in Mean
	Mean (%)	Mean (%)	PUSPs – PVSPs (%)
Traffic_downside risk (TRA_D)	14.15	54.07	-39.92
Traffic_upside gain (TRA_U)	11.37	17.38	-6.02
Financial_downside risk (FIN_D)	13.41	45.47	-32.05
Financial_upside gain (FIN_U)	15.20	22.30	-7.10
Network_downside risk (NET_D)	19.32	22.78	-3.47
Network_upside gain (NET_U)	21.15	31.50	-10.35
*Force majeure*_downside risk (FOR_D)	21.88	14.57	7.31
*Force majeure*_upside gain (FOR_U)	5.98	8.12	-2.14
Sovereign_downside risk (SOV_D)	23.90	17.40	6.50
Sovereign_upside gain (SOV_U)	7.93	9.63	-1.71
Unclear project objectives_downside risk (UNC_D)	33.24	18.60	14.64
Unclear project objectives_upside gain (UNC_U)	12.20	16.43	-4.24
Political and reputational_downside risk (POL_D)	39.20	21.87	17.33
Political and reputational_upside gain (POL_U)	13.41	21.03	-7.62
Media_downside risk (MED_D)	41.17	25.13	16.04
Media_upside gain (MED_U)	13.10	18.05	-4.95
Public perception_downside risk (PUB_D)	45.37	27.63	17.73
Public perception_upside gain (PUB_U)	12.68	20.57	-7.88

(1=PPP the most preferred model, 7=PPP the least preferred model)

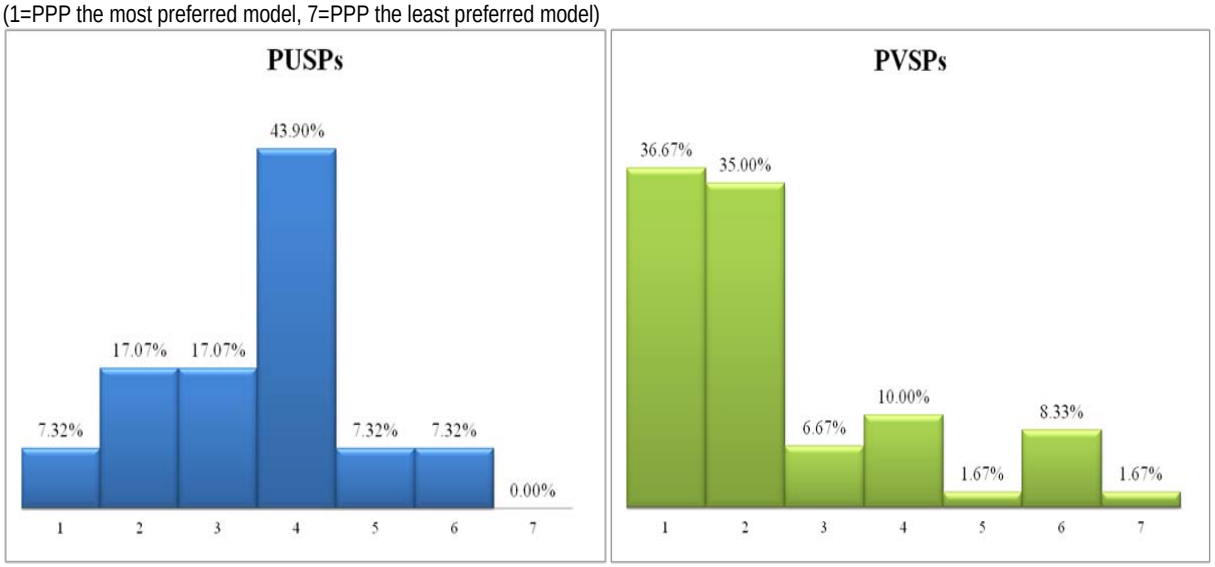


Figure 10: Prefer procurement method – PUSPs vs. PVSPs

[3] The data were collected through a 1-to-7 likert scale. 1 indicates that the factor is very unimportant whereas 7 indicates that the factor is very important.

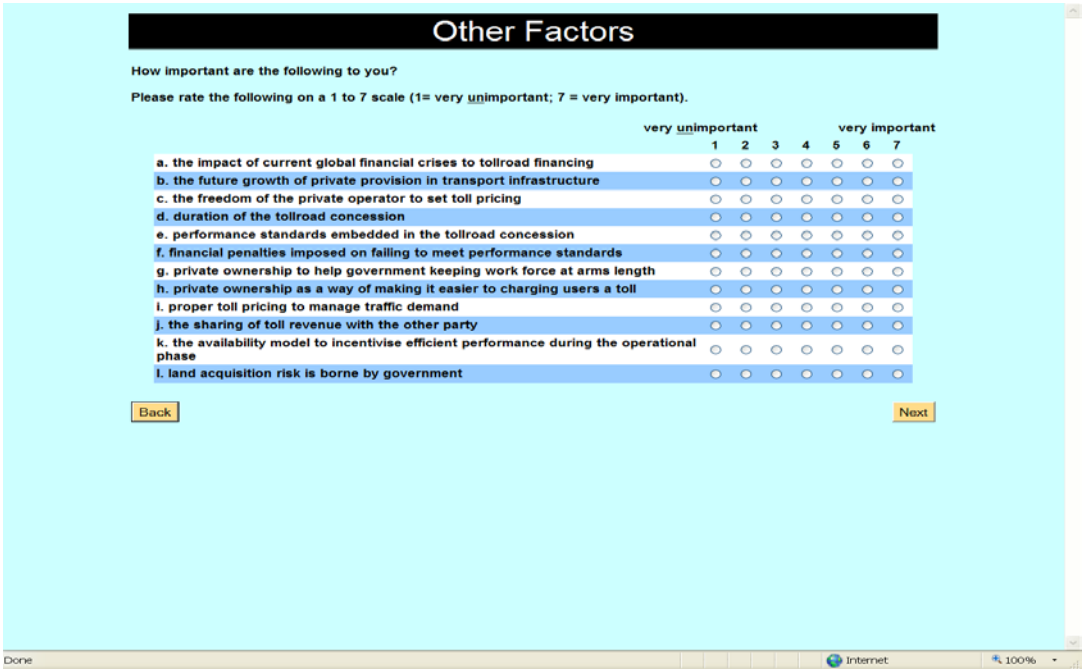


Figure 11: Other factors of influence

Table 3: Other factors – PUSPs vs. PVSPs

	PUSPs (mean)	PVSPs (mean)
Global financial crisis (GFC)	5.51	5.83
Future growth of private provision in transport infrastructure (FGROWTH)	5.12	5.62
Freedom of the private operator to set toll pricing (FREETOLL)	3.07	4.05
Duration of the tollroad concession (DURATION)	4.59	5.05
Performance standards embedded in the tollroad concession (PERSDR)	5.90	5.47
Financial penalties imposed on failing to meet performance standards (FPENALTY)	5.44	5.03
Private ownership to help government keeping work force at arms-length (PVOWNW)	3.10	4.18
Private ownership as a way of making it easier to charging users a toll (PVOWNT)	3.15	3.58
Proper toll pricing to manage traffic demand (TPRICETD)	5.83	5.32
The sharing of toll revenue with the other party (TRSHARE))	4.17	4.05
The availability model to incentivise efficient performance during the operational phase (AM)	4.75	4.00
Land acquisition risk is borne by government (LAND)	5.63	5.50

SC data collected through the five choice situations allow for the estimation of a rich set of parameter estimates in establishing weights associated with each risk attributes. We estimated a LCM jointly by pooling both segments of data, i.e., PUSPs and PVSPs. In the model, we specified two classes.[4] The results are presented in Table 4.

Table 4: Parameter estimates of latent class model

Parameters of Alternative Specific Attributes: Public Sector					*Parameters of Alternative Specific Attributes: Private Sector*				
	Class 1		Class 2			Class 1		Class 2	
	(p = 0.00)		*(p = 0.00)*			*(p = 0.00)*		*(p = 0.00)*	
TRA_D1	-0.03700	(-2.59)	-0.08007	(-1.87)	TRA_D2	-0.17224	(-3.97)	-0.1157	(-3.13)
TRA_U1	0.00862	(0.80)	-0.09079	(-2.05)	TRA_U2	0.04848	(2.69)	-0.03383	(-1.95)
FIN_D1	-0.02462	(-1.99)	-0.06314	(-1.65)	FIN_D2	-0.18267	(-3.83)	-0.07313	(-2.93)
FIN_U1	-0.00078	(-0.07)	-0.09455	(-2.15)	FIN_U2	0.05950	(2.81)	-0.03439	(-2.23)
NET_D1	0.00539	(0.52)	-0.07872	(-1.70)	NET_D2	-0.15676	(-3.89)	0.02921	(1.81)
NET_U1	0.02230	(2.14)	-0.06979	(-1.62)	NET_U2	-0.06101	(-2.69)	0.02742	(1.53)
FOR_D1	-0.00379	(-0.34)	-0.07886	(-1.98)	FOR_D2	-0.06129	(-2.78)	-0.01539	(-0.77)
FOR_U1	0.00131	(0.13)	-0.01321	(-0.51)	FOR_U2	-0.03688	(-2.02)	-0.01812	(-0.97)
SOV_D1	0.03265	(1.73)	-0.12031	(-2.14)	SOV_D2	-0.03380	(-1.66)	-0.13908	(-3.42)
SOV_U1	0.02290	(1.86)	-0.1402	(-2.15)	SOV_U2	0.04036	(1.97)	-0.0773	(-3.08)
UNC_D1	-0.01941	(-1.74)	-0.05915	(-1.65)	UNC_D2	0.01615	(0.99)	-0.01368	(-0.76)
UNC_U1	-0.00632	(-0.60)	0.02399	(0.93)	UNC_U2	0.04990	(2.80)	-0.0107	(-0.65)
POL_D1	-0.04100	(-3.60)	0.00841	(0.30)	POL_D2	-0.01158	(-0.76)	-0.01785	(-0.98)
POL_U1	0.00310	(0.35)	0.12581	(2.09)	POL_U2	0.00838	(0.52)	-0.02235	(-1.26)
MED_D1	-0.29084E-04	(0.00)	-0.00323	(-0.06)	MED_D2	-0.03468	(-2.21)	-0.01337	(-0.81)
MED_U1	0.02143	(1.97)	0.00192	(0.04)	MED_U2	-0.00887	(-0.40)	0.00419	(0.32)
PUB_D1	-0.02684	(-2.28)	-0.06366	(-1.71)	PUB_D2	-0.06199	(-2.26)	-0.07312	(-2.28)
PUB_U1	0.00900	(0.82)	-0.06204	(-1.48)	PUB_U2	-0.11907	(-3.33)	-0.00715	(-0.45)
Model fit									
AIC			***499.140***						
Log-Likelihood			***-176.570***						
No. Of observations:			***1010***						

Note:
1) t values are in brackets;

2) nnnnn.E-xx or E+xx => multiply by 10 to -xx or +xx; and

3) Acronyms: XXX_D = downside risk; XXX_U = upside gain; 1 = public sector; 2 = private sector; TRA = traffic risk; FIN = financial risk; NET = network risk; FOR = *force majeure*; SOV = sovereign risk; UNC = risk of unclear project objectives; POL = political risk; MED = media risk; and PUB = risk of public perception.

The PPRI is calculated by the application of the utility expression in Equation (2.0), and the actual levels of risk allocation that each sampled stakeholder has experienced, captured by the RP data input for "prior experience". After the weights are identified using the LCM, we multiply each attribute level associated with the prior experience by the relevant weight and sum these calculations across all attributes to produce the sector-specific risk indices.

All participants except one PUSPs who displays risk neutrality are risk-averse. The values of risk indices associated with PUSPs (PUBRI) are in the range -18.53 percent and zero percent with a mean value of -7.26 percent; the range of risk indices associated with PVSPs (PRVRI) lies between -56.98 percent and -3.47 percent with a mean value of -23.15 percent. For easy

[4] Changes in classes did not improve model fit nor did it increase numbers of significant parameters.

interpretation, we will standardise these indices into the positive range. These index values are the important source of information for hypothesis testing.

To test Hypothesis 1 using the parameter estimates of the LCM, we need to convert each risk attribute from two classes, i.e., $\beta_{k|q_1}$ and $\beta_{k|q_2}$, into a single β_k , and applied the Krinsky and Robb (1986) procedure to generate confidence intervals (CIs) for $\beta_{k_{PUSPs}}$ and $\beta_{k_{PVSPs}}$ in order to test the following relationship:

Hypothesis 1: $$\boldsymbol{\beta_{k_{PUSPs}} \neq \beta_{k_{PVSPs}}}$$

We report the mean value as well as the CIs, i.e., upper bound of 97.5 percentiles and lower bound of 2.5 percentiles of each risk attribute in Table 5. The table shows that 94 percent or 17 out of 18 parameter estimates associated with PVSPs are significant (the only insignificant parameter is POL_U2), but only 44 percent or eight out of 18 parameter estimates associated with PUSPs are significant (the eight significant parameters are TRA_D1, FIN_D1, UNC_U1, POL_D1, POL_U1, MED_D1, MED_U1 and PUB_D1). Eighty percent or 20 out of 25 significant parameter estimates (PVSPs and PUSPs combined) are of the expected sign, i.e., downside risks have the negative sign and upside gains have the positive sign. The significant parameters of unexpected signs are all associated with PVSPs. Possible explanations of these incorrect signed parameters are as follows.

A possible explanation with regards to NET_U2 (negative), which is expected to be positive, is that the perceived upside gain from network redevelopment around the private toll facility signals that the public would view the project as a vehicle to transfer user costs to private gains. As the Sydney CCT experience entails, such perception has generated significantly unwelcome repercussion to the PPP scheme. This reason may explain PVSPs' aversion to the upside attribute.

The FOR_U2 parameter is also negative when it is expected to be positive. One possible explanation of this is that during the survey, participants informed the author that they did not believe the risk of *force majeure* will have upside gain and none of them have experienced upside benefit of this category; their disbelief may have resulted in the unexpected sign associated with FOR_U2.

In terms of the unexpected positive sign of the parameter estimate associated with UNC_D2, we have hypothesised that ownership transfer in PPPs shields the private sector agent from this risk from the government principal which implicates that the agent dislikes the risk therefore the parameter should have a negative sign. Empirically, a number of PVSPs revealed to the author during the experiment that unclear project objectives by the public sector have in the past provided them with greater opportunities to exercise their own discretion in terms of project scope and delivery. This outcome is consistent with the problem of opportunism identified by Coase and Williamson in that complex and long-term contracts come with difficulties to precision provisions to curtail opportunism; we will further confirm this when testing Hypothesis 4b.

With regards to the MED_U2 and PUB_U2 which are both negative, their significance indicates that PVSPs acknowledge that media and the public are important factors influencing the success of their projects. The negative sign of MED_U2 may be justified on the grounds that PVSPs prefer less public exposure because open appraisal of project success may encourage new entrants therefore increase competition.

Table 5: Risk attributes – post Krinksy and Robb procedure

PUSPs				PVSPs			
$\beta_{k_{PUSPs}}$	mean	Lower	Upper	$\beta_{k_{PVSPs}}$	mean	Lower	Upper
TRA_D1	**-0.03828**	**-0.05093**	**-0.02602**	**TRA_D2**	**-0.13318**	**-0.15205**	**-0.11426**
TRA_U1	*-0.00749*	*-0.02422*	*0.00861*	TRA_U2	0.02798	0.02092	0.03485
FIN_D1	**-0.02294**	**-0.03693**	**-0.00940**	**FIN_D2**	**-0.12545**	**-0.14448**	**-0.10621**
FIN_U1	*-0.01189*	*-0.03154*	*0.00695*	FIN_U2	0.03750	0.02812	0.04675
NET_D1	*-0.00358*	*-0.02213*	*0.01394*	NET_D2	-0.08368	-0.09313	-0.07394
NET_U1	*0.01192*	*-0.00787*	*0.03069*	NET_U2	-0.01783	-0.03033	-0.00521
FOR_D1	*-0.00863*	*-0.02819*	*0.00997*	FOR_D2	-0.03298	-0.04506	-0.02105
FOR_U1	*0.00949*	*-0.00294*	*0.02144*	FOR_U2	-0.01623	-0.02978	-0.00285
SOV_D1	*0.00668*	*-0.01791*	*0.02994*	SOV_D2	-0.05570	-0.06883	-0.04316
SOV_U1	*-0.00200*	*-0.03087*	*0.02531*	SOV_U2	0.01211	0.00101	0.02298
UNC_D1	*-0.01441*	*-0.03192*	*0.00211*	UNC_D2	0.01510	0.00648	0.02355
UNC_U1	**0.01309**	**0.00444**	**0.02148**	**UNC_U2**	**0.04047**	**0.02990**	**0.05076**
POL_D1	**-0.02153**	**-0.02409**	**-0.01883**	**POL_D2**	**-0.01261**	**-0.01364**	**-0.01176**
POL_U1	0.03126	0.01979	0.04402	*POL_U2*	*0.01113*	*-0.00140*	*0.02369*
MED_D1	**-0.00233**	**-0.00327**	**-0.00115**	**MED_D2**	**-0.02611**	**-0.02739**	**-0.02461**
MED_U1	**0.01415**	**0.01389**	**0.01475**	**MED_U2**	**-0.00783**	**-0.01127**	**-0.00460**
PUB_D1	**-0.02720**	**-0.03871**	**-0.01603**	**PUB_D2**	**-0.04124**	**-0.06454**	**-0.01799**
PUB_U1	*-0.00220*	*-0.01445*	*0.00963*	PUB_U2	-0.06015	-0.08004	-0.03977

Note: Values in bold text are statistically significant estimates across both data segments, italicised values are statistically insignificant estimates for at least one segment.

The results depicted in Figure 12 were generated using the estimated CIs. The figure plots the parameter estimates that are significant for both cohorts, which are highlighted in bold in Table 5, to illustrate whether the CIs overlap (overlapping means that the parameters are *not* significantly different across the two sectors). The figure shows that six out of seven significant risk preferences associated with PUSPs are significantly different from their PVSPs counterparts at the 95 percent level, i.e., the 95 percent CIs of the two data segments do not cross. Therefore, Hypothesis 1 is supported with respect to TRA_D, FIN_D, UNC_U, POL_D, MED_D and MED_U. The implications of such results are as follows.

4.5.1 Traffic risk downside (TRA_D)

Both sector participants are averse to the risk, but they are significantly different in terms of their degree of risk aversion. The mean values of TRA_D1=-0.03828 and TRA_D2=-0.13318 suggest that PVSPs are 3.5 times more averse to the risk than PUSPs.

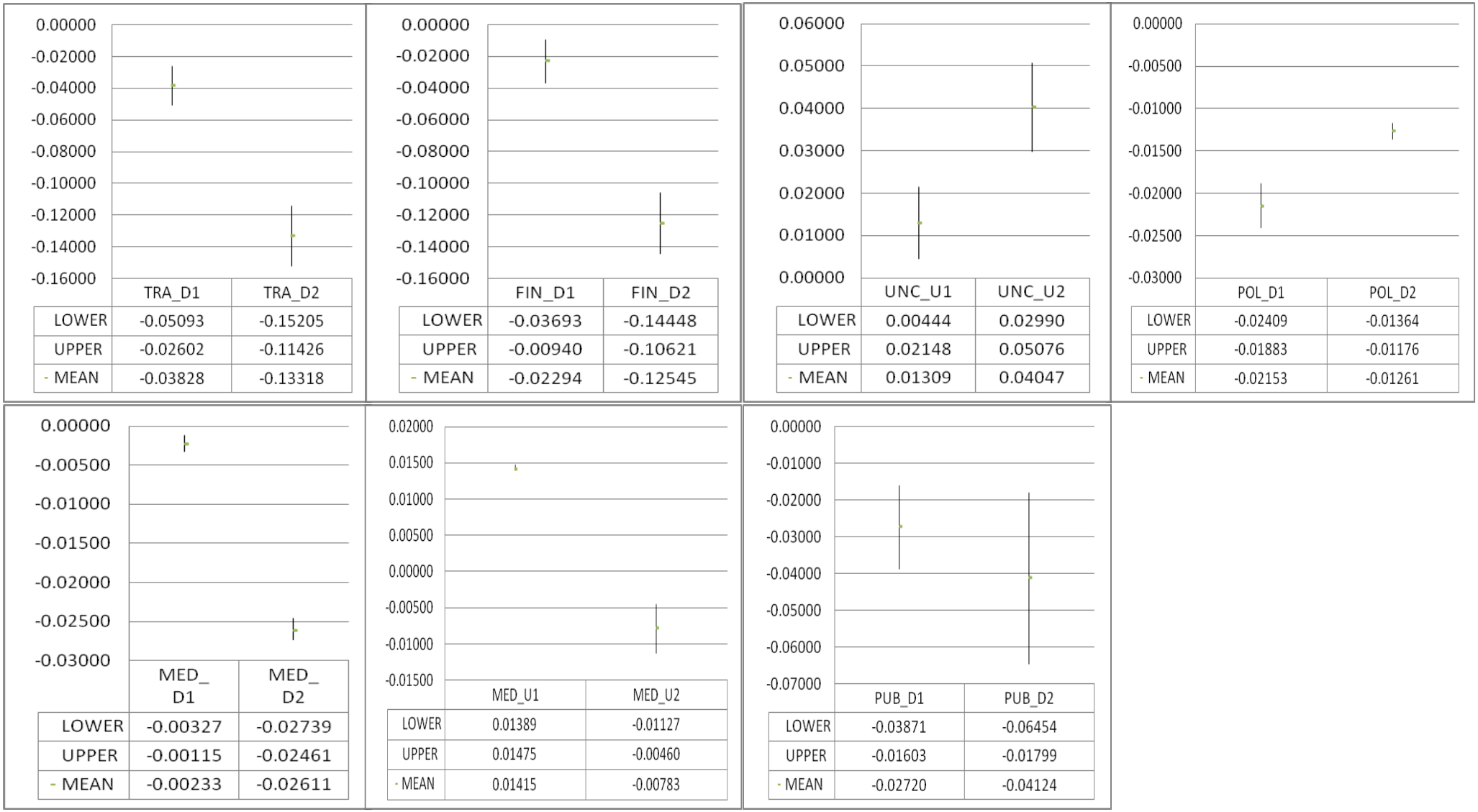


Figure 12: Confidence intervals – test of risk preferences (PUSPs vs. PVSPs)

4.5.2 Financial risk downside (FIN_D)

The mean values of FIN_D1=-0.02294 and FIN_D2=-0.12545 suggest that PVSPs are overwhelmingly (5.5 times) more averse to financial downside risk compared with PUSPs. An inspection of Figure 12 reveals that the largest difference between the two cohorts lies with this category. This is not a surprising result. It is consistent with our descriptive analysis that PPPs are essentially a means of project finance and financial risk is one of the risks that governments want to divest the most therefore exposing private capitals to a great deal of risk.

4.5.3 Unclear project objectives upside (UNC_U)

The mean values of UNC_U1=0.01309 and UNC_U2=0.04047 mean that PVSPs are 3.1 times more *in favour* of well-defined projects compared with PUSPs. This finding sends a strong message to public procurers. Projects with good planning and clear objectives entail that they will come with a well thought-out risk allocation strategy to facility the fulfilment of policy goals. A favourable perception from PVSPs suggests that such projects can drive risk premium down; so clear project objectives are a key driver for value for money.

4.5.4 Political and reputational risk downside (POL_D)

The difference between POL_D1=-0.02153 and POL_D2=-0.01261 arises as the result of PUSPs being almost twice more averse to the risk than PVSPs. This finding reinforces our conclusion drawn in Chung *et al*. (2010) that the public sector has in the past suffered greater repercussion from political backlash due to the controversial of the PPP scheme. It signals to the private sector that if they wish governments continuously open opportunities to the market, they should help strengthening the scheme's public image. Since the private sector plays a significant part in project delivery and operations, the scheme's welcomeness, to a large extent, can be enhanced through their ongoing dialogues with users and with the community.

4.5.5 Media risk downside (MED_D)

The difference in risk preference towards media risk (mean values of MED_D1=-0.00233 and MED_D2=-0.02611) is due to PVSPs having a greater aversion to the risk (11 times greater) in comparison with PUSPs. This is quite the opposite to the RP data collected via "prior experience" presented in Table 2 in which PUSPs appear to be 16 times more averse to the risk than PVSPs. This conflicting evidence strongly suggests that behavioural perceptions can be quite different from real experience.

4.5.6 Media risk upside (MED_U)

The difference (mean values of MED_U1=0.01415 and MED_U2=-0.00783) suggests that PVSPs are 1.6 times more averse to media appraisal compare with PUSPs. The reason is similar to the explanation given above that greater appraisal of project success may increase competition. The result that PUSPs are *in favour* of media's support is consistent with their aversion to POL_D as positive media exposure helps strengthening the public sector's image.

We perform two t-tests to examine Hypothesis 2 in order to understand whether parties to a PPP concession are of the stereotype as described in contract theory, i.e., the agent is risk-averse whereas the principal is risk-neutral.

Hypothesis 2: $\bar{x}_{PRVRI} < 0, \bar{x}_{PUBRI} = \mathbf{0}$

We graphed the derived PUBRI and PRVRI in Figure 13, in which the indices are normalised to a base of zero for the participant with the highest relative index in each sector respectively, so all indices are now standardised into the positive range.[5] The contrast of these two indices shown in Figure 13 clearly illustrates that both indices are in the positive range, i.e., both the principal and the agent are risk-averse. The private sector agents are on average much more risk-averse than the public authority principals; the average risk index of the agent (23.15 percent) is more than three times of the average value of the principal (7.26 percent). The one-tailed t-test in Equation (10.0) asserts that the average of PRVRI is negative, i.e., the private sector agent is risk averse; but the two-tailed t-test in Equation (11.0) strongly rejects that the government principal is risk-neutral. Therefore, Hypothesis 2 is not supported because the government principal is found to be risk-averse, i.e., the stereotype principal in contract theory does not hold up in the ownership concession model.

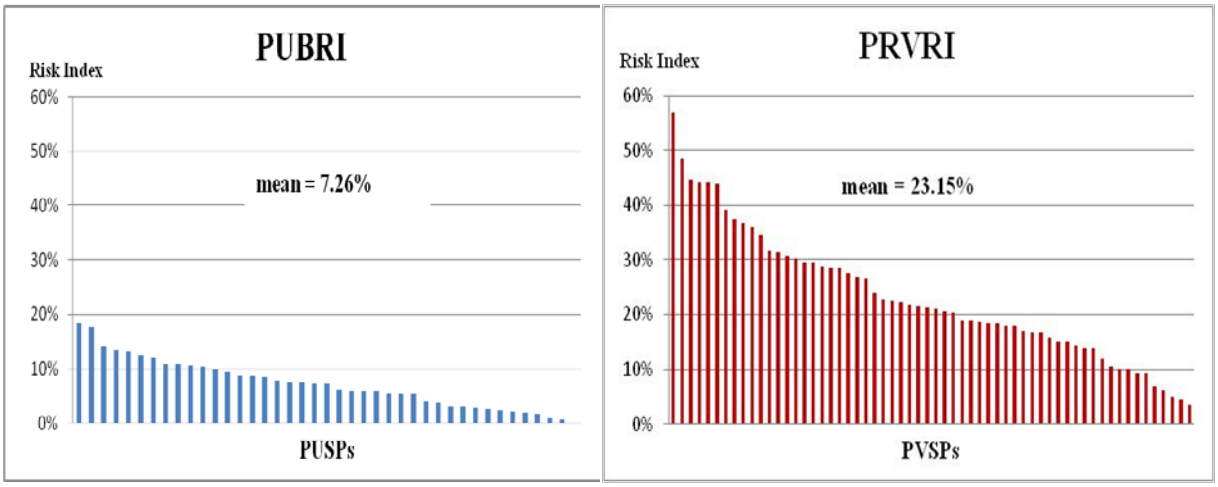


Figure 13: Risk index – PUBRI versus PRVRI

$$t_i = \frac{\bar{x}_{PRVRI} - 0}{\frac{s}{\sqrt{n}}} = \frac{23.15 - 0}{\frac{0.1188}{\sqrt{60}}} = 15.10 > 2.575 \quad \textbf{(10)}$$

$$t_i = \frac{\bar{x}_{PUBRI} - 0}{\frac{s}{\sqrt{n}}} = \frac{7.26 - 0}{\frac{0.04550}{\sqrt{41}}} = 10.21 > 2.575 \quad \textbf{(11)}$$

Two reasons contribute to the profound difference between PUBRI and PRVRI. We have demonstrated in the LCM and the testing of Hypothesis 1 that PUSPs and PVSPs have different preferences toward different risks. Furthermore, the analysis of RP data on "prior experience" shown in Table 2 has confirmed that the experience of the two segments is also profoundly different from each other. It is logical that feeding the parameter estimates from the LCM which clearly show that risk preferences of the two segments are different into different RP levels will produce significantly different risk indices. Nevertheless, this outcome provides us with the necessary condition for our investigation into how would the past experience influence the private agent's choice of contract and how would this experience shape up their attitude towards property rights embedded in the ownership.

[5] From this point onward, all analysis will be based on normalised indices, i.e., risk aversion indices are presented in positive values; higher value means greater risk aversion.

We have argued that if Hypothesis 2 with regards to the risk-averse agent is supported, the agent would choose PPPPs from a menu of contracts due to the ownership benefit to residual claims. Participants' choices of procurement method, as described in Section 4, are presented in an ordered outcome scale of seven levels. Testing a hypothesis that has an ordered scale as dependent variable requires an ordered response model that recognises the nonlinearity of a ranking scale and defines points on the observed rating scale as thresholds. The ordered logit model allows one to include ordinal dependent variables into the outcome model in a way that explicitly recognises their ordinarily and avoids arbitrary assumptions about their scale. The essence of the approach is an assumed probability distribution of the continuous variable that underlies the observed ordinal dependent variable (Jones and Hensher, 2004). In specifying an appropriate model, we assume that the seven-point ranking scale is a monotonic transformation of an unobserved interval variable. Thus, one or more values of an interval-level variable are mapped into the same value of a transformed ordinal variable. An underlying continuous variable is mapped into categories that are ordered but are separated by unknown distances. We cannot, for example, say that the difference between ranks 1-2 is identical to the difference between 2 and 3. Estimates can be obtained for both the parameters associated with each of the independent variables (one, i.e., PRVRI, only in Hypothesis 3), and the threshold parameters. The threshold parameters indicate the extent to which the categories of the ranking scale are equally spaced in the logit scale. They are essentially constants that redefine the utility scale across the set of outcomes to recognise that the utility scale is nonlinear between outcomes. We applied the following ordered logit form using the derived risk index to test Hypothesis 3:

Hypothesis 3: $$\textbf{Choice of PPP} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \cdot \boldsymbol{PRVRI}$$

To estimate an ordered logit model in NLogit 4.0, model specification must include a constant term, one, as the first right hand side variable. Since the equation does include a constant term, one of the threshold parameters (μ_s) is not identified, so μ_0 is normalised to 1. The dependent variable is coded 0, 1, 2, ..., N, and there must be at least three values. We converted the one-to-seven likert scale into a scale of zero-to-six. The results of testing Hypothesis 3 using NLogit 4.0 are reported in Table 6.

A direct interpretation of the parameter estimates in Table 6 is not possible given the logit transformation of the outcome dependent variable required for model estimation. We therefore provide in the table the marginal effects of the two end scales, i.e., Y=0 (PPP is the most preferred method) and Y=6 (PPP is the least preferred method), defined as the derivatives of the probabilities, to explain the influence a one unit change in an independent variable, i.e., risk aversion, has on the probability of selecting a particular outcome, i.e., choice of procurement method, *ceteris paribus*.

Table 6: PPP model versus PRVRI

Dependent Variable	Independent Variable		Parameter	t-value	Hypothesis	Support	Model
Choice of PPP Procurement model	Constant		-0.00114	(-0.01)	3	NO	Ordered logit
	PRVRI		2.41940	(3.77)			
	Threshold parameters						
	μ (0 to 1)	MU (0)	0				
	μ (1 to 2)	MU (1)	1.50508	(18.22)			
	μ (2 to 3)	MU (2)	1.86967	(20.15)			
	μ (3 to 4)	MU (3)	2.61391	(21.14)			
	μ (4 to 5)	MU (4)	2.78739	(20.98)			
	μ (5 to 6)	MU (5)	4.67470	(14.69)			
	Marginal effects						
	Independent variable		Prob (Y=0)	t-value	Prob (Y=6)	t-value	
	PRVRI (at mean)		-0.55997	(-3.75)	0.03821	(3.30)	
	AIC		*1787.60500*				
	LL function		*-886.80233*				
	N		*600*	(N= 60PVSPs×5experiments×2contracts)			

The results suggest that PRVRI has a strong statistical impact, i.e., both parameter estimates are significant at the one percent level, on the probability of choosing PPP as the most preferred procurement method. The negative parameter estimate for Prob(Y=0) indicates that a one unit change in the mean of PRVRI leads to a -0.56 change in the probability of Y=0, i.e., one unit increase in PVSPs' risk aversion reduces the probability of PPP being favoured by the agent by 56 percent, *ceteris paribus*; the positive parameter estimate for Prob(Y=6) suggests the otherwise although at a much less magnitude, i.e., increase in one unit of the risk aversion increase the odds of non-PPP methods being chosen by four percent, *ceteris paribus*. Overall, the results suggest that the greater the risk aversion of the private sector agent the <u>*less*</u> preferred is the PPP model, hence Hypothesis 3 is not supported. This outcome is substantiated by the way that PRVRI was calculated; it was based on participants' prior experience. The evidence shown in Table 2 has revealed that the risks had not been shared equitably across two sectors; such experience has significantly contributed to the finding that the risk-averse private sector agent would not choose the ownership concession in the presence of other alternatives. The evidence goes to show that the assignment of property rights needs to be complemented with equitable risk allocation in order to warrant *ex ante* as well as *ex post* efficiency in a risk-sharing relationship.

To investigate the incentive effect of property rights to encourage the agent invest efficiently *ex ante*, we first performed a simple linear regression model to establish that the agent is averse to unclear project objectives of the principal. After the relationship is confirmed, we followed up with an ordered logit model to study whether the agent would prefer the ownership concession in the presence of risk of unclear project objectives:

Hypothesis 4a $\mathbf{PRVRI} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \cdot \boldsymbol{UNC\_D2}$

Hypothesis 4b $\mathbf{Choice\ of\ PPP} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \cdot \boldsymbol{UNC\_D2}$

Results are shown in Table 7 (data input of "prior experience" from Table 2 was used for UNC_D2). As expected, the risk will worsen the private sector agent's risk aversion, parameter estimate of UNC_D2 in Panel A is positive which means higher the risk of unclear project objectives greater the risk aversion of the agent; this result supports Hypothesis 4a. The positive (negative) parameter estimate associated with the marginal effect of Prob(Y=0) (Prob(Y=6)) under Panel B indicates that the higher the risk of unclear project objectives the more preferred is the PPP model by the agent, hence Hypothesis 4b is also supported.

These results are consistent with the reverse-holdup problem with possible repercussion of *ex post* opportunism. Although property rights elicit *ex ante* investments and determine the distribution of *ex post* surplus (Grossman and Hart, 1986, p. 696), *ex ante* opportunism of overinvestment for non-contractible quality is expected when reverse-holdup occurs, i.e., when the principal has less incentive to bargain hard for low prices which is more likely when the transaction involves government (Wickelgren, 2007); and distortions to *ex post* distribution remain when contracting parties are risk-averse, because reservation of residual rights is most likely (Grossman and Hart, 1986, p. 717).

As stated previously, reference to interview data shows that unclear project objectives by the public sector have in the past provided PVSPs with greater opportunities to exercise their own discretion in terms of project scope and delivery (the Sydney CCT is a case in point). Moreover, *ex post* opportunism was considered inevitable due to the inherent nature of private investments in mega infrastructure projects:

> P_g: *Constructors and short term financial sponsors have too much influence over long term contractual matters to the detriment of the project's viability.*
>
> P_h: *[The resultant] PPPs create a tension between the need to create a winning bid scenario and the most likely ongoing operating conditions.*
>
> P_i: *In the recent projects, the private sector mispriced the risks therefore resulting huge losses to them. The aggressive bidding process by the private consortium was driven by the desire to win a small number of projects offered to the market in an environment where there was over-supply of private capital.*

Table 7: Effect of unclear project objectives

Dependent Variable	Independent Variable		Parameter	t-value	Adjusted R^2	Hypothesis	Support	Model
Panel A (Hypothesis 4a: PRVRI = $\beta_0 + \beta_1 \cdot UNC\_D2$)								
PRVRI	Constant		0.20295	(32.26)	0.06872	4a	YES	Simple linear regression
	UNC_D2		0.00153	(6.72)				
	N			*600*				
Panel B (Hypothesis 4b: Choice of PPP = $\beta_0 + \beta_1 \cdot UNC\_D2$)								
Choice of PPP Procure-ment Model	Constant		0.72181	(6.92)	N/A	4b	YES	Ordered logit
	UNC_D2		-0.00899	(-2.36)	N/A			
	Threshold parameters							
	μ (0 to 1)	MU (0)	0					
	μ (1 to 2)	MU (1)	1.48719	(18.15)				
	μ (2 to 3)	MU (2)	1.84805	(20.07)				
	μ (3 to 4)	MU (3)	2.59356	(21.05)				
	μ (4 to 5)	MU (4)	2.76775	(20.90)				
	μ (5 to 6)	MU (5)	4.64902	(14.62)				
	Marginal effects							
	Independent variable		Prob (Y=0)	t-value	Prob (Y=6)	t-value		
	UNC_D2 (at mean)		0.00208	(2.36)	-0.00014	(-2.23)		
	AIC			*1796.03700*				
	LL function			*-891.01858*				
	N			*600*				

We performed two multivariate regressions to investigate the following effects:

(i) the effect of property rights on the agent's *ex post* operational efficiency;
(ii) the effect of compensation structure on the risk preference of the agent and of the principal respectively;
(iii) the effect of the public perception that the concession model transfers accountability on the risk preference of the agent and of the principal respectively.

$$\textbf{PRVRI} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \cdot \boldsymbol{TPRICETD_{PVSPs}} + \boldsymbol{\beta_2} \cdot \boldsymbol{TSHARE_{PVSPs}} + \boldsymbol{\beta_3} \cdot \boldsymbol{PVOWNT_{PVSPs}}$$

$$\textbf{PUBRI} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \cdot \boldsymbol{TPRICETD_{PUSPs}} + \boldsymbol{\beta_2} \cdot \boldsymbol{TSHARE_{PUSPs}} + \boldsymbol{\beta_3} \cdot \boldsymbol{PVOWNT_{PUSPs}}$$

where

TPRICETD: participants' views on "proper toll pricing to manage traffic demand";
TSHARE: participants' views on "the sharing of toll revenue with the other party"; and
PVOWNT: participants' view on "private ownership as a way of making it easier to charging users a toll".

Table 3 presents a summary of these independent variables; results of the regression models are listed in Table 8.

Table 8: Effects of property rights on ownership-related risks

Dependent Variable	Independent Variable	Parameter	t-value	Adjusted R^2	Hypothesis	Support	Model
Panel A: PRVRI = $\beta_0 + \beta_1 \cdot TPRICETD_{PVSPs} + \beta_2 \cdot TSHARE_{PVSPs} + \beta_3 \cdot PVOWNT_{PVSPs}$							
PRVRI	Constant	0.23384	(11.22)	0.02817			Multivariate regression
	$TPRICETD_{PVSPs}$	0.01044	(3.28)		5	NO	
	$TSHARE_{PVSPs}$	-0.00672	(-2.25)		7	YES	
	$PVOWNT_{PVSPs}$	-0.00855	(-3.29)		6a	NO	
	N	*600*					
Panel B: PUBRI = $\beta_0 + \beta_1 \cdot TPRICETD_{PUSPs} + \beta_2 \cdot TSHARE_{PUSPs} + \beta_3 \cdot PVOWNT_{PUSPs}$							
PUBRI	Constant	0.01391	(1.16)	0.20479			Multivariate regression
	$TPRICETD_{PUSPs}$	0.00033	(0.18)				
	$TSHARE_{PUSPs}$	0.01064	(7.98)				
	$PVOWNT_{PUSPs}$	0.00393	(2.71)		6b	YES	
	N	*410*					

Contract theory asserts that ownership entitles the agent the residual right to adopt measures that would facilitate service delivery *ex post*; therefore the agent would welcome the autonomy to control toll pricing as an effective means to manage traffic demand. However, the significant positive parameter estimate of $TPRICETD_{PVSPs}$ indicates that having the right to control toll pricing worsens the private sector agent's risk aversion, although they considered private ownership would make charging users a toll easier (the significant negative parameter of $PVOWNT_{PVSPs}$ means this perception effect will lower the agent's risk-aversion). Therefore neither Hypothesis 5 nor Hypothesis 6a is supported.

These contrasting effects show that economic incentives induced by property rights are being overpowered by politics surrounding the concession model. There could be a number of reasons. Reference to interview data indicates that due to the strong public adverseness to toll pricing, private proponents did not wish to be seen as using their right to set toll for private gain at the expense of the public purse, which may have a detrimental effect on patronage. We have argued in our descriptive analysis that PPPs are not intended for managing traffic via the pricing mechanism but rather a means of project finance; the insignificant parameter of $TPRICETD_{PUSPs}$ in Table 8 has reinforced this intention. The government principal's strong aversion to sharing revenue with the agent as evidenced by the highly significant positive parameter of $TSHARE_{PUSPs}$ (0.01064), adds to support the proposition that governments did not consider toll pricing a means to earn the public sector a financial return. Furthermore, the public perception that PPPs are a facilitator to transfer ownership-related risks by governments, such as those arising from public's adverse preferences toward toll pricing will worsen the principal's risk-aversion. The highly significant positive parameter of $PVOWNT_{PUSPs}$ suggests that if this perception persists, the concession model may no longer be a preferred procumbent to governments (Hypothesis 6b is strongly supported). These findings suggest that the political considerations surrounding PPPs have caused the private agent's reluctance on exercising their property rights to control toll pricing. The reservation has generated an adverse *ex post* effect on allocative efficiency because road space is not rationalised on usage resulting in unintended consequences for society and for infrastructure planning, as one of the PUSPs commented:

> P_j: *In [some jurisdictions] the piecemeal process of toll road development has led to unintended consequences for road users where there is inequality in the cost of [using] roads. The benefit of the toll road methodology coupled with user demand management could deliver the funding capability to significantly enhance [the city's] public and private transport requirements.*

A further conclusion inferred from the effect of $TSHARE_{PUSPs}$ lends support to the rationale of PPPs that they essentially are a contract of long-term service provision. The government principal desires to incite the agent to deliver quality service by bundling property rights into the construction and management of the asset. In times of demand uncertainty, governments would bear the traffic risk. The AM was designed to remove revenue uncertainty associated with usage for the agent so to encourage greater focus on non-revenue-enhancing performance effort such as service delivery and asset management. We collected the agent's preferences for the AM through a one-to-seven likert scale (see the descriptive statistics reported in Table 3). The significant negative parameter associated with $TSHARE_{PVSPs}$ (-0.00672) reported in Table 8, i.e., revenue-sharing will reduce the agent's risk-aversion, demonstrates that the agent favours revenue-sharing compensation structure as an incentive for *ex post* efficiency. We further performed the following ordered logit model to test the effectiveness of the AM:

Hypothesis 7: $$\mathbf{AM} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \cdot \boldsymbol{PRVRI}$$

If the AM is effective, the risk-averse agent would prefer the AM. The results in the following table (Table 9) suggest the otherwise. The marginal effects of -0.13 for Prob(Y=0) and 0.23 for Prob(Y=6) suggest that the more risk-averse is the private sector agent the less prefer is the AM; i.e., compensation structure with no revenue-sharing provision fails to induce non-revenue-enhancing performance effort, thus Hypothesis 7 is not supported.

Table 9: Risk aversion versus preference for availability model

Dependent Variable (see Table 3)	Independent Variable		Parameter	t-value	Hypothesis	Support	Model
Hypothesis 7: AM = $\beta_0 + \beta_1 \cdot PRVRI$							
AM	Constant		1.63782	(9.48)	7	NO	Ordered logit
	PRVRI		1.21517	(1.92)			
	Threshold parameters						
	μ (0 to 1)	MU (0)	0				
	μ (1 to 2)	MU (1)	0.75994	(10.31)			
	μ (2 to 3)	MU (2)	1.04253	(13.74)			
	μ (3 to 4)	MU (3)	1.89818	(23.65)			
	μ (4 to 5)	MU (4)	2.26617	(27.30)			
	μ (5 to 6)	MU (5)	3.01077	(30.29)			
	Marginal effects						
	Independent variable		Prob (Y=0)	t-value	Prob (Y=6)	t-value	
	PRVRI (at mean)		-0.13476	(-1.90)	0.22959	(1.92)	
	AIC		*2042.06900*				
	LL function		*-1014.03447*				
	N		*550*				

NB: (N= (60-5)PVSPs×5experiments×2contracts); 5 PVSPs took the pilot survey, questions related to AM and Land (see Figure 11) was added as the result of feedback from the pilot.

Conclusion

This paper has sought to empirically test on the theory of property rights to incentivise risk-sharing amongst contracting parties within a choice experiment setting. We have investigated this research question in a special area of application involving government as the principal – the PPP ownership concession model, to examine how conditions at the contract level, such as assignment of ownership and compensation structure, can induce the agent *ex ante* investment behaviour and exert *ex post* performance effort.

One of the important empirical gaps in studies of contract pertains to the role risk plays in the choice of contract. The impediment to performing tests of risk-sharing lies in the difficulty of obtaining data on individual risk preferences. Many studies examining contracting parties' choice of contractx or choice of compensation schemex either take risk preferences as given (Allen and Lueck, 1999; Martimort and Pouyet, 2008; Chen and Chiu, 2010) or use self-reported measures (Gaynor and Gertler, 1995; Jin and Doloi, 2008). In this paper, however, empirical data were collected by way of a SC experiment that is capable of capturing stakeholder preferences at the individual decision-maker level. Choice models are employed to estimate a set of risk indices over a set of defined risk attributes. These quantitatively derived indices empirically measure the risk preferences of all participants. Our results clearly demonstrate that not only the private sector agent is risk-averse but the government principal is also risk-averse. This result rejects the well-accepted proposition prevailing in the contracting literature that assumes the principal is risk-neutral. Our results prove that any economic actor's risk preference is highly contextual dependent. Simply using a sweeping belief that the

principal is risk-neutral commits a serious flaw in contracting research and the resultant outcomes are potentially biased.

The extent to which our results support the contracting theory limits to the proposition that contracting parties are indeed heterogeneous in risk preferences but only in terms of the degree of aversion to different risks, as illustrated by our results to Hypothesis 1 and 2. It is these varying degrees of difference that play a decisive role in participants' choice of contracts, and in understanding how the design of contract through allocation of risks, formulation of contractual conditions can facility contractual efficiency. A number of strong messages emerge from our findings; i) assignment of property rights must be complemented by equitable risk-allocation in order to align the agent's investment behaviour with that of the principal; ii) ownership transfer enhances *ex ante* efficiency in the presence of reverse-holdup in the meantime induces *ex post* opportunism, and iii) compensation structure linking risk-taking with revenue-sharing rewards can exert the agent's non-revenue-enhancing performance effort for the welfare maximiser principal.

An auxiliary contribution is the construction of PPPRI derived from the contribution of each underlying dimension of risk to the overall index of perceived risk. The index is a behaviourally powerful, easy to understand instrument to evaluate the risk preferences of contracting parties. Although the indices are derived from data that are primarily concerned with PPP tollroad concessions, the process of its derivation can be readily applied to other areas of risk management. The PPPRI has great potentials. It captures stakeholder perceptions of risk toward any specific project. The effect of various attribute combinations in a risk-allocation package is achieved by varying the levels around the respondent specific RP inputs; the resulting utility indicators will convey the effect in the form of various risk perceptions toward the project. Contracting parties then can weigh the tradeoffs between different risk combinations and decide what risks they wish to take on and what risks they can transfer, taking into account the risk premium they would require. It can therefore be incorporated into a contract assessment regime that provides a meaningful measure of how risk perceptions can be balanced hence risk preferences can be managed by modifying the level of contractual conditions as well as policy and institutional variables. We will leave the investigation of ways to optimise contract of risk-sharing for future research.

References

Akbiyikli, R., Eaton, D. and Turner, A. (2006) "Project Finance and the Private Finance Initiative (PFI)", *Journal of Structured Finance,* vol. 12, no.2, pp. 67-75

Alchian, A. A. and Demsetz, H. (1972) "Production, Information Costs, and Economic Organization", *The American Economic Review,* vol. 62, no.5, pp. 777-795

Allen, D. W. and Lueck, D. (1999) "The Role of Risk in Contract Choice", *Journal of Law, Economics, & Organization,* vol. 15, no.3, pp. 704-736

Anderson, S. W. and Dekker, H. C. (2005) "Management Control for Market Transactions: The Relation between Transaction Characteristics, Incomplete Contract Design, and Subsequent Performance", *Management Science,* vol. 51, no.12, pp. 1734-1752

Arndt, R. H. (2000) 'Getting a Fair Deal: Efficient Risk Allocation in the Private Provision of Infrastructure', PhD thesis, The University of Melbourne,

Arrow, K. J. (1971) *Essays in the Theory of Risk-bearing,* Markham Pub. Co., Chicago

Atkinson, S. E., Stanley, L. R. and Tschirhart, J. (1988) "Revenue Sharing as an Incentive in an Agency Problem: An Example from the National Football League", *The RAND Journal of Economics,* vol. 19, no.1, pp. 27-43

Bennett, J. and Iossa, E. (2005) End of Award Report: Public-Private Partnerships: an Incomplete Contract Approach, *Economic and Social Research Council (ESRC),* R000223811

Broadbent, J. and Laughlin, R. (2005) "The role of PFI in the UK government's modernisation agenda", *Financial Accountability and Management,* vol. 21, no.1, pp. 75-97

Brockner, J. (1992) "The Escalation of Commitment to a Failing Course of Action: Toward Theoretical Progress", *The Academy of Management Review,* vol. 17, no.1, pp. 39-61

Brousseau, E. (2008) 'Contracts: From Bilateral Sets of Incentives to the Multi-Level Governance of Relations', In (Eds, Brousseau, E. and Glachant, J.-M.), *New Institutional Economics: A Guidebook,*ed., Cambridge University Press, Cambridge, pp. 37-66

Brousseau, E. and Glachant, J.-M. (2002) 'The Economics of Contracts and the Renewal of Economics', In (Eds, Brousseau, E. and Glachant, J.-M.), *The Economics of Contracts: Theories and Applications,*ed., Cambridge University Press, Cambridge, pp. 3-30

Cachon, G. P. and Lariviere, M. A. (2005) "Supply Chain Coordination with Revenue-Sharing Contracts: Strengths and Limitations", *Management Science,* vol. 51, no.1, pp. 30-44

Chen, B. R. and Chiu, Y. S. (2010) "Public–private partnerships: Task interdependence and contractibility", *International Journal of Industrial Organization,* vol. 28, no.6, pp. 591-603

Chung, D. (2009) "Private Provision of Road Infrastructure: Unveiling the Inconvenient Truth in New South Wales, Australia", *Road and Transport Research,* vol. 18, no.1, pp. 68-85

Chung, D., Hensher, D. A. and Rose, J. M. (2010) "Toward the betterment of risk allocation: Investigating risk perceptions of Australian stakeholder groups to public-private-partnership tollroad projects", *Research in Transportation Economics,* vol. 30, no.1, pp. 43-58

Coase, R. H. (1959) "The Federal Communications Commission", *Journal of Law and Economics,* vol. 2, pp. 1-40

Coase, R. H. (1960) "The Problem of Social Cost", *Journal of Law and Economics,* vol. 3, pp. 1-44

Cyert, R. M. and March, J. G. (1963) *A Behavioral theory of the firm,* Prentice Hall, Englewood Cliffs, NJ

de Palma, A., Lindsey, R. and Proost, S. (2007) "Chapter 1 Investment and the use of tax and toll revenues in the transport sector: The research agenda", *Research in Transportation Economics,* vol. 19, pp. 1-26

Debande, O. (2002) "Private Financing of Transport Infrastructure", *Journal of Transport Economics & Policy,* vol. 36, no.3, pp. 355-387

Dewatripont, M. and Legros, P. (2005) "Public-Private Partnerships: Contract Design and Risk Transfer", *EIB papers,* vol. 10, no.1, pp. 120-145

Duffield, C. F. (2001) 'An Evaluation Framework for Privately Funded Infrastructure Projects in Australia', PhD thesis, The University of Melbourne,

Edwards, P. and Bowen, P. (2003) 'Risk Perception and Communication in Public-Private Partnerships', In (Eds, Akintoye, A., Beck, M. and Hardcastle, C.), *Public-Private Partnerships: Managing Risks and Opportunities*,ed., Blackwell Science, London, pp. 79-92

Eisenhardt, K. M. (1989) "Agency Theory: An Assessment and Review", *Academy of Management Review*, vol. 14, no.1, pp. 57-74

English, L. (2005a) "Using public private partnerships to achieve value for money in the delivery of healthcare in Australia", *International Journal of Public Policy*, vol. 1, no.1-2, pp. 91-121

English, L. (2006) "Public private partnerships in Australia: an overview of their nature, purpose, incidence and oversight", *University of New South Wales Law Journal*, vol. 29, no.3, pp. 250-262

English, L. and Baxter, J. (2010) "The Changing Nature of Contracting and Trust in Public-Private Partnerships: The Case of Victorian PPP Prisons", *Abacus*, vol. 46, no.3, pp. 289-319

English, L. and Guthrie, J. (2003) "Driving privately financed projects in Australia: What makes them tick?", *Accounting, Auditing & Accountability Journal*, vol. 16, no.3, pp. 493-511

Evenhuis, E. and Vickerman, R. (2010) "Transport pricing and Public-Private Partnerships in theory: Issues and Suggestions", *Research in Transportation Economics*, vol. 30, no.1, pp. 6-14

Fama, E. F. (1980) "Agency Problems and the Theory of the Firm", *Journal of Political Economy*, vol. 88, no.2, pp. 288-307

Fama, E. F. and Jensen, M. C. (1983a) "Agency Problems and Residual Claims", *Journal of Law and Economics*, vol. 26, no.2, pp. 327-349

Fama, E. F. and Jensen, M. C. (1983b) "Separation of Ownership and Control", *Journal of Law and Economics*, vol. 26, no.2, pp. 301-325

Forward, P. (2006) "Public private partnership or conflict: is it time for a new approach? [Paper in: Forum: Public Private Partnerships.]", *University of New South Wales Law Journal*, vol. 29, no.3, pp. 263-269

Gaynor, M. and Gertler, P. (1995) "Moral Hazard and Risk Spreading in Partnerships", *The RAND Journal of Economics*, vol. 26, no.4, pp. 591-613

Greene, W. H. and Hensher, D. A. (2003) "A latent class model for discrete choice analysis: contrasts with mixed logit", *Transportation Research Part B: Methodological*, vol. 37, no.8, pp. 681-698

Grossman, S. J. and Hart, O. D. (1986) "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration", *Journal of Political Economy*, vol. 94, no.4, pp. 691-719

Hart, O. (1993) 'Incomplete Contracts and the Theory of the Firm', In (Eds, Williamson, O. E. and Winter, S. G.), *The Nature of the Firm: Origins, Evolution, and Development*,ed., Oxford University Press, New York, pp. 138-158

Hart, O. (2002) 'Norms and the Theory of the Firm', In (Eds, Brousseau, E. and Glachant, J.-M.), *The Economics of Contracts: Theories and Applications*,ed., Cambridge University Press, Cambridge, pp. 180-192

Hart, O. (2003) "Incomplete Contracts and Public Ownership: Remarks, and an Application to Public-Private Partnerships", *The Economic Journal*, vol. 113, no.486, pp. C69-C76

Hart, O. D. (1990) "Is "Bounded Rationality" an Important Element of a Theory of Institutions?", *Journal of Institutional and Theorectical Economics*, vol. 146, no.4, pp. 696-702

Hensher, D. (1994) "Stated preference analysis of travel choices: the state of practice", *Transportation*, vol. 21, no.2, pp. 107-107

Hensher, D., Louviere, J. and Swait, J. (1998) "Combining sources of preference data", *Journal of Econometrics*, vol. 89, no.1-2, pp. 197-221

Hensher, D. A. and Prioni, P. (2002) "A Service Quality Index for Area-Wide Contract Performance Assessment", *Journal of Transport Economics and Policy*, vol. 36, no.1, pp. 93-113

Hensher, D. A., Rose, J. and Greene, W. H. (2005) *Applied Choice Analysis : A Primer*, Cambridge University Press

Hensher, D. A., Stopher, P. and Bullock, P. (2003) "Service quality--developing a service quality index in the provision of commercial bus contracts", *Transportation Research Part A: Policy and Practice*, vol. 37, no.6, pp. 499-517

HM Treasury (2006) *PFI: strengthening long-term partnerships* HM Treasury,

Hodge, G. (2005) 'Public-private partnerships: the Australasian experience with physical infrastructure', In (Eds, Hodge, G. and Greve, C.), *The Challenge of Public-Private Partnerships: Learning from International Experience*,ed., Cheltenham, UK: Edward Elgar, pp. 305-331

Hodge, G. A. and Greve, C. (2009) "PPPs: the Passage of Time Permits a Sober Reflection ", *Economic Affairs*, vol. 29, no.1, pp. 33-39

Hofstede, G. (1980) *Culture's consequences*, CA: Sage, Beverly Hills

Holmstrom, B. (1982) "Moral Hazard in Teams", *The Bell Journal of Economics*, vol. 13, no.2, pp. 324-340

Holmström, B. (1979) "Moral Hazard and Observability", *The Bell Journal of Economics*, vol. 10, no.1, pp. 74-91

Jensen, M. C. (1983) "Organization Theory and Methodology", *The Accounting Review*, vol. 58, no.2, pp. 319-339

Jensen, M. C. (1986) "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers", *The American Economic Review*, vol. 76, no.2, pp. 323-329

Jensen, M. C. and Meckling, W. H. (1976) "Theory of the firm: Managerial behavior, agency costs and ownership structure", *Journal of Financial Economics*, vol. 3, no.4, pp. 305-360

Jensen, M. C. and Murphy, K. J. (1990) "Performance Pay and Top-Management Incentives", *Journal of Political Economy*, vol. 98, no.2, pp. 225-264

Jin, X.-H. and Doloi, H. (2008) "Interpreting risk allocation mechanism in public-private partnership projects: an empirical study in a transaction cost economics perspective", *Construction Management & Economics*, vol. 26, no.7, pp. 707-721

Jones, S. and Hensher, D. A. (2004) "Predicting Firm Financial Distress: A Mixed Logit Model", *The Accounting Review,* vol. 79, no.4, pp. 1011-1038

Kahneman, D., Knetsch, J. L. and Thaler, R. H. (1991) "Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias", *The Journal of Economic Perspectives,* vol. 5, no.1, pp. 193-206

Kahneman, D. and Lovallo, D. (1993) "Timid Choices and Bold Forecasts: A Cognitive Perspective on Risk Taking", *Management Science,* vol. 39, no.1, pp. 17-31

Kahneman, D. and Tversky, A. (1979) "Prospect Theory: An Analysis of Decision under Risk", *Econometrica,* vol. 47, no.2, pp. 263-292

Klein, B. (1996) "Why hold-ups occur: The self-enforcing range of contractual relationships", *Economic Inquiry,* vol. 34, no.3, pp. 444

Krinsky, I. and Robb, A. L. (1986) "On Approximating the Statistical Properties of Elasticities", *The Review of Economics and Statistics,* vol. 68, no.4, pp. 715-719

Laffont, J.-J. (1996) "William Vickrey: A pionneer in the economics of incentives", *Nobel Lecture,* vol. 27 December 1996

Laffont, J.-J. and Tirole, J. (1991) "Privatization and Incentives", *Journal of Law, Economics, & Organization,* vol. 7, pp. 84-105

Laughhunn, D. J., Payne, J. W. and Crum, R. (1980) "Managerial Risk Preferences for Below-Target Returns", *Management Science,* vol. 26, no.12, pp. 1238-1249

Lopes, L. L. (1987) "Between Hope and Fear: The Psychology of Risk", *Advances in Experimental Social Psychology,* vol. Volume 20, no.3, pp. 255-295

Martimort, D. and Pouyet, J. (2008) "To build or not to build: Normative and positive theories of public–private partnerships", *International Journal of Industrial Organization,* vol. 26, no.2, pp. 393-411

Masten, S. E. and Saussier, S. (2002) 'Econometrics of Contracts: An Assessment of Developments in the Empirical Literature on Contracting', In (Eds, Brousseau, E. and Glachant, J.-M.), *The Economics of Contracts: Theories and Applications,*ed., Cambridge University Press, Cambridge, pp. 273-292

McFadden, D. (1974) "The Measurement of Urban Travel Demand", *Journal of Public Economics,* vol. 3, no.4, pp. 303-328

Meunier, D. and Quinet, E. (2010) "Tips and Pitfalls in PPP design", *Research in Transportation Economics,* vol. 30, no.1, pp. 126-138

Mirrlees, J. A. (1999) "The theory of moral hazard and unobservable behaviour: Part I", *The Review of Economic Studies,* vol. 66, no.226, pp. 3-21

Morgan, G. (1986) *Images of organization,* CA: Sage, Beverly Hills

Parker, D. and Hartley, K. (2003) "Transaction costs, relational contracting and public private partnerships: a case study of UK defence", *Journal of Purchasing and Supply Management,* vol. 9, no.3, pp. 97-108

Parker, D. and Saal, D. (2003) *International Handbook on Privatization,* Edward Elgar, Cheltenham

Partnerships Victoria (2000) *Department of Treasury and Finance Victoria, Australia*

Ricketts, M. (2009) "The Use of Contract by Government and Its Agents", *Economic Affairs,* vol. 29, no.1, pp. 7-12

Rindfleisch, A. and Heide, J. B. (1997) "Transaction Cost Analysis: Past, Present, and Future Applications", *The Journal of Marketing,* vol. 61, no.4, pp. 30-54

Rohrmann, B. (1994) "Risk perception of different societal groups: Australian findings and crossnational comparisons", *Australian Journal of Psychology,* vol. 46, no.3, pp. 150-163

Ross, S. A. (1973) "The Economic Theory of Agency: The Principal's Problem", *The American Economic Review,* vol. 63, no.2, pp. 134-139

Schmidt, K. M. (1996) "The Costs and Benefits of Privatization: An Incomplete Contracts Approach", *Journal of Law, Economics, & Organization,* vol. 12, no.1, pp. 1-24

Shleifer, A. (1998) "State versus Private Ownership", *The Journal of Economic Perspectives,* vol. 12, no.4, pp. 133-150

Soliño, A. S. and Gago de Santos, P. (2010) "Transaction Costs in Transport Public–Private Partnerships: Comparing Procurement Procedures", *Transport Reviews,* vol. 30, no.3, pp. 389-406

Stopher, P. (1998) "A review of separate and joint strategies for the use of data on revealed and stated choices", *Transportation,* vol. 25, no.2, pp. 187-187

Sykuta, M. E. (2008) 'New Institutional Econometrics: The Case of Research on Contracting and Organization', In (Eds, Brousseau, E. and Glachant, J.-M.), *New Institutional Economics: A Guidebook,*ed., Cambridge University Press, Cambridge, pp. 122-141

Tetlock, P. E. and Boettger, R. (1994) "Accountability amplifies the status quo effect when change creates victims", *Journal of Behavioral Decision Making,* vol. 7, no.1, pp. 1-23

Tversky, A. and Kahneman, D. (1991) "Loss Aversion in Riskless Choice: A Reference-Dependent Model", *The Quarterly Journal of Economics,* vol. 106, no.4, pp. 1039-1061

Välilä, T. (2005) "How Expensive are Cost Savings? On the Economics of Public-Private Partnerships", *EIB papers,* vol. 10, no.1, pp. 94-119

Weber, E. U., Blais, A.-R. and Betz, N. E. (2002) "A Domain-Specific Risk-Attitude Scale: Measuring Risk Perceptions and Risk Behaviors", *Journal of Behavioral Decision Making, Vol. 15, pp. 263-290,*

Wickelgren, A. L. (2007) "Government and the Reverse-Holdup Problem", *Journal of Public Economic Theory,* vol. 9, no.2, pp. 221-229

Williamson, O. E. (1979) "Transaction-Cost Economics: The Governance of Contractual Relations", *Journal of Law and Economics,* vol. 22, no.2, pp. 233-261

Williamson, O. E. (1985) *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting,* Collier Macmillan, London

Williamson, O. E. (1991) "Comparative Economic Organization: The Analysis of Discrete Structural Alternatives", *Administrative Science Quarterly*, vol. 36, no.2, pp. 269-296

Williamson, O. E. (2000) "The New Institutional Economics: Taking Stock, Looking Ahead", *Journal of Economic Literature*, vol. 38, no.3, pp. 595-613

WWG (2006) *Working with Government: Guidelines for Privately Financed Projects* New South Wales Government,